SPECIFICATIONS

FOR

POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT UPGRADES

PARKS CANADA AGENCY
POINT PELEE NATIONAL PARK, ONTARIO

ISSUED FOR TENDER

PCA Project No.: 807
Date: August 23, 2021

Specifications
Issued for Tender

PARKS CANADA
POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT UPGRADES

Standing Offer Agreement: 5P201-20-0046/A
PCA Project No.: 807

Lisa Grasse, P. Eng.
Senior Civil Engineer
Englobe Corp.

PARKS CANADA
POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT UPGRADES

POINT PELEE NATIONAL PARK, Ontario

Englobe Corp. **Issued for Tender – Technical Specifications**						
	Prepared by	**Init**	**Date**	**Checked by**	**Init**	**Date**
Civil	Kyle McConnell		Aug. 23, 2021	Lisa Grasse		Aug. 23, 2021
Project Manager	Lisa Grasse		Aug. 23, 2021			

List of Drawings

PART 1 - GENERAL

1.1 Description of Work

.1 The work will be carried out within Point Pelee National Park in Ontario. It will include the removal, disposal and replacement of ten (10) septic systems within the locations as shown on the drawings including complete removal of septic tanks, lift stations, tile bed (disposal fields), distribution boxes and piping and replacement with new septic tanks, lift stations, advanced treatment units and dispersal fields. The work also includes re-location of an existing building at the Black Willow site to the maintenance compound as directed by the Departmental Representative.

.2 The work of this contract includes the provision of all materials, labour, equipment, and ancillaries, all as necessary for the completion of the work as indicated on the drawings and as described in the specifications and notes. Work on this project consists generally of, but is not limited to, the following:

.1 Supply and installation of all environmental protection measures required such as site erosion and sediment control measures, check dams, silt fencing, vegetative stabilization, and other measures; and maintenance for the duration of the project and removed following completion unless otherwise noted on the drawings. All erosion control measured installations are to be pre-approved by the Departmental Representative prior to installation.

.2 Supply and operation of traffic control and signage for the duration of the project where required.

.3 Excavation to expose existing buried utilities at all crossing locations as indicated on the drawings, as identified during locates, or required by the Departmental Representative and recording their location.

.4 Removal and disposal of existing septic tanks (including removal and disposal of septage from septic tanks by licensed septage hauler), lift stations (controls and electrical), distribution boxes, advanced treatment units and disposal fields as indicated on the drawings.

.5 Supply and installation of new septic systems including new septic tanks, lift stations, advanced treatment units (including phosphorus and nitrogen removals, as noted on drawings) and dispersal fields (sizes as noted on drawings), indicated on the drawings and tender form, including but not limited to all excavation, bedding, compaction, geotextile cover, pre-cast concrete septic tank (with anti-floatation collars), lift station (incl. concrete chamber, duplex pump, control panel, electrical, floats), wall seals, advanced treatment unit, piping, imported sand, septic stone, and operation and maintenance manuals as well as all other necessary infrastructure and materials to be completed per the drawings and specifications.

.6 Reinstatement of all disturbed areas to previous condition or better.

.7 All other labour, materials and work necessary to complete the project to the Departmental Representative's full satisfaction.

.3 All work to be carried out in accordance with applicable federal and provincial regulations for those agencies having jurisdiction for the work. The work is subject to the Canada National Parks Act and Regulations, Canadian Environmental Protection Act, Canada Labour Code and the Provincial Occupational Health and Safety Act and Regulations.

1.2 Work Restrictions

.1 The Contractor is limited to working within the contract limits and lay down areas shown on the drawings. The Contractor must acquire all necessary Clearing Permits and Construction Permits which must be approved by the Field Unit Superintendent. Work beyond these limits is prohibited unless otherwise directed by the Departmental Representative.

.2 The Contractor shall not carry out any work within 30m of any water course, reservoir or wetland without all necessary permits.

1.3 Familiarization With Site

.1 Before submitting a bid, it is mandatory that bidders visit the site to review and verify the form, nature and extent of the work, materials needed, the means of access and the temporary facilities required to perform the Work.

.2 Obtain prior permission from the Parks Canada Asset Manager before carrying out such site inspection.

.3 Contractors, bidders or those they invite to site are to review specification Section 01 35 29 – Health and Safety Requirements before visiting site. Take all appropriate safety measures for any visit to site, both before and after acceptance of bid.

1.4 Interpretation of Documents

.1 Supplementary to the Order of Precedence article of the General Conditions of the Contract, the Division 01 sections take precedence over the technical specification sections in other Divisions of the Specification Manual.

1.5 Term Engineer

.1 Unless specifically stated otherwise, the term Engineer where used in the Specifications and on the Drawings shall mean the Departmental Representative as

defined in the General Conditions of the Contract.

1.6 Setting Out Work

.1 The contractor to provide full layout for this project. The Departmental Representative will provide survey layout data to be used by the contractor.

1.7 Measurement For Payment

.1 Notify Departmental Representative sufficiently in advance of operations to permit required measurements for payment.

1.8 Maintenance of Work During Construction

.1 Maintain work during construction. Undertake continuous and effective maintenance work, day by day, with adequate equipment and forces so that the sewer main, services, structures, clearing limits and roads are continuously kept in a condition satisfactory to the Departmental Representative.

1.9 Codes and Standards

.1 Perform work in accordance with National Parks Act, Code of Practice of the Department of Labour, as it pertains to the Traffic Control Manual (Ministry of Transportation Ontatio (MTO)), Ontario Building Code Part 8 – Sewage Systems and any other code of federal, provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Materials and workmanship must conform to or exceed applicable standards of Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), American Society for Testing and Materials (ASTM) and other standards organizations.

.3 Conform to latest revision of any referenced standard as re-affirmed or revised to date of specification. Standards or codes not dated shall be deemed editions in force on date of tender

advertisement.

1.10 Work Within Park Boundaries

.1 The project is located within a National Park and it is essential that lands remain as undisturbed as possible. The Contractor will be expected to use standards and methods beyond those for normal construction in order to protect the environment and ensure the aesthetics of the work. Contract limits shall be strictly adhered to and every precaution shall be taken to minimize environmental damage and disruption to vegetation, wildlife habitat, and structures or existing services, both on construction and storage sites.

.2 If any damage occurs during construction, the Contractor is responsible to bear the expense to immediately restore such damaged areas to the satisfaction of the Departmental Representative.

.3 If Contractor fails to repair damage to the satisfaction of the Departmental Representative, the Departmental Representative may have repairs completed by others at the Contractor's expense.

.4 The Contractor shall ensure that contracted work meets the standards outlined in the contract specification and drawings.

.5 The Contractor shall ensure that no damage will be done to any existing underground telephone cables or other buried utilities.

.6 All sources of aggregate must be submitted to the Departmental Representative for approval at least two (2) weeks prior to the start of any work. Aggregate sources must be free of invasive species and capable of producing clean material to the satisfaction of the Departmental Representative.

.7 The Contractor will make arrangements with authorities or owners of private properties for quarrying and

transporting materials and machinery over their properties and be responsible for obtaining and paying of fees.

1.11 Documents Required .1 Maintain at job site, one copy each of following:
- .1 Contract drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed drawings.
- .5 Change orders.
- .6 Other modifications to Contract.
- .7 Copy of approved work schedule.
- .8 Approved Permits.
- .9 Field test reports.
- .10 Manufacturer's installation and application instructions.
- .11 Site specific Health and Safety Plan and other safety related documents.
- .12 Other documents as stipulated elsewhere in the Contract Documents.

1.12 Site Conditions .1 The Contractor will be responsible to visit the existing facilities and planned route to review existing site conditions.

.2 Existing geotechnical conditions can be found in the attached report in Appendix A. Should contractors require additional geotechnical investigation this can be done by obtaining all the proper permits and approvals from Parks Canada and carrying out the work at their own expense.

1.13 Departmental Representative .1 Departmental Representative will be assigned after contract award.

1.14 Work Schedule .1 Provide to the Departmental Representative in writing and within five (5) working days after Contract award, a detailed construction schedule and traffic control plan. The schedule shall show proposed work to be undertaken and anticipated completion dates for each category of work.

1.15 Sanitary Services

.1 The Contractor shall provide and maintain sanitary facilities for the use of workers at locations specified by the Departmental Representative. Provision of sanitary facilities shall meet requirements of provincial government and municipal statutes and authorities.

1.16 Contractor's Use of Site

.1 Use of site: for execution of work within the provided right-of-way and those areas specified by the Departmental Representative.

.2 The Departmental Representative will specify the areas for work and storage.

1.17 Project Meetings

.1 The Departmental Representative will arrange project meetings that are to occur, at minimum, every two (2) weeks and assume responsibility for setting times and recording and distributing minutes.

.2 After receiving the Contractor's schedule, traffic control plan, health and safety hazard assessment, and environmental protection plan, and prior to start of construction, a meeting involving Contractor, Departmental Representative and Parks Canada will be held at a place and time to be determined by the Departmental Representative. This meeting will review implications of the contract, design, schedule of work health and safety, methods of construction, environment protection methods, lay down areas and traffic control.

.3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

.4 No work will begin until the pre-construction meeting is held, and all submittals have been approved.

.5 Following the pre-construction meeting and approval of submittals, the work will be carried out to meet the time restraints and have the project completed on time.

1.18 Existing Services

.1 Carry out work at times directed by authorities having jurisdiction, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.

.3 Submit schedule to and obtain approval from Departmental Representative for any shut down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Record locations of maintained, re-routed and abandoned service lines.

.6 Ensure pedestrian and other traffic is not unduly impeded, interrupted or endangered by execution or presence of work.

.7 Maintain existing signs at all times. When it is necessary to temporarily remove a sign, it shall be dismantled and re-established on a temporary post or stand set back from construction area. The work is considered to be incidental and no separate payment will be made for maintaining or moving signs.

.8 The contractor must verify locations of any underground utilities with local utility companies.

1.19 Additional Drawings

.1 Departmental Representative may furnish additional drawings for clarification.

These additional drawings have same meaning and intent as if they were included with plans referred to in Contract documents.

1.20 Relics, Antiquities and Wildlife Habitat

.1 Protect relics, antiquities, wildlife habitat, items of historical or scientific interest such as cornerstones and contents, animal nesting sites, commemorative plaques, inscribed tablets, and similar objects found during course of work.

.2 Give immediate notice to Departmental Representative and await Departmental Representative's written instructions before proceeding with work in this area.

.3 Relics, antiquities and items of historical or scientific interest remain the property of Canada.

1.21 Canada National Parks Act

.1 For projects within boundaries of National Park, perform work in accordance with Canada National Parks Act and Regulations.

1.22 Measurement of Quantities

.1 Linear: Items which are measured by metre are to be measured along centre line of installation. Lengths shall be in agreement with the Departmental Representative.

.2 Volume: Longitudinal and transverse measurements to be measured both horizontally and vertically to calculate a volume which shall be in agreement with the Departmental Representative.

.3 Weight:

.1 Where contract unit prices are for weight measure of material, the Contractor shall provide, install and maintain approved scales for the measurement of such materials. The scales shall be of sufficient capacity and dimension to fully contain the loaded vehicle. The scale

platform and mechanism shall be kept clean and in good working order at all times. The approach roadway shall be on a flat grade, level with the scale platform for at least one truck length.

.2 The scale shall be tested at the beginning of each construction season in accordance with the requirements of the Government of Canada prior to being used. The Certificate issued by the testing authority shall be displayed at the scales at all times.

.3 If the scales are moved, repaired or altered in any way, they shall again be tested and certified in accordance with Government of Canada requirements before additional use. Only original weight certificates from the quarry or pit of material origin will be accepted and used as basis for payment. Copies of weight certificates will not be accepted. Weight certificates are to be original digitally printed vouchers. Hand-written weight certificates and certificates other than those approved will not be accepted.

1.23 Permits/ Authorities

.1 The Contractor shall obtain, and pay for, permits from authorities as required for all operations and construction. He shall also comply with all pertinent regulations of all authorities having jurisdiction over the work. The Contractor shall provide copies of all permits to the Departmental Representative prior to starting the work. The Contractor shall be responsible for obtaining all applicable permits, inspections and approvals required and shall pay all charges in connection therewith.

1.24 Equipment Rental Rates

.1 Upon written request, the Contractor will supply the Departmental Representative with a list of the rental equipment to be used on work beyond the scope of bid items.

Equipment rental rates will be in accordance with current rates published by the Ministry of Transportation Ontario.

1.25 Existing Survey

.1 Topographic survey used in the preparation of these Contract Documents was provided by Englobe Corp.

1.26 Protection

.1 Store all materials and equipment to be incorporated into work to prevent damage by any means.

.2 Repair and replace all materials or equipment damaged in transit or storage to the satisfaction of the Departmental Representative and at no cost to Canada.

.3 Contractor shall take adequate precautions to protect existing structures when operating tracked equipment.

.4 Exercise care so as not to obstruct or damage public or private property in the area.

.5 At completion of work, restore area to its original condition. Damage to ground and property will be repaired by Contractor. Remove all construction materials, residue, excess, etc., and leave site in a condition acceptable to Departmental Representative.

END

PART 1 – GENERAL

1.1 Submittals

.1 Upon acceptance of bid and prior to commencement of work, submit to Departmental Representative the following work management documents:
- .1 Work Schedule as specified herein.
- .2 Health and Safety Plan as specified in Section 01 35 29 – Health and Safety Requirements.
- .3 Environmental Protection Plan as specified in Section 01 35 43 – Environmental Procedures.
- .4 Traffic Control Plan as specified in Section 01 55 26 – Traffic Regulation.

1.2 Work Schedule

.1 The work shall begin in the Fall 2021, no earlier than September 7, 2021 and be substantially completed prior to December 15, 2021. The Blue Heron site to be completed by October 15, 2021 and the Campground South to be completed between November 15 and December 15, 2021. Reinstatement work to start in Spring 2022 and must be completed by April 20, 2022.

.2 Upon acceptance of bid the Contractor shall submit:
- .1 Preliminary work schedule within five (5) calendar days of contract award.

.3 Schedule to indicate all calendar dates from commencement to completion of all work within the time stated in the accepted bid.

.4 Provide sufficient details in schedule to clearly illustrate entire implementation plan, depicting efficient coordination of tasks and resources, to achieve completion of work on time and permit effective monitoring of work progress in relation to established milestones.

.5 Work schedule content to include as a minimum the following:
- .1 Bar (GANTT) Charts, indicating all

work activities, tasks and other project elements, their anticipated durations, planned dates for achieving key activities and major project milestones supported with;

.1 Written narrative on key elements of work illustrated in bar chart, providing sufficient details to demonstrate a reasonable implementation plan for completion of project within designated time.

.2 Generally Bar Charts derived from commercially available computerized project management system are preferred but not mandatory.

.6 Work schedule must take into consideration and reflect the work phasing.

.7 Schedule work in cooperation with the Departmental Representative.

.8 Completed schedule shall be approved by Departmental Representative. When approved, take necessary measures to complete work within scheduled time. Do not change schedule without Departmental Representative's approval.

.9 Ensure that all subtrades and subcontractors are made aware of the work restraints and operational restrictions specified.

.10 Schedule Updates:

.1 Submit when requested by Departmental Representative.

.2 Provide information and pertinent details explaining reasons for necessary changes to implementation plan.

.3 Identify problem areas, anticipated delays, impact on schedule and proposed corrective measures to be taken.

.11 Departmental Representative will make

interim reviews and evaluate progress of work based on approved schedule. Frequency of such reviews will be as decided by Departmental Representative. Address and take corrective measures on items identified by reviews and as directed by Departmental Representative. Update schedule accordingly.

.12 In every instance, any change or deviation from the Work Schedule, no matter how minimal the risk or impact on safety or inconvenience to tenant or public might appear, will be subject to prior review and approval by the Departmental Representative.

1.3 Project Meetings

.1 The Departmental Representative will schedule and administer project meetings every two (2) weeks for entire duration of work.

.2 Departmental Representative will prepare agenda for meetings.

.3 Meetings will be held at project site or as directed by Departmental Representative.

END

PART 1 - GENERAL

1.1 General Requirements

.1 The Form of Tender includes both lump sum priced items and several unit price items.

.2 The total tendered price shall be the sum of the lump sum items plus the amounts calculated from the unit priced items.

.3 The Contractor in submitting their Tender for the project understands that they will only be entitled to payment under the lump sum and unit price items when prior written authorization has been received from the Departmental Representative for utilization and then only to the extent of the work authorized by the Departmental Representative.

.4 Additional instructions for measurement and/or payment for items of the work may be contained in specific sections of the Technical Specifications. In the case of a conflict between the instructions for measurement and payment contained in this section with that of any other section, the requirement of this section shall apply.

.5 The submitted tender prices will be inclusive of all costs for the complete supply and installation of all materials, labour and equipment required to complete the work. No separate payment will be made for any testing, inspections, and approvals required by the Contractor.

1.2 Lump Sum Items

.1 There shall be no separate measurement for payment made for these lump sum items.

.2 General Contract Requirements:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes but is not limited to site maintenance, mobilization, demobilization, common excavation and backfill (if not specifically mentioned in other unit price items), removals as shown on contact drawings, any temporary backfill required to maintain roadways, dust control, miscellaneous landscaping, reinstatement of site where required, any and all ditching and environmental protection required, including environmental protection plan, traffic control plan and operation and controls manuals, record surveys and as-constructed drawings as shown on the drawings and outlined in the specification, and all other works which are required for completion of the project exclusive of those covered by the unit priced items.

1.3 Unit Price Items

.1 There shall be no separate measurement or payment made for these unit price items.

.2 Septic System Removal and Installation of New Advanced Treatment System – Sanctuary, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic

system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.3 Septic System Removal and Installation Blue Heron, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the

drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, additional phosphorus and nitrogen treatment, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.4 Septic System Removal and Installation of New Advanced Treatment System – Dunes, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and

installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.5 Septic System Removal and Installation of New Advanced Treatment System – Sleepy Hollow, Complete:

1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field),

as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.6 Septic System Removal and Installation of New Advanced Treatment System – Madbin Jina, Complete:

1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item

includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.7 Septic System Removal and Installation of New Advanced Treatment System – Black Willow, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as

noted on the drawing and specification.
This item also includes all labour and equipment required to relocate the existing building at Black Willow to the Maintenance Compound in accordance with Departmental Representatives direction.

.8 Septic System Removal and Installation of New Advanced Treatment System – White Pine, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical, advanced treatment unit and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity

piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.9 Septic System Removal and Installation of New Advanced Treatment System – Campground South, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.10 Septic System Removal and Installation of New Advanced Treatment System – West Beach No. 1, Complete:

.1 Method of Measurement: Percentage Complete as agreed by Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.11 Septic System Removal and Installation of New Advanced Treatment System – West Beach No. 2, Complete:

.1 Method of Measurement: Percentage Complete as agreed by

Departmental Representative and the Contractor.

.2 This item includes all of the labour associated with the work required to remove and dispose of the existing septic system, including, but not limited to: pumping and hauling of septage sewage from existing septic system, excavation, removal and disposal of existing septic system (including septic tanks, lift station, electrical and control panel, distribution box, piping, disposal field and all appurtenances) as noted on the drawings or in the specifications.
This item includes: all labour associated with the supply and installation of new septic system (including septic tanks, piping, lift stations, duplex pumps, control panels, electrical, advanced treatment unit, Type 'A' dispersal field), as shown on the drawings, as per manufacturer's recommendations and outlined in the specifications. This item includes all labour and material for the complete installation of all forcemain piping, gravity piping, connection to existing buildings, and insulation as noted on the drawing and specification.

.12 All and any items not specifically included in the unit price items are considered incidental to the work and are to be included in the lump sum portions of the work.

END

PART 1 - GENERAL

1.1 Administrative

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

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

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by

Departmental Representative's review.

.10 Keep one reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow five (5) days for Departmental Representative to review each submission.

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
Accompany submissions with transmittal letter, in duplicate, containing:
.1 Date.

.2 Project title and number.
.3 Contractor's name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 Other pertinent data.

.7 Submissions include:
.1 Date and revision dates.
.2 Project title and number.
.3 Name and address of:
.1 Subcontractor.
.2 Supplier.
.3 Manufacturer.
.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.5 Details of appropriate portions of Work as applicable:
.1 Fabrication.
.2 Layout, showing dimensions, including identified field dimensions, and clearances.
.3 Setting or erection details.
.4 Capacities.
.5 Performance characteristics.
.6 Standards.
.7 Operating weight.
.8 Wiring diagrams.
.9 Single line and schematic diagrams.
.10 Relationship to adjacent work.

.8 After Departmental Representative's review, distribute copies.

.9 Submit one (1) electronic copy of shop drawings for each requirement requested in specification Sections or hard copies as Departmental Representative may reasonably request.

.10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will

not be prepared due to standardized manufacture of product.

.11 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accordance with specified requirements.
.2 Testing must have been within three (3) years of date of contract award for project.

.12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
.2 Certificates must be dated after award of project contract complete with project name.

.13 Submit electronic copies of manufacturer’s instructions for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.14 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Documentation of the testing and verification actions taken by

manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.15 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Delete information not applicable to project.

.17 Supplement standard information to provide details applicable to project.

.18 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, transparency copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.19 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to

fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 Samples

.1 Submit for review samples in triplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative business address.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 Certificates and Transcripts

.1 Immediately after award of Contract, submit current status with Workplace Safety and Insurance Board (WSIB).

.2 Submit transcription of insurance immediately after award of Contract.

END

PART 1 – GENERAL

1.1 Definitions

.1 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.

.2 Competent Person: means a person who is:
- .1 Qualified by virtue of personal knowledge, training and experience to perform assigned work in a manner that will ensure the health and safety of persons in the workplace, and;
- .2 Knowledgeable about the provisions of occupational health and safety statutes and regulations that apply to the Work and;
- .3 Knowledgeable about potential or actual danger to health or safety associated with the Work.
- .4 Medical Aid Injury: any minor injury for which medical treatment was provided and the cost of which is covered by Workers' Compensation Board of the province in which the injury was incurred.

.3 PPE: personal protective equipment
- .1 Work Site: where used in this section shall mean areas, located at the premises where Work is undertaken, used by Contractor to perform all of the activities associated with the performance of the Work.

1.2 Submittals

.1 Make submittals in accordance with Section 01 33 00.

.2 Submit site-specific Health and Safety Plan (including protocols and safe work procedures related to COVID-19) prior to commencement of Work.
- .1 Submit within 10 workdays of notification of Bid Acceptance. Provide 3 copies.
- .2 Departmental Representative will review Health and Safety Plan and provide comments.
- .3 Revise the Plan as appropriate and resubmit within 10 workdays after receipt of comments.
- .4 Departmental Representative's review and comments made of the Plan shall not be construed as an endorsement, approval or implied warranty of any kind by Canada and does not reduce Contractor's overall responsibility for Occupational Health and

Safety of the Work.

.5 Submit revisions and updates made to the Plan during the course of Work.

.3 Submit name of designated Health & Safety Site Representative and support documentation specified in the Safety Plan.

.4 Submit building permit, compliance certificates and other permits obtained.

.5 Submit copy of Letter in Good Standing from Provincial Workers Compensation or other department of labour organization.

.1 Submit update of Letter of Good Standing whenever expiration date occurs during the period of Work.

.6 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.7 Submit copies of incident reports.

.8 Submit WHMIS MSDS - Material Safety Data Sheets.

1.3 Compliance Requirements

.1 Comply with Occupational Health and Safety Act for Province of Ontario, and Occupational Health & Safety Regulations made pursuant to the Act.

.2 Comply with Canada Labour Code - Part II (entitled Occupational Health and Safety) and the Canada Occupational Health and Safety Regulations (COSH) as well as any other regulations made pursuant to the Act.

.1 The Canada Labour Code can be viewed at: www.http://laws.justice.gc.ca/en/L-2/

.2 COSH can be viewed at: www.http://laws.justice.gc.ca/eng/SOR-86-304/ n e.html

.3 A copy may be obtained at: Canadian Government Publishing Public Works & Government Services Canada Ottawa, Ontario, K1A 0S9 Tel: (819) 956-4800 (1-800-635-7943) Publication No. L31-85/2000 E or F)

.3 Observe construction safety measures of:

.1 Part 8 of National Building Code

.2 Provincial Worker's Compensation Board.

.3 Municipal by-laws and ordinances.

.4 In case of conflict or discrepancy between above specified requirements, the more stringent shall apply.

.5 Maintain Workers Compensation Coverage in good standing for duration of Contract. Provide proof of clearance through submission of Letter in Good Standing.

.6 Medical Surveillance: Where prescribed by legislation or regulation, obtain and maintain worker medical surveillance documentation.

.7 Comply with all works outlined in the Ministry of Transportation's Ontario Traffic Manual, 2014

1.4 Responsibility

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons and environment adjacent to the site to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by all workers, sub-contractors and other persons granted access to Work Site with safety requirements of Contract Documents, applicable federal, provincial, and local by-laws, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.5 Site Control and Access

.1 Control the Work and entry points to Work Site. Approve and grant access only to workers and authorized persons. Immediately stop and remove non-authorized persons.

.1 Departmental Representative will provide names of those persons authorized by Departmental Representative to enter onto Work Site and will ensure that such authorized persons have the required knowledge and training on Health and Safety pertinent to their reason for being at the site, however, Contractor remains responsible for the health and safety of authorized persons while at the Work Site.

.2 Isolate Work Site from other areas of the premises by use of appropriate means.

.1 Erect fences, hoarding, barricades and temporary lighting as required to effectively delineate the Work Site, stop non-authorized entry, and to protect

pedestrians and vehicular traffic around and adjacent to the Work and create a safe environment. See Section 01 56 00 – Temporary Barriers and Enclosures for minimum acceptable requirements.

.2 Post signage at entry points and other strategic locations indicating restricted access and conditions for access.

.3 Use professionally made signs with bilingual message in the 2 official languages or international known graphic symbols.

.3 Provide safety orientation session to persons granted access to Work Site. Advise of hazards and safety rules to be observed while on site.

.4 Ensure persons granted site access wear appropriate PPE. Supply PPE to inspection authorities who require access to conduct tests or perform inspections.

.5 Secure Work Site against entry when inactive or unoccupied and to protect persons against harm. Provide security guard where adequate protection cannot be achieved by other means.

1.6 Protection

.1 Give precedence to safety and health of persons and protection of environment over cost and schedule considerations for Work.

.2 Should unforeseen or peculiar safety related hazard or condition become evident during performance of Work, immediately take measures to rectify situation and prevent damage or harm. Advise Departmental Representative verbally and in writing.

1.7 Filing of Notice

.1 File Notice of Project with pertinent provincial health and safety authorities prior to beginning of Work.

.1 Departmental Representative will assist in locating address if needed.

1.8 Permits

.1 Post permits, licenses and compliance certificates, specified in section 01 11 00 – General Instructions, at Work Site.

.2 Where a particular permit or compliance certificate cannot be obtained, notify Departmental

Representative in writing and obtain approval to proceed before carrying out applicable portion of work.

1.9 Hazard Assessments

.1 Perform site specific health and safety hazard assessment of the Work and its site.

.2 Carryout initial assessment prior to commencement of Work with further assessments as needed during progress of work, including when new trades and subcontractors arrive on site.

.3 Record results and address in Health and Safety Plan.

.4 Keep documentation on site for entire duration of the Work.

1.10 Project/Site Conditions

.1 Following are potential health, environmental and safety hazards at the site for which Work may involve contact with:

.1 Known latent site and environmental conditions:
- .1 Tree lines, forested areas.
- .2 Streams, brooks and other water bodies.
- .3 Wildlife.
- .4 Work around raw wastewater.

.2 Facility on-going operations:
- .1 Vehicular traffic.
- .2 Pedestrian Traffic.

.2 Above items shall not be construed as being complete and inclusive of potential health and safety hazards encountered during Work.

.3 Include above items in the hazard assessment of the Work.

1.11 Meetings

.1 Attend pre-construction health and safety meeting, convened and chaired by Departmental Representative, prior to commencement of Work, at time, date and location determined by Departmental Representative. Ensure attendance of:
- .1 Superintendent of Work
- .2 Designated Health & Safety Site Representative

.3 Subcontractors

.2 Conduct regularly scheduled toolbox and safety meetings during the Work in conformance with Occupational Health and Safety regulations.

.3 Keep documents on site.

1.12 Health and Safety Plan

.1 Prior to commencement of Work, develop written Health and Safety Plan and Safety Control Plan specific to the Work. Implement, maintain, and enforce Plan for entire duration of Work and until final demobilization from site.

.2 Health and Safety Plan shall include the following components:

.1 List of health risks and safety hazards identified by hazard assessment.
.2 Control measures used to mitigate risks and hazards identified.
.3 On-site Contingency and Emergency Response Plan as specified below.
.4 On-site Communication Plan as specified below.
.5 Name of Contractor's designated Health & Safety Site Representative and information showing proof of his/her competence and reporting relationship in Contractor's company.
.6 Names, competence and reporting relationship of other supervisory personnel used in the Work for occupational health and safety purposes.

.3 On-site Contingency and Emergency Response Plan shall include:

.1 Operational procedures, evacuation measures and communication process to be implemented in the event of an emergency.
.2 Evacuation Plan: site and floor plan layouts showing escape routes, marshalling areas. Details on alarm notification methods, fire drills, location of fire fighting equipment and other related data.
.3 Name, duties and responsibilities of persons designated as Emergency Warden(s) and deputies.
.4 Emergency Contacts: name and telephone number of officials from:
.1 General Contractor and

subcontractors.
.2 Pertinent Federal and Provincial Departments and Authorities having jurisdiction.
.3 Local emergency resource organizations.

.5 Harmonize Plan with Facility's Emergency Response and Evacuation Plan. Departmental Representative will provide pertinent data including name of PCA and Facility Management contacts.

.4 On-site Communication Plan:
.1 Procedures for sharing of work related safety information to workers and subcontractors, including emergency and evacuation measures.
.2 List of critical work activities to be communicated with Facility Manager which have a risk of endangering health and safety of Facility users.

.5 Address all activities of the Work including those of subcontractors.

.6 Review Health and Safety Plan regularly during the Work. Update as conditions warrant to address emerging risks and hazards, such as whenever new trade or subcontractor arrive at Work Site.

.7 Departmental Representative will respond in writing, where deficiencies or concerns are noted and may request re-submission of the Plan with correction of deficiencies or concerns.

.8 Post copy of the Plan, and updates, prominently on Work Site.

1.13 Safety Supervision

.1 Employ Health & Safety Site Representative responsible for daily supervision of health and safety of the Work. Representative to be trained in occupational health and safety procedures and practices.

.2 Health & Safety Site Representative may be the Superintendent of the Work or other person designated by Contractor and shall be assigned the responsibility and authority to:
.1 Implement, monitor and enforce daily compliance with health and safety requirements of the Work.
.2 Monitor and enforce Contractor’s site-specific

Health and Safety Plan.

.3 Conduct site safety orientation session to persons granted access to Work Site.

.4 Ensure that persons allowed site access are knowledgeable and trained in health and safety pertinent to their activities at the site or are escorted by a competent person while on the Work Site.

.5 Stop the Work as deemed necessary for reasons of health and safety.

.3 Health & Safety Site Representative must:

.1 Be qualified and competent person in occupational health and safety.

.2 Have site-related working experience specific to activities of the Work.

.3 Be on Work Site at all times during execution of the Work.

.4 All supervisory personnel assigned to the Work shall also be competent persons.

.5 Inspections:

.1 Conduct regularly scheduled safety inspections of the Work on a minimum bi-weekly basis. Record deficiencies and remedial action taken.

.2 Conduct Formal Inspections on a minimum monthly basis. Use standardized safety inspection forms. Distribute to subcontractors.

.3 Follow-up and ensure corrective measures are taken.

.6 Cooperate with Facility's Occupational Health and Safety representative should one be designated by Departmental Representative.

.7 Keep inspection reports and supervision related documentation on site.

1.14 Training

.1 Use only skilled workers on Work Site who are effectively trained in occupational health and safety procedures and practices pertinent to their assigned task.

.2 Maintain employee records and evidence of training received. Make data available to Departmental Representative upon request.

.3 When unforeseen or peculiar safety-related hazard, or condition occur during performance

of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.15 Minimum Site Safety Rules

.1 Notwithstanding requirement to abide by federal and provincial health and safety regulations; ensure the following minimum safety rules are obeyed by persons granted access to Work Site:
- .1 Wear appropriate PPE pertinent to the Work or assigned task; minimum being hard hat, safety footwear, safety glasses, hearing protection and high-visibility workwear.
- .2 Immediately report unsafe condition at site, near-miss accident, injury and damage.
- .3 Maintain site and storage areas in a tidy condition free of hazards causing injury.
- .4 Obey warning signs and safety tags.

.2 Brief persons of disciplinary protocols to be taken for non-compliance. Post rules on site.

1.16 Correction of Non-Compliance

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Departmental Representative will stop Work if non-compliance of health and safety regulations is not corrected in a timely manner.

1.17 Incident Reporting

.1 Investigate and report the following incidents to Departmental Representative:
- .1 Incidents requiring notification to Provincial Department of Occupational Safety and Health, Workers Compensation Board or to other regulatory Agency.
- .2 Medical aid injuries.
- .3 Property damage in excess of $10,000.00,
- .4 Interruptions to Facility operations resulting in an operational lost to a

department in excess of $5000.00.

.2 Submit report in writing.

1.18 Hazardous Products

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS).

.2 Keep MSDS data sheets for all products delivered to site.
- .1 Post on site.
- .2 Submit copy to Departmental Representative.
- .3 For interior work in an occupied Facility, post additional copy in one or more publicly accessible locations.

1.19 Confined Spaces

.1 Abide by occupational health and safety regulations regarding work in confined spaces.

.2 Obtain an Entry Permit in accordance with Part XI of the Canada Occupational Health and Safety Regulations for entry into an existing identified confined space located at the Facility or premises of Work.
- .1 Obtain permit from Facility Manager
- .2 Keep copy of permit issued.

.3 Safety for Inspectors:
- .1 Provide PPE and training to Departmental Representative and other persons who require entry into confined space to perform inspections.
- .2 Be responsible for efficacy of equipment and safety of persons during their entry and occupancy in the confined space.

1.20 Site Records

.1 Maintain on Work Site copy of safety related documentation and reports stipulated to be produced in compliance with Acts and Regulations of authorities having jurisdiction and of those documents specified herein.

.2 Upon request, make available to Departmental Representative or authorized Safety Officer for inspection.

1.21 Posting of Documents

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on Work Site in accordance with Acts and Regulations of Province having jurisdiction.

.2 Post other documents as specified herein, including:
- .1 Site specific Health and Safety Plan
- .2 WHMIS data sheets
- .3 Incident reports
- .4 Toolbox and safety meeting minutes

END

PART 1 - GENERAL

1.1 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.2 Related Sections

.1 Section 01 35 45 – Environmental Protection Refueling Vehicles.

.2 Section 01 74 21 – Constructional Demolition Management and Disposal.

1.3 Fires

.1 Fires and burning of rubbish on site not permitted.

1.4 Disposal of Wastes

.1 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

.3 Dispose of uncontaminated construction/demolition material which cannot be recycled or reused, at an approved construction and debris disposal site.

.4 All waste/surplus/recyclable materials removed from site becomes property of the Contractor.

1.5 Drainage

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 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 No vegetation clearing will be permitted without the written approval from the Departmental Representative.

.2 Protect trees and plants on site and adjacent properties where indicated and as directed by the Departmental Representative.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict vegetation removal to areas indicated or designated by Departmental Representative.

.6 Vegetation and topsoil should not be removed to obtain fill for road construction purposes.

.7 Whenever possible, organic debris removed during grading operations should be stored for re-use during site restoration. Such stockpiles should be located well away from any stream or water body and should be covered with coarse material or tarps to minimize wind and water erosion.

1.7 Work Adjacent to Waterways

.1 Do not operate construction equipment in waterways.

.2 Do not use waterway beds for borrow material without Departmental Representative's approval.

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Do not skid logs or construction materials across waterways.

.6 Temporary diversion ditches, approved by the Departmental Representative, are to be plastic lined.

.7 Temporary storage sites for debris generated from clearing operations should be deposited away from watercourses and should be surrounded by a natural vegetative buffer.

.8 Do not pump or drain water containing suspended materials into waterways. Water containing suspended materials shall be pumped into vegetation a minimum of 30 m away from watercourses.

1.8 Pollution/Dust Control

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant to local authorities' emission requirements.

.3 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads or roads under construction. Chemicals used in dust control must have prior approval of the Departmental Representative.

1.9 General Requirements

.1 Work under this contract is to be carried out in a National Park, and environmental protection must be given a high priority by all staff involved with the work. Perform work in accordance with Canada National Parks Act and Regulations.

.2 An Environmental Briefing will be held prior to work commencing at the site, which will outline environmental factors to be considered during the work. It is mandatory that all current staff of the Contractor attend this meeting with the Departmental

Representative and Environmental Protection Officer (EPO).

.3 The Contractor shall meet all requirements as detailed in Appendix B – Basic Impact Assessment (BIA). This document is not all-inclusive, and site adjustment of the mitigation methods for the work may be required. The Departmental Representative will advise the Contractor of any additional requirements as they arise.

.4 The Contractor to ensure that all equipment entering the site be cleaned to prevent potentially invasive species of plants from being transported into the National Park from previous projects.

1.10 Site Set-up and Use

.1 All site activities related to construction are to be confined within the defined project boundaries.

.2 Work sites will be equipped with appropriate and properly maintained sanitary facilities.

.3 Garbage must be collected and removed daily from the work site. All material must be removed, transported and disposed of in accordance with existing provincial – municipal and Park solid waste disposal guidelines and/or regulations.

.4 Littering is prohibited.

.5 Temporary storage, parking areas, and turn-a-round facilities for contractor-related equipment and vehicles will be limited to those areas agreed to and designated by the Departmental Representative.

1.11 Environmental Protection Plan

.1 The Contractor is required to submit a plan showing all pollution control measures that will be used to fulfill the requirements of the Environmental Protection Section. This plan will be reviewed by the Departmental

Representative and the Environmental Protection Officer prior to commencement of any work. Any deviation from this plan will require further approval by the Departmental Representative. The protection plan shall be submitted prior to the pre-construction meeting.

.2 The Environmental Plan will outline how the Contractor will address the environmental protection requirements, including the installation of pipes and culverts, cleaning equipment prior to entering the site. It will show sufficient detail on products to be used and physical placement on site to determine effectiveness of these items.

.3 The plan must cover all activities within the limits of all construction, laydown and traffic diversion areas.

1.12 Environmental Performance

.1 The Contractor is required to follow the Canadian Environmental Protection Act and Canadian National Parks Act.

.2 The Contractor is held responsible to ensure that all necessary permits related to Environmental Protection have been obtained and that necessary documentation is available on-site.

1.13 Vehicular Movements

.1 Restrict movement of vehicles and equipment to existing disturbed areas (access roads, borrow pits, disposal areas and right-of-ways).

1.14 Storage and Handling of Fuels and Dangerous Fluids

.1 Locate fuel storage facility a minimum of 30m from any water body in an area approved by Departmental Representative and construct impermeable dykes so that any spillage is contained. Fueling of vehicles or equipment will not be permitted within 30m of any water body. Maintenance of vehicles and equipment will be permitted only in designated areas as directed by the Departmental Representative.

.2 Exercise care in handling of fuels or dangerous materials to minimize potential for spills. Report immediately any spills to Departmental Representative. Contractor is responsible for responding immediately to any spill to minimize environmental damage and for clean-up, repair or rehabilitation resulting from any spills to the satisfaction of the Departmental Representative.

.3 Supply and maintain on site emergency response material to contain spills and minimize environmental damage, i.e. absorbent material, to the approval of Departmental Representative. Disposal of all contaminated material shall be off-site at an approved facility.

.4 Dangerous goods, whose release into the environment could cause adverse effect, should be stored and handled in a manner which gives due regard for workers and public safety, and for the protection of the environment.

.5 No material toxic to fish or any aquatic life shall be permitted to enter any stream, river, or lake. This shall include, but not be limited to lubricants, fuels, testing fluids, insecticides, detergents, herbicides, cement, lime or concrete.

.6 The management of fuels, lubricants and chemicals must meet with the requirements of the Ontario’s Ministry of the Environment, Conservation and Parks, and all other appropriate provincial and federal regulations.

.7 Fuel storage containers must be accompanied by impermeable structures that would provide containment of 125% of the container capacity in the event of a leak or spill.

.8 All refueling and lubricating operations should employ protection measures such as drip pans, to reduce the potential for

escape of petroleum products to the environment.

.9 The Departmental Representative and the Park's Environmental Protection Officer (EPO) must be immediately contacted after a spill of fuel or lubricant, and after any amount of other chemical products has escaped.

.10 Storage of any fuel has to occur only in previously approved locations, and with Park consent. The Contractor must submit plans for fuel management and a Spill Contingency Plan seven days prior to the start of the Work. The Contractor is expected to be prepared to effect the containment and cleanup of all spills related to the Work.

.11 Storage of hazardous material, including explosives, shall not be permitted, except for quantities which shall normally be expected to be utilized in a day of Work, and which are not permitted to stockpile.

.12 Emulsion storage tanker and transfer of emulsion from tanker to spray vehicle are not permitted.

1.15 Erosion and Sediment Control

.1 Appropriate preventative controls should be in place at all times during construction to prevent undue erosion and sedimentation. The Contractor is required to provide to the Departmental Representative for approval ten (10) working days before start-up an erosion and sedimentation control plan, as part of the Environmental Protection Plan. The plan shall incorporate all necessary silt fences, silt traps, plastic lined trenches and ditches as approved by the Departmental Representative. **Hay or any other type of seed contaminant shall not be used in any type of erosion control method.**

.2 The Contractor shall install and maintain all sedimentation and erosion control features for the duration of the project,

in accordance with the approved plan. The Contractor shall remove all sedimentation and erosion control upon completion of the work and when requested by the Departmental Representative.

.3 Sediment fences and erosion control structures shall be installed around stockpiles, in roadside ditches or at culvert inlets prior to any excavation as directed by Departmental Representative. Fence placement must be approved by Departmental Representative before installation.

.4 To minimize run-off, work on slopes which may affect water body will be curtained during periods of heavy rainfall, as directed by the Departmental Representative.

.5 Prior to carrying out work, check long range weather forecast to ensure that there is adequate time before forecast of heavy rain storms to stabilize the work. Provide details of stabilization plan to Departmental Representative for review.

.6 Maintain a stockpile of appropriate erosion and environmental protection materials (e.g. silt fences, clean rock fill and aggregate base course) on site at all times.

.7 Install additional erosion control measures as required by site conditions to prevent sediment from entering drainage courses.

.8 Inspect erosion and sediment control measures on a daily basis and maintain as necessary.

1.16 Relics and Antiquities

.1 Relics and antiquities and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site or in structures to be demolished, shall remain property of

Canada. Protect such articles and request direction from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archaeological finds are encountered during construction and await his written instructions before proceeding with work in this area.

1.17 Treated Wood

.1 Workers shall be made aware of the possible health risks associated with exposure to CCA or creosote treated timber as well as the recommended safe practices for handling such materials.

.2 Disposal of treated wood wastes including saw-dust must be outside of the site, and in accordance with all applicable Provincial and Municipal regulations. Similar attention must be given to disposal of any replaced guiderail posts which have been treated with creosote, which must also be removed from the park for disposal.

1.18 Environmental Incident or Emergency

.1 In the event of an environmental incident or emergency such as:

.1 Chemical spill or petroleum spill;
.2 Poisonous or caustic gas emission;
.3 Hazardous material spill;
.4 Sewage spill;
.5 Contaminated water into waterways.
.6 The Contractor or his employees shall immediately:
.1 Notify the Contractor’s job superintendent.
.2 Call the local emergency services and give type of emergency.
.3 Notify the Departmental Representative and the Park’s Environmental Protection Officer (EPO).

.2 The Contractor is to submit to Departmental Representative a copy of its Environmental/Spill Response Plan for approval.

1.19 Site Decommissioning

.1 Unless prior permission from the Departmental Representative is obtained, all contractor equipment, facilities and materials must be removed from the Park at the finish of each work phase, or if work is suspended due to weather or other circumstances, upon the suspension of work activities.

.2 All work sites must be returned to a neat and tidy condition upon site abandonment.

1.20 Site Clearing

.1 Under no circumstances shall clearing and grubbing be conducted without written approval from the Departmental Representative.

END

PART 1 - GENERAL

1.1 Refueling

.1 Refueling of equipment to be performed in locations as directed by Departmental Representative.

.2 Do not refuel equipment within 30 meters of any watercourse or storm water catch basin unless protection against spills is in place and location is approved by Departmental Representative.

.3 Use petroleum containers approved for products with no spill fill spouts for dispensing fuels. The sure pour nozzle to have self closing valve, prevent any flow of fuel until the nozzle is inserted into the receiving container. On removal from the receiving container the slide valve closes to eliminate any fuel spill. Nozzle to be equipped with its own automatic vent eliminating the need for the user to open or close air inlets on the pouring container.

.4 Nozzle to support the weight of the pouring container. Nozzles to automatically stop the flow when the receiving container becomes full. The nozzle to be such that it reduces evaporative losses of volatile organic compounds during the fuel transfer.

.5 **All spills** of hydrocarbon based products such as gasoline, kerosene, naphtha, lubricating oils, engine oils, greases and de-icing fluids or antifreeze **no matter how large or small** to be reported to Departmental Representative and the Park's Environmental Protection Officer (EPO).

.6 Oil changes or equipment repairs in the field or on Parks Canada land are not permitted.

.7 Refueling to be performed on level surfaces, PCC Portland cement concrete or HMAC surfaces when approved by the Departmental Representative unless otherwise directed.

.8 Contractor to have drip pans sized for amounts of product to be recovered and customized to fit under pieces of equipment to perform routine maintenance to equipment while maintaining equipment on property. Drip Pans to be used whenever leaving equipment on site or parking overnight when not in use.

.9 Parking of equipment on site to be on level ground in locations away from watercourses and as approved by Departmental Representative. Equipment with leaks or poor mechanical repair to be removed from site when so ordered by Departmental Representative.

1.2 Spill Control Kit

.1 Contractor to have at the work site a spill control kit consisting of the following minimum types of equipment:
- .1 a spaded shovel;
- .2 a stable broom;
- .3 a broad nosed shovel;
- .4 a container(s) suitable, compatible to and of sufficient size to contain petroleum products being used with equipment;
- .5 Absorbents;
- .6 rags;
- .7 metal container for soiled rags;
- .8 Booms when working next to a watercourse that will traverse the width of the watercourse by two times; and
- .9 Spill control kit to be inspected and approved by both Ontario's Ministry of the Environment, Conservation and Parks and the Departmental Representative prior to Work commencing. Spill control kits to be available to Contractor employees at all areas where Work of the Contract is being performed and at all times during the course of the Contract.
- .10 Contractor employees to be trained in the use of the spill control kit and the equipment they contain.

1.3 Spills

.1 Disposal of spilled materials to be off Parks Canada property and at approved locations for materials to be disposed of.

.2 When parking of equipment on site, the equipment is to be secured from entry, inspected for leaks and the ground protected from leaks.

.3 Contractor to protect all wells, catch basins, drywells, drains and watercourses from contamination in event of a spill.

.4 All equipment to be used for the Work of the Contract to be inspected by the Departmental Representative for leaks. Equipment not in good repair to be removed/repaired when directed by Departmental Representative.

.5 Spills to be reported immediately to Departmental Representative, the Park’s Environmental Protection Officer (EPO) and Ontario’s Ministry of the Environment, Conservation and Parks.

.6 Contractor to immediately notify the Resource Conservation Manager (RCM) prior to removal. Once approved the contractor must remove as much or all of the contaminated soils as possible, from any spills created from Work of the Contractor.

.7 Contaminated soils/materials to be placed in containers compatible to the contaminants.

.8 Any remaining clean-up to be performed at no extra cost to Parks Canada. Clean-up to be to the Departmental Representative's satisfaction.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

1.2 Inspection

.1 Give minimum 72 hours notice requesting inspection of Work designated for special tests, inspections or approvals by Departmental Representative or by inspection authorities having jurisdiction.

.2 In accordance with the General Conditions, Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.

.3 If Contractor covers or permits to be covered Work designated for special tests, inspections or approvals before such is made, uncover Work until particular inspections or tests have been fully and satisfactorily completed and until such time as Departmental Representative gives permission to proceed.

.4 Pay costs to uncover and make good work disturbed by inspections and tests.

1.3 Testing

.1 Tests on materials, as specified in various sections of the Specifications are the responsibility of the Department except where stipulated otherwise.

.2 Departmental Representative will engage and pay for service of Independent Inspection and Testing Agencies for purpose of inspecting and testing portions of Work except for the following which remain part of Contractor's responsibilities:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's

convenience.

.3 Mill tests and certificates of compliance.

.4 Tests as specified within various sections designated to be carried out by Contractor under the supervision of Departmental Representative.

1.5 Access to Work

.1 Facilitate Departmental Representative's access to Work. If part of Work is being fabricated at locations other than construction site, make preparations to allow access to such Work whenever it is in progress.

.2 Furnish labour and facility to provide access to the work being inspected and tested.

.3 Co-operate to facilitate such inspections and tests.

1.6 Rejected Work

.1 Remove and replace defective Work, whether result of poor workmanship, use of defective or damaged products and whether incorporated in Work or not, which has been identified by Departmental Representative as failing to conform to Contract Documents.

.2 Make good damages to new construction and finishes resulting from removal or replacement of defective work.

END

PART 1 - GENERAL

1.1 Section Includes

.1 Construction aids.

.2 Office and sheds.

.3 Parking.

.4 Project identification.

1.2 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 Related Sections

.1 Section 01 56 00 - Temporary Barriers and Enclosures.

1.4 References

.1 Canadian General Standards Board (CGSB)
- .1 CGSB 1-GP-189M-84, Primer, Alkyd, Wood, Exterior.
- .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)
- .1 CAN3-A23.1-/A23.2-94, Concrete Materials and Methods for Concrete Construction/Method of Test for Concrete.
- .2 CSA-0121-M1978, Douglas Fir Plywood.
- .3 CAN/CSA-Z321-96, Signs and Symbols for the Occupational Environment.

1.5 Installation and Removal

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.6 Scaffolding

.1 Provide and maintain scaffolding, ladders and temporary stairs.

1.7 Hoisting

.1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists cranes shall be operated by qualified operator.

1.8 Site Storage/Loading

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.9 Construction Parking

.1 Parking will be limited to Contractor vehicles and equipment required to carry out work only, provided it does not disrupt performance of Work.

.2 Provide and maintain adequate access to project site.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.10 Equipment, Tool and Materials Storage

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.11 Sanitary Facilities

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as

required by local health authorities. Keep area and premises in sanitary condition.

1.12 Construction Signage .1 No other signs or advertisements, other than warning signs, are permitted on site.

.2 Signs and notices for safety and instruction shall be in both official languages Graphic symbols shall conform to CAN3-Z321.

.3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative. Signs to be above grade, digging for posts is not permitted and signs are not to be attached to any buildings.

END

PART 1 - GENERAL

1.1 Description

.1 This section is to provide traffic control as stipulated in the Ministry of Transportation's Ontario Traffic Manual Book 7, 2014.

.2 A Traffic Control Plan must be approved by the Departmental Representative prior to commencing any work. Traffic Control Plan to be submitted prior to the pre-construction meeting.

1.2 Related Sections

.1 Section 01 11 10 - General Instructions.

.2 Section 01 35 29 - Health and Safety Requirements.

.3 Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 Reference Standard

.1 Government of Ontario, Ministry of Transportation.
.1 Ontario's Traffic Control Manual (TCM), latest edition.

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 will 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 roadway without approval of Departmental Representative. The Contractor must formally request a

road closure with the Departmental Representative if they feel it is necessary. Before re-routing traffic, erect suitable signs and devices in accordance with instructions contained in the TCM. Provide sufficient crushed gravel to ensure a smooth riding surface during work.

.4 Roads that cannot be closed include:
.1 Point Pelee Drive (Main Access Road.)
.2 Emergency Exit.
.3 Campground Parking Lot (campground will remain operational)

.5 Keep travelled way well graded, free of potholes and of sufficient width that required number of lanes of traffic may pass.

.6 Maintain dust control as needed with water.

.7 When directed by Departmental Representative, provide well graded, detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway.

.8 Provide and maintain reasonable road access and egress to property fronting along or in vicinity of work under Contract unless approved otherwise by Departmental Representative.

.9 All flag persons and traffic control personnel shall have successfully completed a traffic control training course from Safety First Training approved by Ontario Ministry of Transportation, Traffic Control Manual. Proof of training for all persons shall be available on site at all times.

1.5 Informational and Warning Devices

.1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual

conditions resulting from project work which may require road user response.

.2 All traffic signs are to be bilingual or symbolic and shall be Level 1 reflectivity.

.3 Supply and erect signs, declinators, barricades and miscellaneous warning devices as specified in TCM.

.4 Place signs and other devices in locations recommended in the TCM.

.5 A Traffic Control Plan must be approved by the Departmental Representative prior to commencing any work.

.6 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 conditions existing from day to day.

1.6 Control of Public Traffic

.1 Provide traffic control personnel at each entrance who have valid provincial certification and are trained in accordance with and properly equipped as specified in the TCM, in following situations:
.1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
.2 When it is necessary to institute one way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
.3 When workers or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.

.4 Where temporary protection is required while other traffic control devices are being erected or taken down.

.5 For emergency protection when other traffic control devices are not readily available.

.6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

.2 All Traffic Control Personnel shall be equipped with portable radios of sufficient range to ensure continuous communication within the traffic control zone.

.3 All construction vehicles shall operate in accordance with and are subject to traffic control restrictions and operations in place on the project.

.4 In addition to traffic control during the normal hours of work, the contractor shall have a responsible person on site at all times to monitor that the traffic signage is working properly (including nights, weekends and holidays).

.5 Flag persons are to be equipped with portable radios only, not cellular devices. Any flag person using cellular devices, except for emergency use only, shall be deemed incompetent and shall be removed from site immediately. PCA shall not be held responsible for lost time incurred due to the removal of such an individual.

1.8 Operational Requirements

.1 Maintain existing conditions for traffic crossing right-of-way containing work except that, when required for construction under this Contract and when measures have been taken as specified herein and approved by Departmental Representative, to protect and control public traffic.

END

PART 1 - GENERAL

1.1 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.2 Related Sections

.1 Section 01 52 00 - Construction Facilities.

.2 Section 01 55 26 – Traffic Regulation.

1.3 References

.1 Canadian General Standards Board (CGSB)
- .1 CGSB 1.189M-84, Primer, Alkyd, Wood, Exterior.
- .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)
- .1 CSA-O121-M1978, Douglas Fir Plywood.

.3 Government of Ontario, Ministry of Transportation.
- .1 Ontario’s Traffic Manual Book 7, 2014.

1.4 Installation and Removal

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.5 Guard Rails and Barricades

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs. Barricades or rails to be above ground, digging for posts is not permitted.

.2 Provide as required by governing authorities.

.3 Provide Traffic Control guard rails, barricades and delineators in accordance with Section 01 55 26 – Traffic Regulation.

1.6 Access to Site	.1	Provide and maintain access roads, as may be required for access to Work.
1.7 Public Traffic Flow	.1	Provide Traffic Control in accordance with Section 01 55 26 – Traffic Regulation.
1.8 Fire Routes	.1	Maintain access to properties for use by emergency response vehicles.
1.9 Protection for Off-Site and Public Property	.1	Protect surrounding private and public property from damage during performance of Work.
	.2	Be responsible for damage incurred.

END

PART 1 - GENERAL

1.1 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.2 Reference Standards

.1 Within text of each specifications section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.3 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Tenders, except where specific date or issue is specifically noted.

1.3 Quality

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace

defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

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

1.4 Availability

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

.2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.5 Storage, Handling and Protection

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber, fencing on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 Transportation

.1 Pay costs of transportation of products required in performance of Work.

1.7 Manufacturer's Instructions

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 Quality of Work

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.9 Co-Ordination

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

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

1.10 Remedial Work

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 Existing Utilities

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 78 00 - Closeout Submittals.

1.2 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 References

.1 Parks Canada's identification of existing survey control points and property limits. Contractor is responsible for record surveys and layout of work.

1.4 Survey Reference Points

.1 Contractor is to locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.2 Make no changes or relocations without prior written notice to Departmental Representative.

.3 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.4 The Contractor is responsible to replace control points in accordance with original survey control, if disturbed unnecessarily during construction activities.

1.5 Survey Requirements

Contractor will:

.1 Establish permanent bench marks on site, as required, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Stake for grading, fill and topsoil

placement.

.4 Stake slopes.

.5 Establish pipe invert elevations and location of any exposed pipe not being removed under this contract.

.6 Record elevation and location of all existing and installed end caps of abandoned underground services.

.7 Provide coordinates, elevations and dimensions in the field, as required by the Departmental Representative.

1.6 Existing Services

.1 Before commencing work, establish location and extent of existing utilities in area of Work and notify Departmental Representative of findings.

1.7 Records

Contractor will:

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of site works, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

.3 Record locations of maintained, re-routed and abandoned service lines.

END

PART 1 - GENERAL

1.1 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.2 Related Section

.1 Section 01 77 00 - Closeout Procedures.

1.3 Project Cleanliness

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Parks Canada or other Contractors.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use clearly marked separate bins for recycling.

.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Dispose of waste materials, and debris off site at approved facilities.

1.4 Final Cleaning

.1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.6 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.7 Remove dirt and other disfiguration from exterior surfaces.

.8 Sweep and wash clean paved areas.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

1.2 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 Definitions

.1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.

.3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.5 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.6 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for

purpose of reuse or recycling.

.7 Separate Condition: Refers to waste sorted into individual types.

.8 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.

1.4 Documents

.1 Maintain at job site, one copy of following documents:
.1 Material Source Separation Plan.

1.5 Submittals

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

.2 Prepare and submit following prior to project start-up:
.1 Submit two (2) copies of Materials Source Separation Program (MSSP) description.

1.6 Waste Reduction Workplan (WRW)

.1 Prepare, Waste Reduction Workplan.

.2 Structure WRW to prioritize actions and follow as first priority Reuse, then followed by Recycle.

.3 Describe management of waste.

.4 Post workplan or summary where workers at site are able to review its content.

1.7 Materials Source Separation Program (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up. The Demolition Waste Audit (DWA), with related weight bills and/or receipt must be submitted on a monthly basis with the Contractor's monthly Progress claim.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separated condition.

.1 Transport to approved and authorized recycling facility.

1.8 Storage, Handling and Protection

.1 Store, materials to be reused, recycled and salvaged in locations as specified in MSSP.

.2 Unless specified otherwise, materials for disposal and recycling leaving the Park site boundaries shall become the property of the Contractor. The Contractor shall obtain permits from authorities having jurisdiction for disposal and recycling of all materials removed from the Park site boundaries.

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect structural components not removed for demolition from movement or damage.

.6 Support affected structures. If safety of building is endangered, cease operations

and immediately notify Departmental Representative.

.7 Protect surface drainage, mechanical and electrical from damage and blockage.

.8 Separate and store materials produced during dismantling of structures in designated areas.

.9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
- .1 On-site source separation is recommended.
- .2 Remove co-mingled materials to off-site processing facility for separation.
- .3 Provide waybills for separated materials.

1.9 Disposal of Wastes

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil or paint thinner into waterways, storm, or sanitary sewers.

.3 Keep records of construction waste including:
- .1 Number and size of bins.
- .2 Waste type of each bin.
- .3 Total tonnage generated.
- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.

.4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.10 Use of Site

.1 Execute work with least possible

and Facilities

interference or disturbance to normal use of premises.

.2 Maintain security measures established by PCA.

1.11 Scheduling

.1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

PART 2 - PRODUCTS

.1 (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Application

.1 Do Work in compliance with WRW.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 Cleaning

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

END

PART 1 - GENERAL

1.1 Precedence

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.2 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 – Testing and Quality Control.

.3 Section 01 71 00 - Examination and Preparation.

.4 Section 01 77 00 - Closeout Procedures.

1.3 Submission

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products and submit to Departmental Representative.

.2 A copy of this document will be returned after final inspection, with Departmental Representative's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, final copies of shop drawing and materials testing manuals in English.

.5 If requested, furnish evidence as to type, source and quality of products provided.

.6 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

1.4 Format

.1 Electronic copies to be provided on a USB.

1.5 Contents - Each Volume

.1 Table of Contents: provide title of project;

.1 date of submission; names,
.2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
.3 schedule of products and systems, indexed to content of volume.

.2 For each product or system:
.1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

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

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

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Testing and Quality Control.

1.6 As-Builts and Samples

.1 Maintain at the site for Departmental Representative one record copy of:
.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to the Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

1.7 Recording Actual Site Conditions

.1 Record information on set of drawings, provided by Departmental Representative.

.2 Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
- .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .2 Field changes of dimension and detail.
- .3 Changes made by change orders.
- .4 Details not on original Contract Drawings.
- .5 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:
- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
- .2 Changes made by Addenda and change

orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 Final Survey

.1 Contractor is to submit final site survey certificate, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 Warranties and Bonds

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

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

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

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

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

.6 Co-execute submittals when required.

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

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 01 74 21 – Construction /Demolition Waste Management Disposal

.2 Section 33 05 16 – Manhole and Catch Basin Structures

.3 Section 33 31 13 – Public Sanitary Utility Sewerage Piping

1.2 Related Requirements

.1 Refer to detailed drawings for specific requirements for removals.

1.3 References

.1 Reference Standards:
- .1 Canadian Council of Ministers of the Environment (CCME)
  - .1 PN1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

1.4 Site Conditions

.1 Site Environmental Requirements:
- .1 Perform work in accordance with Section 01 35 43 - Environmental Procedures.
- 2 Ensure that removals work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .3 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.

.1 Ensure proper disposal procedures are maintained throughout the project.

.4 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.

.6 Protect trees, plants and foliage on site and adjacent properties where indicated.

.2 Existing Conditions.

.1 Remove contaminated or hazardous materials from site as directed by Department Representative, prior to start of demolition Work, and dispose of at designated disposal facilities in safe manner in accordance with applicable regulatory requirements.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Preparation

.1 Inspect site with Department Representative and verify extent and location of items designated for removal, disposal, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Contact proper utility companies in order to coordinate excavation.

3.2 Removal of Hazardous Waste

.1 Remove contaminated or dangerous materials defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in

safe manner in accordance with applicable regulations, to minimize danger at site or during disposal.

3.3 Removal Operations

.1 Remove items as indicated in their corresponding Sections.

.2 Do not disturb items designated to remain in place.

.3 Electrical decommissioning: as indicated on Drawings. Electrical decommissioning shall be completed by a Registered Electrician.

.4 Removal/abandonment of pipes:
- .1 Remove sections of piping as indicated.
- .2 Piping to be abandoned shall be capped.
- .3 Caps shall also be provided where required to block off and seal ends of pipes that are being abandoned or otherwise isolated, incidental to the work.

.5 Removal of septic tanks, distribution boxes, lift stations and advanced treatment units:
- .1 Remove in accordance with Provincial and Federal Guidelines and as indicated on the Drawings.
- .2 Pump out contents and dispose of at an approved receiving facility.
- .3 Remove tanks, distribution boxes, lift stations and advanced treatment units where indicated.
- .4 Tanks and distribution boxes are not to be abandoned in place.

.7 Decommissioning of septic fields:
- .1 Septic fields to be excavated and disposed of in accordance with Provincial and Federal Guidelines unless indicated otherwise on the Drawings.
- .2 New septic fields are to be constructed in same location as

existing. The existing septic field materials including granular material, pipes, sand etc., shall be removed to the bottom of septic stone material or as indicated on the Drawings, and disposed of at an appropriate facility.

.8 Once the items have been removed the site is to be properly shaped and graded to match existing ground. The site is to be restored with approved topsoil and hydroseed.

.9 Disposal of Material:
.1 Dispose of materials not designated for salvage or reuse on site.

.10 Backfill:
.1 Backfill in areas as indicated and in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

3.4 Restoration

.1 Restore areas and existing works outside areas of demolition match condition of adjacent, undisturbed areas.

.2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
.2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
.3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6 Protection

.1 Repair damage to adjacent materials or property caused by selective site demolition.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Section 32 11 20 – Granular Base

.3 Section 32 11 19 – Granular Subbase

1.2 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D 4791-10, Standard Test Method for Flat Particles, Elongated Particles or Flat and Elongated Particles in Coarse Aggregate.

1.3 Source Approval

.1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling two (2) weeks minimum before starting production. The Contractor or his representative is to be present during sampling.

.2 Aggregate sources must be free of invasive species and capable of producing clean material to the satisfaction of the Departmental Representative.

.3 If, in opinion of Departmental Representative, aggregate from the proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that aggregate from source in question can be processed to meet specified requirements.

.4 Should a change of aggregate source be proposed during work, advise Departmental Representative one (1) week in advance of proposed change to allow sampling and testing.

.5 Acceptance of an aggregate at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is

found to be unsatisfactory.

1.4 Sampling

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

.2 Allow continual sampling by Departmental Representative during production.

.3 Provide Departmental Representative with access to source and processed material for sampling.

.4 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

PART 2 - PRODUCTS

2.1 Materials

.1 Aggregate quality: sound, hard, durable aggregate free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in a deleterious manner for the use intended.

.2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
.1 Greatest dimension to exceed three times least dimension.

.3 Fine aggregate satisfying requirements of applicable section to be one, or a blend of following:
.1 Natural sand.
.2 Manufactured sand.
.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.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.

.5 Refer to Section 33 36 33 Utility Drainage

field for septic stone and imported sand specifications.

PART 3 – EXECUTION

3.1 Equipment

.1 All equipment brought on site by the contractor or any subcontractor must be thoroughly washed clean of any soil and debris prior to arrival on site. Equipment containing debris or soil from a previous job site will not be permitted to enter the project site.

3.2 Stripping of Topsoil

.1 Commence topsoil stripping of areas as indicated by the Guidelines and as directed by the Departmental Representative.

.2 Avoid mixing topsoil with subsoil.

.3 Stockpile in locations as indicated by the Guidelines. Stockpile height not to exceed 2m.

.4 Refer also to Section 31 14 13 - Soil Stripping and Stockpiling.

3.3 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.4 Stockpiling

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative.

.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 coarse aggregate.
.2 Maximum 1.5 m for fine aggregate and sub-base aggregate.
.3 Maximum 1.5 m for other aggregate.

.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.

3.5 Aggregate Stockpile Cleanup

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

3.6 Source Abandonment

.1 For temporary or permanent abandonment of aggregate source, rehabilitate source to condition meeting requirements of the Guidelines.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 31 23 33 - Excavating, Trenching, and Backfilling.

.2 Section 31 14 13 - Soil Stripping and Stockpiling.

.3 Section 01 35 43 - Environmental Procedures.

1.2 References

.1 Environment Canada.

1.3 Definitions

.1 Clearing consists of cutting off trees (manual cutting only, no machinery clearing permitted) and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.

.2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.

.3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees and disposing of felled trees and debris.

.4 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of fallen timber and surface debris off site.

.5 Grubbing consists of excavation and disposal of stumps, roots, and other embedded or partially embedded organic matter including boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.4 Quality Assurance .1 Do construction occupational health and safety in accordance with Section 01 35 29 – Health and Safety Requirements.

1.5 Storage and Protection .1 Prevent damage to adjacent properties, fencing, root systems of trees, natural features, bench marks, survey markers and monuments, existing pavement, landscaping, natural features, utility lines, buildings, site appurtenances, and water courses which are to remain.
.1 Repair damaged items to approval of Departmental Representative.
.2 Replace trees designated to remain, if damaged, as directed by Departmental Representative.

PART 2 – PRODUCTS

2.1 Materials .1 Soil Material for Fill:
.1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials. Must be approved for use by the Departmental Representative for use on this project.

PART 3 – EXECUTION

3.1 Equipment

.1 All equipment brought on site by the contractor or any subcontractor must be thoroughly washed clean of any soil and debris prior to arrival on site. Equipment containing debris or soil from a previous job site will not be permitted to enter the project site.

3.2 Preparation

.1 Inspect site and verify with Departmental Representative items designated to remain.

.2 Contractor to ensure that ALL equipment that is brought onsite is thoroughly washed prior to arrival to ensure that no seeds, soil or other possible contaminants are transferred to this site.

.3 Locate and protect existing structures and features within the work area.

.4 Locate and protect utility lines: preserve in operating condition active utilities traversing site.

.1 Notify Departmental Representative immediately of damage to or when unknown existing utility lines are encountered.

.5 Notify all applicable utility authorities before starting clearing and grubbing.

.6 Obtain all necessary permits and approvals prior to start of any clearing and grubbing operations.

.7 Keep roads and walks free of dirt and debris.

3.3 Clearing

.1 Clearing includes felling, trimming, and cutting of trees by manual methods only (chain saws) into sections and satisfactory disposal of trees and other vegetation designated for removal occurring within cleared areas.

.2 Clear as indicated by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.

.3 Bulldozing of trees is not permitted.

.4 Cut off branches and cut down trees overhanging area cleared as directed by Departmental Representative.

.5 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.4 Isolated Trees

.1 Cut off isolated trees as indicated or as directed by Departmental Representative at height of more than 300 mm above ground surface.

.2 Grub out isolated tree stumps.

3.5 Grubbing

.1 Grubbing is not required for area under temporary roadway.

.2 Remove and dispose of roots larger than 75 mm in diameter, matted roots, and designated stumps from indicated grubbing areas. Authorization from Departmental Representative is required prior to any stump removals.

.3 Grub out stumps and roots to not less than 200 mm below ground surface.

.4 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m^3.

.5 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.6 Removal and Disposal

.1 Stockpile grubbed materials and topsoil for re-use in off road areas, with the exception of roots and stumps, on-site within the Right-of-Ways or the identified lay down areas in agreement with the Departmental Representative.

.2 Cut timber greater than 125 mm diameter and stockpile. Stockpiled timber becomes property of Contractor.

.3 Remove diseased trees identified by Departmental Representative and dispose of this material in accordance with all applicable municipal, provincial and federal regulations.

3.7 Finished Surface

.1 Leave ground surface in condition suitable for subsequent stripping of remaining topsoil, to approval of Departmental Representative.

3.8 Cleaning

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 01 35 43 Environmental Procedures.

.2 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 References

.1 Environment Canada.

.2 When conflicts occur between EPA and Environment Canada, the more stringent requirement shall apply.

PART 2 – PRODUCTS

.1 (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 Stripping of Topsoil

.1 All equipment brought on site by the contractor or any subcontractor must be thoroughly washed clean of any soil and debris prior to arrival on site. Equipment containing debris, seeds, or soil from a previous job site will not be permitted to enter the project site.

.2 Ensure that procedures are conducted in accordance with applicable federal, provincial and municipal requirements.

.3 Remove topsoil before construction procedures commence to avoid compaction of topsoil.

.4 Handle topsoil only when it is dry and warm.

.5 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by alternative disposal.

.6 Remove brush from targeted area by non-chemical means and dispose of through alternative disposal.

.7 Strip topsoil to depths as indicated and to satisfaction of Departmental Representative.

.1 Avoid mixing topsoil with subsoil.

.8 Stockpile topsoil in berms in the Right-of-Ways or in the provided lay down locations approved by Departmental Representative.

.1 Stockpile height not to exceed 2 m.

.2 During the months of September to November, stockpiled soil that is not used within the same day must be covered to prevent species from using and hibernating in the piles. If piles are not covered, soil must be carefully removed from site with PCA Staff present to observe and rescue wildlife as needed.

.3 Except where stockpiled on acceptably stabilized areas, provide compacted **imported** sand base not less than 300 mm in depth to prevent contamination. Stockpile topsoil on ground but do not incorporate bottom 300 mm of pile into work. Existing materials is not to be used to create the 300mm base layer. Imported sand to be removed from site once work is complete.

.9 Dispose of unused topsoil as indicated and in accordance with all applicable federal, municipal and provincial regulations.

.10 Protect stockpiles from contamination and compaction.

.11 Cover topsoil that has been piled for long term storage with anchored waterproof and insulated tarps, as required to resist wind, water and winter conditions. Place silt fence around the stockpiles to filter sediment entering or exiting the pile.

3.2 Preparation of Grade .1 Verify that grades are correct and notify Departmental Representative if discrepancies occur. Do not begin work until instructed by Departmental Representative.

.1 Grade area only when soil is dry to lessen soil compaction.

.2 Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.3 Placing of Topsoil

.1 Place previously stripped topsoil only after Departmental Representative has accepted subgrade.

.2 Spread topsoil during dry conditions in uniform layers not exceeding 100 mm, over unfrozen subgrade free of standing water.

.3 Establish traffic patterns for equipment to prevent driving on topsoil after it has been spread to avoid compaction.

3.4 Cleaning

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

PART 1 – GENERAL

1.1 Related Sections
.1 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 References
.1 American Society for Testing and Materials (ASTM)
.1 ASTM D 698-12, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400ft – 1bf/ft^3 (600 KN-m/m^3)).

1.3 Existing Conditions
.1 Examine the geotechnical report which is bound into this specification.

.2 Refer to dewatering in Section 31 23 33 - Excavating Trenching and Backfilling.

1.4 Protection
.1 Protect existing fencing, trees, landscaping, natural features, benchmarks, buildings, pavement, surface or underground utility lines which are to remain. If damaged, restore to original or better condition unless directed otherwise by Departmental Representative.

.2 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 2 – PRODUCTS

2.1 Materials
.1 Fill material: in accordance with Section 31 23 33 – Excavating, Trenching and Backfilling.

PART 3 – EXECUTION

3.1 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 or as directed by Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.

.3 Strip topsoil to depths as directed by Departmental Representative. Avoid mixing topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.

.5 Dispose of unused topsoil off site.

3.2 Grading

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Rough grade to depths as indicated. Proof roll exposed subgrade.

.3 Slope rough grade away from building as indicated.

.4 Grade ditches to depth required for maximum run-off as indicated.

.5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.6 Compact filled and disturbed areas in accordance with the Geotechnical Report.

.7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 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 approval from Departmental Representative to use non-standard proof rolling equipment.

.3 Proof roll at level in subgrade as indicated. If 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 subgrade material to depth and extent as directed by Departmental Representative.
- .2 Backfill excavated subgrade in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.6 Where proof rolling reveals areas of defective subgrade remove and replace in accordance with this section at no extra cost.

3.4 Stockpiling

.1 Pile excavated fill, suitable for re-use as approved by Departmental Representative, in locations as directed by Departmental Representative.
- .1 Stockpile height not to exceed 2 m.

.2 Protect stockpiles from contamination and compaction.

.3 Cover fill that has been piled for long

term storage with anchored waterproof and insulated tarps, as required, to resist wind, water and winter conditions. Place silt fence around the stockpile to filter sediment entering or exiting the pile. Hay or any other type of seed contaminant shall not be used in any type of erosion control method.

3.5 Testing .1 Quality control testing shall be conducted and paid for by Contractor. Submit results of quality control testing to Departmental Representative for review when requested. Quality assurance inspection and testing will be carried out by a third party designated by the Departmental Representative. Costs of these tests will be paid by Departmental Representative.

3.6 Surplus Material .1 Remove surplus material and material unsuitable for fill, grading or landscaping off site to satisfaction of Departmental Representative.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 31 05 16 – Aggregate Materials

.2 Section 31 14 13 – Soil Striping and Stockpiling

.3 Section 32 11 19 – Granular Sub-Base

.4 Section 32 11 20 – Granular Base

.5 Section 33 05 16 – Manholes and Catch Basin Structures

.6 Section 33 31 13 – Public Sanitary Utility Sewerage Pipe

.7 Section 33 36 00 – Utility Septic Tanks

.8 Section 35 42 19 – Preservation of Water Courses and Wetlands

1.2 References

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C 117-13, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D 422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
- .4 ASTM D 698-10, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3) (600 kN-m/m3).
- .5 ASTM D 4318-10, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.2-M88, Sieves, Testing,

Woven Wire, Metric.

.3 Department of Justice Canada (Jus)
- .1 Canadian Environmental Protection Act (CEPA), 1999, c.33.
- .2 Transportation of Dangerous Goods Act(TDGA), 1992, c.34.

.4 Newfoundland and Labrador Department of Transportation and Works
- .1 Specifications Book (latest edition).

1.3 Definitions

.1 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.

.2 Excavation classes: two classes of excavation will be recognized; common excavation and rock removal.
- .1 Rock: the removal of material from solid masses of igneous, sedimentary or metamorphic rock which prior to removal was integral with the parent mass and the removal of boulders and rock fragments larger than 1.0 cubic metre in volume.
- .2 Common: all other excavation.

.3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.

.5 Recycled fill material: material,

considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.6 Unsuitable materials:

.1 Weak, chemically unstable, wet and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318-10, and gradation within limits specified when tested to ASTM D 422-63(2007) and ASTM C 136-06: Sieve sizes to CAN/CGSB-8.2-M88.

.2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 – 100
0.02 mm	10 – 80
0.005 mm	0 – 45

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

.7 Contaminated Soil: Soil containing hydro-carbons as identified by sampling performed by an approved testing facility.

1.4 Submittals

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

.2 Quality control: in accordance with Section 01 45 00 - Quality Control:
.1 Submit to Departmental Representative testing results and reports as described in Part 3 of this section.

.3 Preconstruction Submittals:
.1 Submit construction equipment list for major equipment to be used in this section prior to start of work.

.4 Samples:
.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Inform Departmental Representative at least four (4) weeks prior to beginning Work, of proposed source(s) of fill materials and provide access for sampling.

1.5 Quality Assurance

.1 For design of any temporary structures submit design and supporting data at least 2 weeks prior to installation or construction.

.2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

.3 Keep design and supporting data on site.

.4 Engage services of qualified professional Engineer who is registered or licensed in Province of Ontario, Canada in which Work is to be carried out to design and inspect shoring, bracing and underpinning required for Work.

1.6 Existing Conditions .1 Examine Geotechnical Report prepared by Englobe attached in Appendix B.

.2 Existing buried utilities and structures:

.1 Before commencing work obtain all required digging permits from local utilities and/or authorities and verify and establish location of buried services on and adjacent to site.

.2 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.3 Prior to beginning excavation Work, notify applicable owner or authorities to clearly mark such locations to prevent disturbance during Work.

.4 Confirm locations of buried utilities by hand digging or careful test excavations in presence of Departmental Representative. Hand dig all cables one metre either side of cable prior to machine excavation.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.6 Where unidentified utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or otherwise disturbing utilities or structures.

.7 Record location of maintained, re-routed and abandoned underground lines.

.3 Existing surface features:

.1 Conduct, with Departmental Representative, condition survey of existing fencing, trees and other plants, service poles, wires, lighting fixtures, pavement, survey benchmarks and monuments, and all

other surface features which may be affected by Work.

.2 Protect existing surface features from damage while Work is in progress unless otherwise directed in the drawings. In event of damage, immediately make repair as directed by Departmental Representative.

.3 Protect existing asphalt and concrete pavements which may be affected by Work from damage while work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.4 Where required for excavation, cut roots or branches as directed by Departmental Representative.

1.7 Cofferdams, Shoring, Bracing, and Underpinning

.1 Shoring will be required to safely install new piping where depth exceeds 2.5 metres. This is deemed incidental to the work.

.2 Comply with safety requirements and applicable local legislation to protect existing features.

.3 Engage services of qualified Professional Engineer who is registered in the Province of Ontario to design and inspect shoring and bracing required for work.

.4 At least 2 weeks prior to commencing work, submit design and supporting data.

.5 Design and supporting data submitted to bear the stamp and signature of qualified Professional Engineer licensed in the Province of Ontario.

PART 2 – PRODUCTS

2.1 Materials

.1 Rock Borrow: Blasted or crushed rock consisting of durable crushed stones, having 100% by mass pass through a 150mm x 150mm screen, and a maximum 10% by mass pass through a maximum 100mm x 100mm screen. Rock to consist of angular fragments obtained by breaking and crushing solid or natural rock, reasonably free from thin, flat elongated or other objectionable pieces and fines or as otherwise approve by the Departmental Representative.

.2 Granular Base in accordance with Section 32 11 20 – Granular Base

.3 Select Backfill Material: from excavations or other sources, approved by the Departmental Representative for use intended, dry, unfrozen and free from rocks larger than 80 mm, cinders, ashes, sods, refuse or other deleterious or unsuitable materials.

.4 Refer to Section 33 36 33 – Utility Drainage Field for material specification for Type 'A' Dispersal field.

PART 3 – EXECUTION

3.1 Equipment

.1 All equipment brought on site by the contractor or any subcontractor must be thoroughly washed clean of any soil and debris prior to arrival on site. Equipment containing debris or soil from a previous job site will not be permitted to enter the project site.

3.2 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.3 Stockpiling

.1 Stockpile fill materials in areas approved by Departmental Representative and as shown on the drawings.
  .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. Note that no hay mulch or possible seed contaminants are to be used on this project site.

3.4 Cofferdams and Shoring

.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.

.2 Obtain permit from authority having jurisdiction for any temporary diversion or pumping of water course.

.3 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.

.4 Upon completion of substructure construction:
  .1 Remove shoring and bracing.
  .2 Remove excess materials from site and restore watercourses as directed by Departmental Representative.

3.5 Dewatering

.1 Keep excavations free of water while Work is in progress.

.2 Submit for Departmental Representative's 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 areas and in manner not detrimental to public and private property, existing facilities, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.6 Provide settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.6 Excavation

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Excavation must not interfere with normal 1:1 (H:V) splay of bearing capacity of adjacent foundations and traffic areas. If interference will occur, excavation must be shored, braced or underpinned as described elsewhere in this specification.

.3 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.

.4 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.

.1 Trenches and open excavations that are left overnight must be covered. If cover is not feasible, excavations must be checked regularly to remove trapped wildlife. Excavations that pose a risk to fallen wildlife and/or visitors must be covered or filled prior to leaving site each day.

.5 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.6 Restrict vehicle operations directly adjacent to open trenches.

.7 Dispose of surplus and unsuitable excavated materials off-site in accordance with applicable provincial and municipal regulations.

.8 Do not obstruct flow of surface drainage or natural watercourses. Diversions of flow are to be submitted in detailed plan and approved by Departmental Representative and other authorities before proceeding.

.9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.10 Notify Departmental Representative when bottom of excavation is reached and/or appears unsuitable and proceed as directed by Departmental Representative.

.11 Obtain Departmental Representative's approval of completed excavation.

.12 If encountered, remove unsuitable material from excavation bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.1 In areas occupied by foundations or structures, replace excavated material with Fill Against Structure compacted to not less than 100% Standard Proctor maximum dry density.

.13 Correct unauthorized over-excavation as follows:

.1 In areas not occupied by foundations or structures, replace excavated material with Select Backfill Material compacted to not less than 98% of Standard Proctor Maximum Dry Density.

.14 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.

3.7 Backfill types and compaction

.1 Use types of backfill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698.

.1 Aggregate Base Courses (for access roads and paths): compact to 95% of maximum dry density.

.2 Fill Against Structure: compact to 95% of maximum dry density.

.3 Select Backfill Material: compact to 95% of maximum dry density.

3.8 Backfilling

.1 Do not proceed with backfilling operations until completion of following:

.1 Departmental Representative has inspected and approved installations.

.2 Removal of shoring and bracing;

.3 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 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer. Departmental Representative may authorize thicker lifts if it can be shown specified compaction can be achieved.

.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 3 days or until it has sufficient strength to withstand earth and compaction pressure and obtain approval from Departmental Representative.
- .5 Place unshrinkable fill in areas as indicated or directed by Departmental Representative. Consolidate and level unshrinkable fill with internal vibrators.

.6 Backfilling at surface:
- .1 Shall be re-used existing stockpiled topsoil, where excavation is outside of paved or granular surfaces.

3.9 Restoration

.1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil with clean topsoil, source to be approved by Departmental Representative.

.3 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.4 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.5 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 05 16 – Aggregate Materials.

.2 Section 31 23 33 – Excavating Trenching and Backfilling.

1.2 References

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM C 117-13, Standard Test Methods for Material Finer Than 75-micro m (No. 200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM D6928-10, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.
- .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 698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ftn) (600kN-m/mn).
- .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 Ontatio Provincial Standards (OPSS)
- .1 OPSS 1010 – Aggregates, Base, Subbase, Select Subgrade, and Backfill Material

PART 2 - PRODUCTS

2.1 Materials

.1 Granular "B" Sub-base Material: in accordance with Section 31 05 16 – Aggregates: General and following requirements:
- .1 Crushed rock.
- .2 Gravel and crushed gravel composed of naturally formed particles of stone.
- .3 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.

.4 Table:

Sieve Designation	% Passing
106 mm	100
26.5 mm	50 – 100
4.75 mm	20 – 55
1.18 mm	10 – 40
0.300 mm	5 – 22
0.075 mm	0 – 10

.5 Other Properties as follows:
- .1 Liquid Limit: to ASTM D 4318, Maximum 25.
- .2 Plasticity Index: to ASTM D 4318 Maximum 0.
- .3 Los Angeles degradation: to ASTM C131. Max % loss by mass: 35.
- .4 Crushed Particles: at least 50% of particles by mass retained on the 4.75 mm sieve to have at least two (2) fractured faces.

.6 Particles smaller than 0.02 mm: to ASTM D 422, Maximum 3%.

.7 Flat and elongated particles: maximum percent by mass: 15.

.8 Granular Subbase shall not consist of sandstone.

.2 Shouldering material, composed of crushed rock and gravel to the gradations listed above.

PART 3 - EXECUTION

3.1 Inspection of Underlying Sub-Base

.1 Place granular sub-base after surface is inspected and approved by Departmental Representative.

.2 Underlying material to be compacted to 100% of Standard Proctor Density to ASTM D698

3.2 Placing

.1 Place granular sub-base after subgrade is to the satisfaction of the 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 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace portion of layer in which material has become segregated during spreading.

.9 Place and compact shouldering to 2% cross slope in reconstruction areas. In overlay sections, feather new shoulder material from top of new asphalt to rounding of shoulder slope.

.10 Compacted shouldering to be flush with asphalt concrete surface.

.11 Hand work will be required to form base for asphalt concrete gutters/offtakes.

.12 Place, hand rake and compact new shoulder material under and behind guiderail.

3.3 Compaction

.1 Compaction equipment to be vibratory-type and capable of obtaining required material densities.

.2 Compact to density of not less than 100% of Maximum Dry Density in accordance with ASTM D

698.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

.4 Apply water as necessary during compaction to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers to the satisfaction of the Departmental Representative.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 Site Tolerances

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

3.5 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 the Departmental Representative.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.3 Shouldering cross slope is to be 2% or match the cross slope of the roadway surface, whichever is steeper.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 05 16 – Aggregate Materials

.2 Section 31 23 33 – Excavating, Trenching and Backfilling.

.3 Section 32 11 19 – Granular Sub-Base

1.2 References

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM C 117-13, Standard Test Methods for Materials Finer Than 75-mirco m Sieve in Mineral Aggregates by Washing.
- .2 ASTM D 6928-10, Standard Test Method for Resistance of coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus.
- .3 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .4 ASTM D 698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ftn) (600kN-m/mn).
- .5 ASTM D 1883-07e1, Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.
- .6 ASTM D 4318-10, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Ontatio Provincial Standards (OPSS)
- .1 OPSS 1010 – Aggregates, Base, Subbase, Select Subgrade, and Backfill Material

PART 2 - PRODUCTS

2.1 Materials

.1 Granular base: material in accordance with Section 31 05 16 – Aggregates: General and following requirements.

.1 Crushed rock.

.2 Gravel and crushed gravel composed of naturally formed particles of stone.

.3 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 to:

Sieve Designation	% Passing
26.5 mm	100
19.0 mm	85-100
13.2 mm	65-90
9.5 mm	50-73
4.75 mm	35-55
1.18 mm	15-40
0.300 mm	5-22
0.075 mm	2-8

.2 Liquid limit: to ASTM D 4318, maximum 25.

.3 Plasticity index: to ASTM D 4318, maximum 0.

.4 Los Angeles degradation: to ASTM C131. Maximum % loss by mass: 35.

.5 Crushed particles: at least 60% of particles by mass within each of following sieve designation ranges to have at least one (1) freshly fractured faces. Material to be divided into ranges using methods of ASTM C 136.

.6 Flat and elongated particles: maximum by mass: 15%.

PART 3 - EXECUTION

3.1 Placing

.1 Place granular base after sub-base or subgrade surface is inspected and

approved by the Departmental Representative.

.2 Construct granular 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 and ice.

.5 Place material using methods which do not lead to segregation or degradation of aggregate.

.6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.2 Compaction

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Compact to density not less than 100% of standard proctor Maximum Dry Density in accordance with ASTM D 698.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.4 Apply water as necessary during compacting to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers to the satisfaction of the. Departmental Representative.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 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.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.4 Protection

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

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 05 16 – Aggregate Materials.

.2 Section 32 11 20 – Granular Base

1.2 References

.1 American Society for Testing and Materials (ASTM)

- .1 ASTM C 117-95, Standard Test Methods for material finer than 0.075 mm Sieve in Mineral aggregates by washing.
- .2 ASTM C 131-96, Standard Test Method for Resistance to degradation of small-size coarse aggregate by abrasion and impact in the Los Angeles machine.
- .3 ASTM C 136-96a, Standard Test Method for Sieve analysis of fine and coarse aggregates.
- .4 ASTM D 698-00a, Standard Test Methods for laboratory compaction characteristics of soil using standard effort (12,400ft-lbf/ft^3) (600kN-m/m^3).
- .5 ASTM D 1557-00, Test Method for laboratory compaction characteristics of soil using modified effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).
- .6 ASTM D 1883-99, Standard Test Method for CBR (California Bearing Ratio) of laboratory compacted soils.
- .7 ASTM D 4318-00, Standard Test Methods for liquid limit, plastic limit and plasticity index of soils.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-8.2-M88, sieves, testing, woven wire, metric.

1.3 Delivery, Storage and Handling

.1 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregate Materials. Stockpile minimum 50% of total bedding material/aggregate required prior to beginning operation.

1.4 Waste Management And Disposal

.1 Remove un-used bedding material from site.

PART 2 – PRODUCTS

2.1 Materials

.1 Pipe Bedding Material: Bedding material shall consist of well graded sand or granular material free of clay, frozen lumps, organic or deleterious matter and meet the gradation limits specified below:

Sieve Designation (mm)	Percent Passing
25	100
19	75-100
12.5	-
9.5	50-100
4.75	30-70
2	20-45
0.425	10-25
0.18	-
0.075	3-8

.2 Granular base shall also be accepted as a pipe bedding material. For Specification on Granular Base, see Section 32 11 20 – Granular Base

.3 Stone Bedding Material: Stone bedding shall be used only as deemed necessary by the Departmental Representative in wet trenches where de-watering is not possible. Stone bedding shall consist of approved, well graded material free of clay, frozen lumps, organic or deleterious matter; and meet the gradation limits as specified below.

Sieve Designation (mm)	Percent Passing
25.4	100
19	75-100
9.5	0-75
4.75	0-15
2.36	0-5

When using stone bedding, the entire pipe bedding zone must be completely enveloped

with geotextile fabric to prevent the migration of fine from the surrounding soil.

.4 Refer to Section 33 36 33 Utility Drainage Field for drainage field material specifications.

PART 3 - EXECUTION

3.1 Sequence of Operation

.1 Placement

.1 Place pipe bedding material and compact as necessary to meet the grades shown on the drawings.

.2 Ensure no frozen material is placed.

.3 Place material only on properly shaped, clean unfrozen surface, free from snow and ice.

.4 Place material using methods which do not lead to segregation or degradation of aggregate.

.5 Place bedding material to a thickness of 150mm below the underside of pipe when the trench is not in solid rock. If the trench is in solid rock, the bedding material shall be placed 300mm thick below the underside of pipe.

.6 Bedding material shall be placed to a width of 300mm beyond the outside of the pipe, on both sides as well as 300mm thick on top of the pipe.

.7 Bedding shall be placed in uniform layers not exceeding 150mm compacted thickness. Departmental Representative may authorize thicker layers if specified compaction can be achieved.

.2 Compaction Equipment

.1 Compaction equipment to be capable of obtaining required material densities.

.3 Compacting

.1 Compact to density not less than 95% corrected maximum dry density in accordance with ASTM D698, latest edition.

.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 by Departmental Representative.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 32 12 16 – Hot-Mix Asphalt Concrete Paving

1.2 References

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM D 140-2009, Standard Practice foR Sampling Bituminous Materials.
- .2 ASTM D 244-09, Standard Test Methods and Practices for Emulsified Asphalts.
- .3 ASTM D 997-13, Standard Specification for Emulsified Asphalt.

1.3 Environmental Provisions

.1 Tack coat spills larger than 70 L shall be immediately reported to Ontario's Ministry of Environment, Conservation and Parks and the Departmental Representative.

.2 The Contractor shall take such steps as are necessary to abate the discharge, clean up the area affected, dispose of waste materials in an approved waste disposal site, and restore the environment to the satisfaction of the Ontario's Ministry of Environment, Conservation and Parks and the Departmental Representative, all at the Contractor's expense.

PART 2 – PRODUCTS

2.1 Materials

.1 Emulsified Asphalt: Type SS-1 or Type SS-1h emulsified asphalt, to ASTM D 997 as the tack coat material.
- .1 The Departmental Representative shall be notified in advance as to which type the Contractor intends to use and the tack coat shall meet the following standards.

.2 Water: Water for forming the solution shall be clean water free from impurities.

PART 3 – EXECUTION

3.1 Equipment

.1 Tack coat shall be applied by means of an approved pressure distributor equipped with thermometer, pressure gauge, fifth wheel tachometer and suitable spray nozzles which shall all be of the same orifice and manufacturer and capable of producing a fog-type spray. The slot of each nozzle shall be set at 30 degrees to the axis of the spray bar and the spray bar shall be set at a height above the existing pavement that will permit the fan from each nozzle to overlap its neighbouring fan by exactly half.

3.2 Application

.1 Obtain Departmental Representative's approval of existing surface before applying asphalt tack coat. Clean surface as required.

.2 Tack coat shall only be placed on surfaces that are clean and dry and then only when the atmospheric temperature is at least 10°C and when rain is not forecast within 2 hours of application.

.3 Should the surface to be treated be dirty, then the Contractor shall thoroughly clean the surface by means of a power broom, or equivalent.

.4 The Contractor shall plan his work so that no more tack coat than is necessary for the day's paving operation is applied at one time.

.5 Paint contact surfaces of existing abutting asphalt surface with thin, uniform coat of asphalt tack coat material.

.6 To avoid nuisance and possible property damage to the travelling public, the Contractor shall install portable traffic lights or other means of directing one-way traffic while working on the adjacent part of the road.

.7 Type SS-1 or Type SS-1h emulsion shall be diluted with an equal volume of water prior to the application. The diluted SS-1 or SS-1h emulsion shall be applied at a rate of 0.3 to 0.5 l/m^2 of diluted emulsion on old pavement. Both the mixing temperature and the application temperature shall be between 20°C and 50°C. Care must be exercised not to exceed the recommended application rate.

.8 Tack coat application shall be visually uniform. Areas of insufficient or non-uniform tack coat coverage shall be corrected by the contractor at no cost to Canada.

.9 Where traffic is to be maintained, treat no more than one half of width of surface in one application.

.10 Keep traffic off tacked areas until asphalt tack coat has set.

.11 Re-tack contaminated or disturbed areas as directed by Departmental Representative.

.12 Permit asphalt tack coat to set before placing asphalt pavement.

3.3 Curing

.1 No hot mix shall be placed upon the tack coat until it has dried to a proper condition of tackiness, as determined by the Departmental Representative. The Contractor is advised that the period required for such drying will depend upon weather conditions.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 01 35 43 - Environmental Procedures.

.2 Section 31 05 16 – Aggregates Material.

.3 Section 32 11 20 - Granular Base.

.4 Section 32 12 13 – Asphalt Tack Coat.

1.2 References

.1 ASTM International

.1 ASTM C 88-13, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.

.2 ASTM C 117-13, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C 123-12, Standard Test Method for Lightweight Particles in Aggregate.

.4 ASTM C 127-12, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

.5 ASTM C 128-12, 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 207-06(2011), 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 3203-11, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

.12 ASTM D 4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

.13 ASTM D 6373-13, Standard Specification for Performance Graded Asphalt Binder

.14 ASTM D 6927-06, Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
.15 ASTM D 6928-10, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
.16 ASTM C 1252-06, Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
.17 ASTM D 4867, Standard Test for Effect of Moisture on Asphalt Concrete Paving Mixtures (Lottman Test)

.2 Government of Ontario, Ministry of Transportation
.1 Ontario Provincial Standards.

1.3 Supply of Materials

.1 Notify Departmental Representative of proposed date for use of materials; order and schedule shipments to coincide with construction schedule.

1.4 Source Sampling

.1 At least 4 weeks prior to commencing work inform Departmental Representative of proposed source of aggregates and provide access for sampling.
.1 A copy of the location letter shall be forwarded to the Superintendent, Point Pelee National Park.

1.5 Material Certification

.1 Submit manufacturer's test data and certification that asphalt cement meets requirements of this section.

1.6 Submission of Mix Design

.1 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 4 weeks prior to commencing work.

.2 All asphalt concrete mix supplied for the work shall conform to the requirements of the 'surface course' designation.

1.7 Delivery and Storage

.1 Deliver and stockpile aggregates in accordance with Section 31 05 16 – Aggregates Materials. Stockpile minimum 50% of total amount of aggregate required before commencing asphalt mixing operation.

.2 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.

.3 Stockpile fine aggregate separately from coarse aggregate.

.4 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

.5 Furnish copies of freight and weigh bills for asphalt cement as shipments are received. Departmental Representative reserves right to check weights as material is received.

PART 2 – PRODUCTS

2.1 Materials

.1 Asphalt cement: PG 58-28 in accordance with ASTM D6373.

.2 Aggregate material to following requirements:
.1 Crushed rock consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, and other deleterious materials.
.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

Binder Course (HL8):

Sieve Designation		% Passing
26.5	mm	100
19.0	mm	94-100
16.0	mm	77-95
13.2	mm	65 – 90
9.5	mm	48 – 78
4.75	mm	30 – 50
2.36	mm	21 - 50

1.18 mm	12 – 49
0.600 mm	6 - 38
0.300 mm	3 - 22
0.150 mm	1 – 9
0.075 mm	0 – 6

Surface Course (HL3):

Sieve Designation	% Passing
16.0 mm	100
13.2 mm	98 – 100
9.5 mm	75 – 90
4.75 mm	50 – 60
2.36 mm	36 - 60
1.18 mm	25 – 58
0.600 mm	16 - 45
0.300 mm	7 - 26
0.150 mm	3 – 10
0.075 mm	0 – 5

.3 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm when tested to ASTM C136.

.4 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.

.5 Coarse aggregate stockpile shall contain no more than 15% passing 4.75 mm sieve.

.6 Fine aggregate stockpile shall contain no more than 15% retained on 4.75 mm sieve.

.7 Petrographic Number: CSA A23.2 – 15A, Max: 135.

.8 Do not use aggregates having known polishing characteristics in mixes for surface courses.

.9 Sand equivalent: ASTM D2419 Min: 50

.10 Magnesium Sulphate Soundness: ASTM C88. Max.% loss by mass: Coarse aggregate, surface course: 12. Fine aggregate, surface course: 16

.11 Los Angeles abrasion; Gradation B. to ASTM C131. Max. % loss by mass: Coarse aggregate, surface course: 35

.12 Absorption: ASTM C127, max. % by mass: Coarse aggregate, surface course: 1.75

.13 Loss by washing: to ASTM C117. Max. % passing 0.075 mm sieve: Coarse aggregate, surface course: 1.75

.14 Flat and elongated particles with length to thickness ratio greater than 4: Max. % by mass: Coarse aggregate, surface course: 20

.15 Crushed fragments at least 100% of particles by mass within each of following sieve designation ranges to have at least 2 freshly fractured faces. Material to be divided into ranges using methods of ASTM C136.

Passing		Retained on
19.0 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.

.17 Micro – Deval abrasion, to ASTM D6928, Coarse aggregate: Max. 20%.

.18 Micro – Deval abrasion, to CSA A23.2 – 23A, Fine aggregate: Max 20%.

.19 Fine aggregate angularity, to ASTM C1252, Min. 45%.

.3 Mineral filler:

.1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non- plastic mineral matter, thoroughly dry and free from lumps.

.2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.

.3 Mineral filler to be dry and free flowing when added to aggregate.

2.2 Mix Design

.1 Job mix formula to be provided by Contractor and designed and certified by a Professional Engineer licensed to practice in the Place of Work. Job mix formula to be approved by Departmental Representative.

.2 Design of mix: by Marshall method to requirements below and as directed by Departmental Representative.
- .1 Compaction blows on each face of test specimens: 75.
- .2 Mix physical requirements:
  1. Marshall Stability at 60°C: 8000 N(minimum)
  2. Flow Value mm: 2 to 4.25
  3. Air Voids in Mixture, %: 4 ± 0.5
  4. Voids in Mineral Aggregate, % minimum: 15
  5. Index of Retained Stability % Minimum: 75
- .3 Measure physical requirements as follows:
  - .1 Marshall load and flow value: to ASTM D6927.
  - .2 Air voids: to ASTM D3203.
- .4 Do not change job-mix without prior approval of Departmental Representative. Should change in material source be proposed, new job-mix formula to be reviewed by Departmental Representative.
- .5 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.
- .6 Asphalt content: 5.0%(HL3) and 4.7%(HL8) based on total weight.
- .7 Asphalt mixtures containing RAP shall be designed in accordance with the latest edition of the Asphalt Institute Manual Series No. 2.
- .8 The quality of the final pavement mixture shall meet all requirements set forth in this specification.
- .9 Use liquid type anti-stripping agent. Ensure compatibility with cement being used. Tensile Strength Ration (TSR) required is 80% minimum.

PART 3 – EXECUTION

3.1 Plant and Mixing Requirements

.1 Batch and continuous mixing plants:
- .1 To ASTM D995.
- .2 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160°C.

.3 Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.

.4 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Departmental Representative will direct temperature of completed mix at plant and at paver after considering hauling and placing conditions.

.5 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.

.6 Feed cold aggregates to plant in proportions that will ensure continuous operations.

.7 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.

.8 Store hot screened aggregates in a manner to minimize segregation and temperature loss.

.9 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.

.10 Maintain temperature of materials within plus or minus 5°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 a thoroughly blended mix but not less than 30 s or more than 75 s.

.2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45 s.

.3 Do not alter mixing time unless directed by Departmental Representative.

.2 Dryer drum mixing plant:

.1 Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.

.2 Meter total flow of aggregate by an electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt entering mixer remain constant.

.3 Provide for easy calibration of weighing systems for aggregates without having material enter mixer.

.4 Calibrate individual feed bin conveyors to ensure mix proportions are achieved.

.5 Make provision for conveniently sampling the full flow of materials from the cold feed.

.6 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.

.7 Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.

.8 Accomplish heating and mixing of asphalt mix in an approved parallel flow dryer-mixer in which aggregate and asphalt enter drum at burner end and travel parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with a printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each day.

.9 Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 1%.

.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 h.

.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):

16.0 mm sieve and larger	±5.0%
13.2/9.5 mm sieve	±4.0%
4.75/2.36/1.18 mm sieve	±3.0%
.600/.300/.150 mm sieve	No Limits
0.075 mm sieve	±1.0%

.2 Permissible variation of asphalt cement from job mix, ±0.20%
.3 Permissible variation of mix temperature at discharge from plant, 10°C.

3.2 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, general: sufficient number of rollers of type and weight to obtain specified density of compacted mix.

.3 Haul trucks: 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 Trucks which cannot be weighed in single operation on scales supplied will not be accepted.

.4 Hand tools:
.1 Lutes or rakes with covered teeth for spreading operations.
.2 Provide tamping irons having mass not less than 12 kg and a 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.

3.3 Preparation

.1 Reshape granular roadbed to Departmental Representative's approval.

.2 Prior to laying mix, clean surfaces of loose and foreign material.

.3 Saw cut adjacent asphalt surfaces and prior to placing new asphaltic pavement.

.4 Tack coat existing asphalt surfaces and edges prior to placing new asphalt mix in accordance with Section 32 12 13 – Asphalt Tack Coat.

.5 Construct key joint at locations where the new top lift of asphalt will meet existing asphalt as indicated on the drawings.

3.4 Transportation of Mix

.1 Transport mix to job site in vehicles cleaned of foreign material in good mechanical working order, tight gates and with tarps.

.2 Paint or spray truck beds with limewater, soap or detergent solution, or non-petroleum based commercial product at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted.

.3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.

.4 Deposit mix from surge or storage silo into trucks in multiple drops and use methods necessary to prevent segregation.

.5 Deliver materials to paver at a 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. Deliver and place mixes at a temperature within range directed, but not less than 130°C.

3.5 Placing

.1 Obtain Departmental Representative's approval of base prior to placing asphalt.

.2 Place asphalt concrete to thicknesses, grades and lines indicated or directed by Departmental Representative.

.3 Placing conditions:
- .1 Place asphalt mixtures only when air temperature is above 5°C.
- .2 When temperature of surface on which material is to be placed falls below 10°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 A material transfer device shall be used for the placement of all asphalt mix on the project. Prior to use, the material transfer device shall be approved by the Departmental Representative.

.4 Place asphalt concrete in compacted lifts of thickness as noted on the plans.

.5 Spread and strike off mixture with self-propelled mechanical finisher:

.1 Construct longitudinal joints and edges true to line markings. Lines for paver to follow will be established by Departmental Representative 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. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.

.3 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.

.4 Correct irregularities in alignment left by paver by trimming directly behind machine.

.5 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.

.6 Do not throw surplus material on freshly screeded surfaces.

.6 When hand spreading is used:

.1 Approved wood or steel forms, rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.

.2 Distribute material uniformly. Do not broadcast material.

.3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. 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. Avoid high temperatures which may burn material. Do

not use tools at a higher temperature than temperature of mix being placed.

3.6 Compacting

.1 Roll asphalt continuously to a density not less than 93% of the mix maximum theoretical density.

.2 General:

.1 Provide minimum three (3) rollers and as many additional rollers as necessary to achieve specified pavement density. One roller must be pneumatic-tired type.

.2 Start rolling operations as soon as placed mix can bear weight of roller without undue displacement of material or cracking of surface.

.3 Operate rollers slowly initially to avoid displacement of material. For subsequent rolling do not exceed 5 km/h for static steel- wheeled rollers and 8 km/h for pneumatic-tired rollers.

.4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel.

.5 Overlap successive passes of roller by at least one half width of roller and vary pass lengths.

.6 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.

.7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism.

.8 Do to permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.

.9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.

.10 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.

.11 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.

.3 Breakdown rolling:

.1 Commence breakdown rolling 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. Exceptions may be made when working on steep slopes or super-elevated sections.

.4 Use only experienced roller operators for this work.

.4 Second 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 shall be continuous after initial rolling until mix placed has been thoroughly compacted.

.5 Finish rolling:

.1 Accomplish finish rolling with two- axle or three-axle tandem steel wheel rollers while material is still warm enough for removal of roller marks. If necessary to obtain desired surface finish, Departmental Representative shall specify use of pneumatic-tired rollers.

.2 Conduct rolling operations in close sequence.

3.7 Joints

.1 General:

.1 Trim vertical face by sawcutting to provide true surface and cross section against which new pavement may be laid. Remove loose particles.

.2 Paint joint face with thin coat of hot asphalt cement or cutback asphalt or preheat joint face with approved heater, prior to placing of fresh mix.

.3 Overlap previously laid strip with spreader by 100 mm.
.4 Remove surplus material from surface of previously laid strip. Do not dispose on surface of freshly laid strip.
.5 Construct joints between asphalt concrete pavement and portland cement concrete pavement as directed by Departmental Representative.
.6 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

.2 Transverse joints:
.1 Construct and thoroughly compact transverse joints to provide a smooth riding surface.
.2 Stagger joint locations 2 m.
.3 Offset transverse joint in succeeding lifts by at least 600 mm.

.3 Longitudinal Joints:
.1 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with a lute or rake.
.2 Roll longitudinal joints directly behind paving operation.
.3 When rolling with static roller, shift roller over onto previously placed lane in order that 100 to 150 mm of drum width rides on newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until thoroughly compacted neat joint is obtained.
.4 When rolling with static or vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
.5 Offset longitudinal joints in succeeding lifts by at least 150 mm.

3.8 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 5mm when checked with a 4.5 m straight edge place in any direction.

3.9 Defective Work

.1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form a 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.

3.10 Hours of Work

.1 Unless specifically authorized otherwise by the Departmental Representative, all spreading of asphalt mix shall stop at least 1/2 hour before sunset and the paver shall be off the road by sunset.

3.11 Pollution Control/Site Clean-up

.1 Control emissions from equipment and plant to Site Clean-up Provincial emission requirements.

.2 Copies of the Contractor's current Provincial Asphalt Plant Approval Permit must be provided to PCA and the EPO.

.3 Excess asphaltic concrete material must be disposed of at approved locations. No material will be deposited outside the lines and grades indicated for asphalt paving, except as approved by the Departmental Representative.

.4 The EPO on behalf of Provincial Department of Environment and Conservation will be monitoring the Contractor's operation, including site cleanup.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 32 11 19 – Granular Subbase.

.2 Section 32 11 20 – Granular Base.

.3 Section 31 23 33 – Excavating, Trenching and Backfilling

PART 2 – PRODUCTS

2.1 Water

.1 Water: in accordance with Departmental Representative's approval.

PART 3 – EXECUTION

3.1 Application

.1 Apply water with distributors equipped with means of shut-off and with a fine spray system to ensure uniform application.

3.2 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 recycling.

.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

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 14 13 - Soil Stripping and Stockpiling.

.2 Section 31 23 33 - Excavating, Trenching and Backfilling.

1.2 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.

1.3 Action and Informational Submittals

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

.2 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.

1.4 Quality Assurance

.1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements in accordance with Section 01 14 10 – Scheduling and Management of Work.

PART 2 - PRODUCTS

2.1 Topsoil

.1 Topsoil to come from material salvaged on site previously stockpiled on-site or from imported topsoil. Imported topsoil source to be approved.
1. Inform Departmental Representative of the proposed source of topsoil and provide access for sampling two (2) weeks minimum before starting production. The Contractor or his representative is to

be present during sampling.

.2 Topsoil sources must be free of invasive species and capable of producing clean material to the satisfaction of the Department Representative.

.3 If, in the opinion of Departmental Representative, topsoil from the proposed source does not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that aggregate from a source in question can be processed to meet specified requirements.

.4 Should a change of topsoil source be proposed during work, advise Departmental Representative one (1) week in advance of the proposed change to allow sampling and testing.

.5 Acceptance of the topsoil at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

2.2 Source Quality Control

.1 Contractor is responsible for amendments to supply topsoil as required.

.2 Provide for soil testing by recognized testing facility for PH, P and K, and organic matter.

.1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

PART 3 - EXECUTION

3.1 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 and sediment and erosion control drawings.

.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.

.4 No hay mulch or possible seed contaminants are to be used on this project as a part of erosion control or any other activity.

3.2 Stripping of Topsoil

.1 Strip topsoil in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.

3.3 Preparation of Existing Grade

.1 Verify that grades are correct.

.2 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.

.3 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

.4 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.

3.4 Placing and Spreading of Topsoil/Planting Soil

.1 Screen previously stripped material prior to use using 50mm square screen. Material retained on screen shall be disposed of incidental to the work.

.2 Place topsoil after Departmental Representative has accepted subgrade.

.3 Spread topsoil in uniform layers not exceeding 100 mm.

.4 Spread topsoil as indicated to following minimum depths after settlement.
.1 50 mm for all areas.

.5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.5 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.

3.6 Acceptance

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

3.7 Surplus Material

.1 Dispose of materials not required where directed by Departmental Representative off site.

3.8 Cleaning

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 32 98 00 – Reinstatement.

1.2 Submittals

.1 Product Data.
- .1 Submit product data in accordance with 01 33 00 - Submittal Procedures.
- .2 Provide product data for:
  - .1 Seed.
  - .2 Mulch.
  - .3 Tackifier.
  - .4 Fertilizer.
  - .5 Fibre Reinforced Matrix

.3 Submit in writing to Departmental Representative fourteen (14) days 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.

1.3 Quality Assurance

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 Scheduling

.1 Schedule hydraulic seeding to coincide with preparation of soil surface.

.2 Hydroseeding shall be carried out as soon as possible after completion of the surface preparation in order to prevent erosion by wind and water. Hydroseeding shall take place no more than two (2) weeks after excavation and embankment

construction is complete.

PART 2 – PRODUCTS

2.1 Materials

.1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
  .1 Grass mixture: "Certified", "Canada No.1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
  .2 Mixture composition:
    .1 60% Certified Annual Rye Grass.
    .2 40% Creeping Red Fescue

.2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, with an environmentally acceptable dye, free of germination and growth inhibiting factors with following properties:
  .1 Type I mulch:
    .1 Made from wood cellulose fibre.
    .2 Organic matter content: 95% plus or minus 0.5%.
    .3 Value of pH: 6.0.
    .4 Potential water absorption: 900%.

.3 Tackifier: water dilutable, liquid dispersion water soluble vegetable carbohydrate powder.

.4 Water: free of impurities that would inhibit germination and growth.

.5 Fertilizer:
  .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
  .2 The fertilizer is to have a plant food ratio of 10 nitrogen, 20 phosphorus, and 20 potash plus 2% Fritted Trace Elements.
  .3 The fertilizer to be spread the following spring during the

maintenance period shall have a plant food ratio of 19 nitrogen, 19 phosphorus, and 19 potash.

.6 Inoculants: inoculant containers to be tagged with expiry date.

PART 3 – EXECUTION

3.1 Workmanship

.1 Do not spray onto structures, signs, guide rails, fences, plant material, utilities, and other than surfaces intended.

.2 Clean-up immediately, any material sprayed where not intended, to satisfaction of Departmental Representative.

.3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, immediately prior to heavy rain events, frozen ground or ground covered with snow, ice or standing water.

.4 Protect seeded areas from trespass until plants are established.

3.2 Preparation of Surfaces

.1 Fine grade areas to be seeded free of humps and hollows. Ensure areas are free of deleterious and refuse materials.

.2 Ensure areas to be seeded are moist to depth of 150 mm before seeding.

.3 In areas of hard earth, spread suitable excavated material at a minimum depth of 150mm to promote growth.

.4 Obtain Departmental Representative's approval of grade before starting to seed.

3.3 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 all materials are in the seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.4 Slurry Application

.1 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 50m hand operated hoses and appropriate nozzles.

.2 Slurry mixture applied per hectare.
- .1 Seed: Grass mixture 175kg.
- .2 Mulch: Type I 1350kg.
- .3 Tackifier: 300kg.
- .4 Water: Minimum 30,000L.
- .5 Fertilizer: 400kg.

.3 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.

.4 Blend application 300mm into adjacent grass areas or sodded areas and previous applications to form uniform surfaces.

.5 Re-apply where application is not uniform.

.6 Remove slurry from items and areas not designated to be sprayed.

.7 Protect seeded areas from trespass

satisfactory to Departmental Representative.

.8 Remove protection devices as directed by Departmental Representative.

3.5 Application of Fibre Reinforced Matrix

. 1 FRM slurry shall be applied at locations as identified on the Drawings or as directed by the Departmental Representative.

.2 FRM shall be thoroughly mixed with water in a hydraulic.1 FRM shall be applied at a minimum rate of 3,700kg of dry product per hectare. FRM shall be thoroughly mixed with water in a hydraulic seeder and mulcher at a rate of 20-30 kg of dry product to 500-600 litres of water to form a homogeneous slurry.

.3 The FRM slurry may be applied in a 1-step application with seed or a two-step application on already seeded earth. FRM shall be applied by nozzle sprayer or extension hose. The FRM slurry shall be evenly dispersed in successive applications from different directions to form a uniform, cohesive mat. The spray shall not dislodge soil or cause erosion.

.4 FRM shall be installed by personnel certified and trained by the manufacturer in the proper mixing and installation of the product.

3.6 Maintenance During Establishment Period

.1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.

.2 The Contractor shall be responsible for maintaining hydroseeded areas to ensure proper and adequate growth of the vegetation during the warranty period. The Contractor shall also be responsible for an additional application of fertilizer the following spring after initial application. This application shall be by a method approved by the

Department. The fertilizer shall be 5-10-30 and shall be applied at a rate of 300 kg/ha. No additional payment will be made for maintenance or the extra application of fertilizer.

3.7 Acceptance

.1 Seeded areas will be accepted by the Departmental Representative provided evidence of growth and that plants are uniformly established.

3.8 Warranty Period

.1 All areas hydroseeded under this contract shall have a warranty period of one (1) year starting from the date of initial acceptance. This warranty shall cover any defects in materials and workmanship, and damages caused by the elements of weather. During this period, any defect brought to the attention of the Contractor by the Departmental Representative shall be fixed, repaired or made good to the satisfaction of the Departmental Representative and at no additional cost to the Department.

3.9 Cleaning

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END

PART 1 - GENERAL

1.1 Work Included

.1 This section specifies requirements for reinstatement of surfaces, property, and structures damaged or disturbed by operations under this Contract. Work includes but is not limited to reinstatement of gravelled and grassed surfaces; except as noted herein.

1.2 Related Sections

.1 Section 31 23 33 – Excavating, Trenching and Backfilling

.2 Section 32 91 19 - Topsoil Placement and Grading.

.3 Section 33 05 16 - Manholes, Catch Basin Structures.

.4 Section 33 31 13 - Public Sanitary Utility Sewerage Piping.

.5 Section 32 11 19 – Granular Subbase

.6 Section 32 11 20 – Granular Base

PART 2 - PRODUCTS

2.1 Materials

.1 Granular materials: to Section 32 11 20.

.2 Topsoil: to Section 32 91 19.

.3 0-6mm Crushed Rock:

.1 Composed of clean, hard sound, durable uncoated particles that do not contain friable, soluble or reactive mineral, free of clay, organic, frozen lumps or other deleterious materials or conditions that would make the crushed rock prone to decomposition or disintegration, or present any environmental hazard, from the presence of the parent material or its by-products, when exposed to the

natural elements after placement in the work.

.2 The source and quality of the crushed rock material shall be as approved by the Departmental Representative.

PART 3 - EXECUTION

3.1 General

.1 Reinstate all surfaces to lines, elevations, and dimensions which existed prior to construction and to match abutting surfaces.

.2 Make good all damage or disturbances to surfaces, survey markers, properties and structures disturbed during construction.

.3 Conduct and confine all construction operations within the limits of the work as shown on the Drawings or as laid out by the Department Representative.

.4 Fully restore the entire site and all properties, facilities, structures, fences, shrubs, lawns, trees, signs, driveways, sidewalks, ditches, culverts, appurtenances, etc. affected by the work to original or better condition before issuance of the "Certificate of Final Acceptance".

3.2 Gravel Surfaces

.1 Place, spread, and fine grade Granular Base to minimum compacted thickness of 150 mm for shoulders and other gravel surfaces. Compact to 100 % Standard Proctor Density.

3.3 Gravel/Crushed Stone Driveways

.1 Existing crushed rock driveways shall be restored to a depth of 150 mm with approved Crushed Rock material. Crushed rock for driveway restoration shall be

Class "A" (19 mm minus) (unless otherwise directed), but in all cases driveway restoration materials must match as closely as possible to the existing driveway materials. This work shall include any excavation and removal of materials to prepare the subgrade and produce a smooth and firm surface on which to place the crushed rock.

3.4 Landscaped Surfaces to be reinstated.

.1 Fine grade to smooth surface all areas

.2 Reinstate landscapes to Sections 32 91 19.

3.5 Asphalt Surfaces

.1 Reinstate damaged asphalt surfaces as required.

.2 Make vertical saw cut to full depth of asphalt concrete in straight lines. Cut back 300 mm minimum from edge of excavation or beyond to eliminate tension cracks.

.3 Place or remove gravel to depth required.

.4 Shape, fine grade and compact gravel surface to 100 % Standard Proctor Density.

.5 Clean contact surfaces and apply tack coat prior to placing asphalt concrete.

.6 Place and compact hot-mix, submit mix for approval by Departmental Representative. Hot-placed asphalt concrete to the following minimum thickness as indicated:
.1 Asphalt Binder: 60 mm.
.2 Asphalt Surfaces: 40 mm
.3 Granular Base: 150mm
.4 Granular Subbase: 300mm

.7 Asphalt Roadway Repair:
.1 When repairing existing asphalt roadways, cut the edge of existing asphalt in a straight line to full depth using a cutting saw.

.2 In areas requiring paving, sweep clean the surface of the existing asphalt adjacent to the cut.

.3 Complete restoration as soon as possible. Make roadways accessible at the end of each day.

3.6 Ditches

.1 Re-establish ditches to provide profiles and drainage that existed prior to construction.

3.7 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.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 23 33 - Excavating Trenching and Backfilling.

.2 Section 33 31 13 Public Sanitary Utility Sewerage Piping.

1.2 References

.1 ASTM International

.1 ASTM A48/A48M-03(2012), Standard Specification for Gray Iron Castings.

.2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM B148-14 Standard Specification for Aluminum-Bronze Sand Castings.

.4 ASTM C117-13, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

.5 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.6 ASTM C139-11, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.7 ASTM C478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).

.8 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3(600 kN-m/m3)).

.9 ASTM D1248-12 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

.10 ASTM F593 -13a Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

.11 ASTM F594 -09e1 Standard Specification for Stainless Steel Nuts.

.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 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 CSA A257, Standards for concrete pipe and manhole sections.
.4 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
.5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

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 manholes, catch basins, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 It is the Contractor’s responsibility to approve all Shop Drawings and verify their correctness.
.2 Review of the Contractor’s drawings by the Department Representative shall not relieve the Contractor of the responsibility for the correctness thereof, nor from the results arising from any error or omission in details of design.

.3 Prior to the production of fill concrete for use in this contract, provide to the Department Representative a certificate from a certified testing company stating that the concrete to be supplied conforms to the requirements of this Section.

1.4 Quality Assurance

.1 Submit in accordance with Section 01 45 00 - Quality Control.

.2 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.

1.5 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 manholes from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

1.6 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 - PRODUCTS

2.1 Materials

.1 Precast manhole units: to ASTM C478M, circular or oval.
  .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
  .2 Precast base sections with reinforced concrete slab within:
    .1 Rubber gaskets to suit the inlet and outlet pipes and factory installed benching.
    .2 Install benching to minimize hydraulic losses through chamber.
    .3 Channels and benching: smooth and uniform and not less than 75% of the diameter of the largest pipe.
    .4 Approved product: Capital Precast Ltd. or approved equivalent.

.2 Joints between sections: rubber gasket and Ram-Nek gasket as indicated on the detail drawings and meeting the requirements of the latest CSA A257.3.

.3 Adjusting rings: 150- and 300-mm concrete riser sections to ASTM C478M.

.4 Adjusting rings: to ASTM C478M.

.6 Manhole Frames, covers to dimensions as indicated and following requirements:
  .1 Standard manhole frames and covers: 411W cast iron meeting the requirements of the latest ASTM Standard A48, Class 30. Covers: snug fit and rattle free.
    .1 Manhole 411W frame outside flange to be 870mm dia., with a 580mm cover opening, and a min. weight of 95.3 kg.
    .2 Manhole 411W solid cover to be 575mm dia., with a min. of four ribs, two - 25mm lift holes, and a min. weight of 43.1 kg.

.7 Standard off-road manhole frames and covers: lock-down type, R12S as manufactured by IMP Group Ltd. or approved equivalent, meeting the requirements of the latest ASTM Standard A-48.
.1 Off-road frame outside flange dia. to be 838mm, secured with 4 – 12mm dia. stainless steel anchors, grouted a min. of 50mm into a 685mm dia. conc. riser.
.2 Off-road cover to be 610 mm dia., secured to frame with 2 pentagon-shaped (5-sided), stainless steel fasteners.

.12 Granular bedding and backfill: in accordance with Section 31 23 33 – Excavating, Trenching and Backfilling.

.13 Unshrinkable fill: in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.18 Backfill material: in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.19 Fill Concrete:
.1 Portland cement: to CSA CAN3-A5-M, Type 10 or Type 30 (High Early Strength for winter construction).
.2 Supplementary cementing materials, when permitted: to CSA CAN3-A23.5-M.
.3 Fine and coarse aggregate: to CSA CAN3-A23.1-M. Gradation to conform to Table 1 of the CSA Standard for 10 mm minus.
.4 Mixing water: to CAN3-A23.1-M.
.5 Air-entraining admixtures: to CSA CAN3-A266.1-M.
.6 Mix Design:
.1 Maximum cement content: 25 kg/m3.
.2 Maximum strength at 28 days: 0.40 MPa (measured in accordance with CAN3-A23.2-9C).

.3 Slump: 150-200 mm (measured in accordance with CAN3-A23.2-5C).
.4 Air content: 4% - 6% (measured in accordance with CAN3-A23.2).

.20 Backfill material: in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for manhole installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of the Department Representative.
.2 Inform the Department Representative 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 the Department Representative.

3.2 Excavation and Backfill

.1 Excavate and backfill in accordance with Section 31 23 33 - Excavating Trenching and Backfilling and as indicated.

3.3 Installation

.1 Construct manholes of pre-cast concrete sections according to drawing details.

.2 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.3 Complete units as pipe laying progresses.
.1 Maximum of 3 units behind point of pipe laying will be allowed.

.4 Install manholes at the locations indicated on the drawings, at all changes in grade, pipe size or alignment, at all intersections, at the end of each line and at distances not greater than 120 m for sewer 600 mm nominal diameter and smaller and 150 m for sewers 600 mm nominal diameter and larger. Where possible, manholes in roadways will be located so as to avoid principal wheel travel areas.

.5 Dewater excavation to approval of the Department Representative and remove soft and foreign material before placing concrete base.

.6 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% corrected maximum dry density maximum density to ASTM D698.

.7 Make each successive joint watertight.

.8 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.9 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.

.10 Compact granular backfill to 95% corrected maximum dry density maximum density to ASTM D698.

.11 Place unshrinkable backfill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.12 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.

.14 Installing units on new lines where connections are to be made to existing sewer lines:
- .1 Install when the downstream systems are ready to receive wastewater.
- .2 By-pass flows in the existing sewer around the connection area during construction and testing.
  - .1 A plug may also be required at the downstream manhole to which wastewater is being pumped, to prevent backflow to the work area.
- .3 Test these manholes as they are constructed, before flows are permitted to pass through the new connection.
- .4 Whenever bypassing of sewer flow is being carried out, the Contractor shall have personnel on site continuously and back-up

system components must be kept on site in the event of a failure of the first system.

.5 Provide plugs or caps where required to block off and seal ends of pipes that are being abandoned or otherwise isolated, incidental to the work.

.15 Set frame and cover on top section to elevation as indicated.

.1 Paved roadways: 10 mm below finished grade and conforming to crown of road.

.2 Gravel roadways: 25 mm below finished grade.

.3 Off traveled roadways: 50 to 100 mm above finished grade.

.1 Include lock-down frame and cover.

.1 Approved product: R12S or approved equivalent.

.4 If adjustment required use concrete ring.

.16 Clean units of debris and foreign materials.

.1 Remove fins and sharp projections.

.2 Prevent debris from entering system.

3.4 Field Quality Control .1 Test all sanitary sewer manholes for leakage.

.2 Notify the Department Representative at least forty-eight (48) hours in advance of performing sanitary manhole ex-filtration tests.

.3 Should the sanitary sewer main ex-filtration tests prove unsatisfactory, the Contractor shall excavate to determine the cause, make repairs, backfill and retest at his own expense.

3.5 Sanitary Manhole

Vacuum Test (Air)

.1 To latest version of ASTM C1244M.

.2 Conduct testing one manhole at a time:
- .1 Plug all lift holes. Plug all pipe inlets discharging into the test manhole and all pipe outlets discharging from the test manhole. Install a bulkhead on the test manhole.
- .2 Use a vacuum pump to increase the negative pressure to 27.6 KPa (4.0 psi). Close the vacuum source. Begin recording of the test time. Allow the negative pressure to increase to 24.1 KPa (3.5 psi).
- .3 Department Representative will calculate the allowable leakage and notify the Contractor. If the actual leakage time is greater than the allowable leakage time, the test section is acceptable.

3.6 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.

3.7 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair Damage to adjacent materials

END

PART 1 - GENERAL

1.1 Work Included

.1 This section includes the supply of all labour, materials and equipment and incidentals necessary for the complete installation of all sanitary sewer mains, sanitary sewer laterals and insulation and testing of all sanitary sewer mains as shown on the drawings and herein specified.

1.2 Related Sections

.1 Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Section 33 05 16 - Manholes and Catch basin Structures.

1.3 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 C12-09, Standard Practice for Installing Vitrified Clay Pipe Lines.
- .2 ASTM C14M-07, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
- .3 ASTM C76M-10a, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
- .4 ASTM C117-04, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
- .5 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .6 ASTM C425-09, Standard Specification for Compression

Joints for Vitrified Clay Pipe and Fittings.

.7 ASTM C428-05(2006), Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe.

.8 ASTM C443M-07, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

.9 ASTM C663-98(2008), Standard Specification for Asbestos Cement Storm Drain Pipe.

.10 ASTM C700-09, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

.11 ASTM C828-06, Standard Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines.

.12 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft4-lbf/ft3 (600 kN-m/m3)).

.13 ASTM D1869-95(2005)e1, Standard Specification for Rubber Rings for Asbestos Cement Pipe.

.14 ASTM D2680-01(2009), Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

.15 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.16 ASTM D3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.3 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.

1.4 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 the Department Representative 24 hours minimum in advance of any interruption in service.

1.5 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 include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:
.1 Certification to be marked on pipe.

.4 Test and Evaluation Reports:
.1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

1.6 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Load and unload pipe and accessories by lifting with hoists and slings, on pallets, or careful skidding so as to prevent shock and damage.

.3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.4 Storage and Handling Requirements:
.1 Store materials in accordance with manufacturer's recommendations.
.2 Store and protect pipes and coatings from damage.
.3 Replace defective or damaged materials with new.
.4 Do not drop or drag pipe.
.5 Avoid severe impact blows, abrasion damage, and gouging or cutting of PVC pipe by metal surfaces or rocks.
.6 For pipe handled on skidways, do not skid or roll pipe against pipe already on the ground.
.7 Avoid stressing bell joints and damage of bevel ends.

PART 2 - PRODUCTS

2.1 General

.1 Sanitary sewer pipe and gaskets will be supplied by the Contractor. Sewer pipe gaskets to be supplied to the Contractor by the pipe manufacturer.

.2 Sanitary service lateral pipes, bored pipes, tees, wyes, bends, couplings, rings, fittings, elbows, caps and saddles will be provided by the Contractor.

.3 Joints to be push-on type and must be watertight.

2.2 Plastic Pipe

.1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.
- .1 Standard Dimensional Ratio (SDR): 35.
- .2 Gasket to ASTM D3212 and integral bell system with no reduction in the wall thickness.
- .3 Nominal lengths: 6 m.
- .4 Color coded “green”.

2.3 Marker Tape

.1 Metal marker tape:
- .1 50 mm wide, c/w tracer wire.

.2 To carry the message “CAUTION – SEWER MAIN BURIED”

2.4 Service Connections

.1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.

.2 Plastic pipe and fittings: to ASTM 3034 and CSA B182.1, with push-on joints.
- .1 PVC DR35, colour coded green.
- .2 Minimum 100 mm diameter.
- .3 Joints: bell and spigot type with locked in rubber gasket.

.3 Bends: long radius type only.

.4 Caps for ends of laterals: PVC.

.5 Saddles: PVC gasket and strap on type of the size as indicated on the drawings, meeting the same requirements as the sanitary service pipe. Rubber "Insert-a-tee" or "Kor-n-tee" type connections with stainless steel bands are also accepted.

.6 Bends: long radius type only.

.7 Only PVC tees will be accepted when main sewer pipe has a depth of 3 metres or greater.

.8 Settlement joint: as manufactured by Royal Pipe Systems or approved equivalent.
.1 Required when main sewer pipe has a depth of 3 metres or greater.

2.5 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.

2.6 Pipe Penetration Seal

.1 As shown on the Contract Drawings, where cast in rubber gaskets cannot be installed and core drilling is required, suitable pipe penetrations seal is to be installed to ensure that the hole is watertight. All core drilling pipe perforations shall be sealed with Proco Pen-Seal or Link-Seal for a watertight seal. Size of the core drilling holes shall be in accordance with the manufacturer's recommendations.

2.7 Pipe Bedding and Surrounding Material

.1 Granular material to Section 31 23 33 - Excavating, Trenching and Backfilling.

2.8 Backfill Material

.1 In accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

2.9 Insulation

.1 Insulation: extruded, expanded closed-cell polystyrene insulation with the following minimum characteristics:
- .1 Compressive strength – 210 kPa;
- .2 Water absorption (% by volume) - Max. 0.7%;
- .3 Capillarity (none);
- .4 Shear strength - 275kPa.

.2 Acceptable Products:
- .1 Styrofoam HI-40, Celfort 300 as manufactured by Owens Corning, or approved equivalent.

2.10 Layout Equipment

.1 The Contractor will be responsible in laying out the locations and elevations of all new infrastructure.

.2 Use approved laser beam instrumentation and techniques to determine intermediate line and grade for all pipes except where and when the Department Representative may allow other methods to be used.
- .1 Install laser beam in the pipe, just above the pipe, or in the bottom of the manhole, unless otherwise approved by the Department Representative.

.3 Use an approved laser sighting triangle or template to set each pipe.

PART 3 - EXECUTION

3.1 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 the Department Representative.

.2 Inform the Department Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Preparation

.1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of the Department Representative.

.2 Clean and dry pipes and fittings before installation.

.3 Obtain Department Representative’s approval of pipes and fittings prior to installation.

3.3 Trenching

.1 Do trenching Work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Protect trench from contents of sewer or sewer connection.

.3 Trench alignment and depth require approval of the Department Representative prior to placing bedding material and pipe.

3.4 Granular Bedding

.1 Place bedding in unfrozen condition.

.2 Place granular bedding materials in uniform layers not exceeding 300 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% maximum density to ASTM D698.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material or lean mix concrete mud slab, as indicated on drawings.

3.5 Installation

.1 Install sanitary sewer mains according to the sizes and locations indicated on the drawings.

.2 Provide and use proper implements, tools and facilities for safe and efficient execution of the work.

.3 Lay and join pipes to: ASTM C12.

.4 Lay and join pipes in accordance with manufacturer's recommendations, in accordance with recognized good practice and to approval of the Department Representative.

.5 Handle pipe using methods approved by the Department Representative.
.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
.2 Carefully lower pipe and fittings into trench in such a manner as to prevent damage to them. Do not drop pipe or fittings into trench.

.6 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
- .1 Minimum grade, unless otherwise indicated:
  - .1 Pipe diameter 200 mm to 300 mm: 0.4%
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .3 Remove and re-lay any pipe which is not in true alignment or shows undue settlement after laying.

.7 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.8 Do not lay pipe on a foundation into which frost has penetrated, or at any time when the Department Representative may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.

.9 Inspect pipe thoroughly before and after laying. Remove defective or damaged pipe from the site and replace with new sound material.

.10 Trenches where pipe laying is in progress are to be kept dry. Pipes are not to be laid in water or upon wet bedding. Dewater excavations as required.

.11 Thoroughly clean pipes as they are laid and protect pipes from dirt and water.

.12 No length of pipe shall be laid until the preceding length has been thoroughly bedded and secured in place so as to prevent movement or disturbance of the pipe.

.13 Do not walk on or work over pipes until there is a minimum of 300 mm of cover over them, except as necessary in refilling trench and compacting the bedding material.

.14 Joint deflection permitted within limits recommended by pipe manufacturer.

.15 Water to flow through pipe during construction, only as permitted by the Department Representative.

.16 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.17 Install plastic pipe and fittings in accordance with CSA B182.11.

.18 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. Wipe clean ends of pipe, rubber gaskets, fittings, etc. immediately before jointing.

.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 Apply lubricant as approved by the pipe manufacturer to the spigot up to the reference mark and to the face of the gasket (mechanical joint gaskets included).

.7 Complete each joint before laying next length of pipe.

.8 Minimize joint deflection after joint has been made to avoid joint damage.

.1 Joint deflection permitted within limits recommended by pipe manufacturer.

.9 At rigid structures, install pipe joints not more than 1.2 m from side of structure.

.10 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.11 Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, by using a suitable pipe puller at the joint, or in some instances by very carefully pushing with the backhoe, or by any other method approved by the Department Representative.

.1 Use a block of wood when pushing against the pipe to prevent damage,

.12 Ensure pipe gaskets are not rolled, pinched, dislodged, or torn during jointing.

.19 When stoppage of Work occurs, block pipes as directed by the Department Representative to prevent creep during down time.

.20 Plug lifting holes with pre-fabricated plugs approved by the Department Representative, set in shrinkage compensating grout.

.21 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.

.22 Make watertight connections to manholes.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

.23 Connections to existing piping:

.1 Install new pipes to within 2 m of existing pipe, but do not make connection until all downstream system work is complete and ready to receive wastewater flows.

.2 Install watertight plug at the end of new pipe to prevent groundwater, dirt or debris from entering the pipe. Obtain survey coordinated of end of the pipe to facilitate the location of the pipe later.

.3 When the remainder of the system is ready to receive wastewater flows, excavate the end of the new pipe and complete the connection. The Contractor shall as part of the work supply plugs and pumps to by-pass existing flows while the connection is being made. The sewer section and manhole to be leakage tested prior to opening this pipe section to use.

.4 The Contractor shall be aware that at these connection points it may not be possible for all work to be done at one time and shall allow for this in pricing the work.

.5 Use prefabricated saddles or field connections approved by the Department Representative, for connecting pipes to existing sewer pipes.

.6 Joints to be structurally sound and watertight.

3.6 Pipe Surround

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after the Department 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 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% maximum density to ASTM D698.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 90% maximum density to ASTM D698.

.7 When field test results are acceptable to the Department Representative, place surround material at pipe joints.

3.7 Insulation

.1 Install insulation in the locations shown on the drawings and as directed by the Department Representative.

.2 Install insulation 50 mm thick at 300 mm above the pipe for a width of 1200 mm.

.3 Level and prepare the surface on which the insulation is to be placed so the insulation is not cracked or broken when backfilled.

.4 Secure joints between sheets of insulation with an appropriate sheeting tape. Acceptable product: duct tape, or approved equivalent.

.5 Cover insulation with a minimum of 150 mm of bedding before backfilling.

3.8 Backfill

.1 Place backfill material in unfrozen condition.

.2 Install marker tape 600 mm above the top of the pipe.

.3 Place backfill material, above pipe surround in uniform layers not exceeding

300 mm compacted thickness up to grades as indicated.

.4 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698.

.1 In other areas, compact to at least 90% maximum density to ASTM D698.

.5 Place unshrinkable fill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

3.9 Service Connections

.1 Install pipe to manufacturer's instructions and specifications.

.2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless indicated otherwise.

.3 Install pipe in the locations as staked and according to the sizes as indicated on the Drawings.

.4 Greater depths may be required where existing structures require services and the sewer main permits the greater depth.

.5 Where reconnection of an existing lateral pipe is being completed as part of the work, the existing lateral pipe will be reconnected to the new or existing main section by inserting a new lateral section between the existing lateral and the new or existing main section. This new lateral section will be connected to the existing lateral pipe with an approved coupling (Fernco or equivalent) and to the new or existing main as set out in this Section.

.6 All connections shall be made watertight. Contractor to supply all labour, material including the section of new laterals and equipment necessary for connection of the existing lateral to the existing main.

.7 Marker Tape
.1 Install marker tape 600 mm above the top of the pipe.

.8 Service connections to main sewer: standard Tee fittings or approved saddles, properly fitted to the sewer main.
.1 Do not use break-in and mortar patch-type joints.
.2 Orientation of the connection to be as detailed on the drawings.
.3 When connecting a saddle, neatly cut the appropriate circular hole with an appropriately sized hole saw, without seriously damaging the pipe. Remove and properly dispose of all material generated by this cutting.

.9 Service connection pipe: not to extend into interior of main sewer.

.10 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.

.11 Plug service laterals with water tight caps or plugs as approved by the Department Representative.

.12 Place location marker at ends of plugged or capped unconnected sewer lines.
.1 Each marker: 100 x 100 mm stake extending from pipe end at pipe level to 1.0 m above grade.
.2 Paint exposed portion of stake green with designation SAN SWR LINE in black.

3.10 Field Testing

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 When directed by the Department 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 Provide all labour, equipment and materials required to provide leakage tests on sanitary sewer mains and manholes.

.5 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
.1 Where the groundwater table may normally be below the level of the pipeline, test the pipeline using an air exfiltration method. Where the groundwater table may normally be above the level of the pipeline, test the pipeline using an air infiltration method.

.6 Do infiltration and exfiltration test to ASTM C828.

.7 Do infiltration and exfiltration testing as specified herein and as directed by the Department Representative.
.1 Perform tests in presence of the Department Representative.
.2 Notify the Department Representative 48 hours minimum in advance of proposed tests.

.8 Carry out tests on each section of sewer between successive manholes including service connections.

.9 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.

.10 Exfiltration test:
.1 Do exfiltration test to ASTM C969.

.2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of an air hose;

.3 Using a low-pressure air pump, apply a pressure of 27.6 kPa to the test section;

.4 Close the valve between the air pump and the test section and allow the pressure to drop to 24.1 kPa and begin recording the test time at this point;

.5 the Department Representative will calculate the allowable exfiltration. If the actual leakage time is greater than the allowable, the section tested has passed the test.

.6 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.

.7 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.

.8 Duration of exfiltration test: 2 hours.

.9 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.

.11 Infiltration test:

.1 Do infiltration tests to ASTM C1618 for concrete pipe and F1417 for PVC pipe testing using low pressure air.

.2 Plug pipe outlets that discharge into the upstream manhole and plug the outlet of the test section at

the downstream manhole; the plug in the test section at the upstream manhole shall have a fitting to permit connection of a vacuum hose;

.3 Use a vacuum pump to increase the negative pressure to 27.6 kPa Close the vacuum source and allow the negative pressure to decrease to 24.1 kPa; begin recording of the test time;

.4 the Department Representative will calculate the allowable infiltration; if the actual leakage time is greater than the allowable then the test section is acceptable.

.5 Test all pipe less than 1200 mm in diameter from manhole to manhole. Test all pipe 1200 mm in diameter or greater one joint at a time.

.6 The maximum allowable leakage per joint tested individually shall be that calculated for a 1 metre length of pipe of that diameter at the rate of 0.001 cubic metres per minute square metre of internal pipe surface area.

.7 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.

.8 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.

.9 Install watertight plug at upstream end of pipeline test section.

.10 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.

.11 Prevent damage to pipe and bedding material due to flotation and erosion.

.12 Place 90 degrees V-notch weir, or other measuring device approved by

the Department Representative in invert of sewer at each manhole.

.13 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.

.12 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

Nominal Pipe diameter	Asbestos-Cement or Plastic pipe	Concrete or Vitrified Clay pipe
(mm)	(L/h/100 m of pipe)	(L/h/100 m pf pipe)
100	3.88	25.5
125	4.62	30.0
150	5.51	34.0
200	7.45	41.5
250	9.39	49.5
300	11.33	56.5
350	13.27	63.5
400	14.91	70.0
450	16.84	76.0
500	18.78	81.5
550	20.72	87.0
600	22.80	92.5
700	26.53	102.0
800	30.11	110.5
900	33.69	118.0
1000	37.56	124.5
1100	41.29	130.0
1200	45.01	135.0

.13 Leakage: not to exceed following limits in litres per hour per 100 m of sewer for diameter tested including service connections:

.1 Exfiltration, based on 600 mm head: 0.175 L.

.2 Infiltration: 0.150 L.

.14 Repair and retest sewer line as required, until test results are within limits specified.

.15 Repair visible leaks regardless of test results.

.16 Television and photographic inspections:

.1 Clean sewers, manholes, and all related appurtenances of all foreign material either by flushing or by hand.

.1 Intercept any debris by installing a basket or other suitable device at the downstream end of the section(s) being flushed

.2 Video inspection is not permitted before or during the flushing operation.

.3 After flushing but before the video inspection begins, add enough water to the upstream manhole so it can be seen flowing at the downstream manhole.

.4 Carry out inspection of installed sewers by passing the video camera through the sewer pipe in the direction of the flow.

.1 One hundred percent (100%) of the sewers will be video inspected.

.5 Provide means of access to permit the Department Representative to do inspections.

.6 The sewer will be inspected for alignment and obstructions. Water ponding in gravity sewers that cannot be eliminated by flushing and cleaning will be considered as evidence of pipe settlement.

.7 Any and all defects such as water ponding, leaking joints, sags, improper grade or alignment, excessive deflection, obstructions, etc. may be cause for rejection and such defects must be repaired by the Contractor at no expense to Parks Canada. The Department Representative shall make the decision if such defects warrant correction.

.8 The Departmental Representative shall be present when new sewer is being video inspected.

.9

3.11 Pipe Penetration Seal

.1 As shown on the Contract Drawings, where cast in rubber gaskets cannot be installed and core drilling is required, suitable pipe penetrations seal is to be installed to ensure that the hole is watertight. All core drilling pipe perforations shall be sealed with Proco Pen-Seal or Link-Seal for a watertight seal. Size of the core drilling holes shall be in accordance with the manufacturer's recommendations.

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.

END

PART 1 - GENERAL

1.1 Work Included

.1 This section governs the supply of all labour, materials and equipment and incidentals necessary for the complete installation and testing of all sanitary sewer pressure pipes, gate valves, valve boxes, valves and chambers as shown on the drawings and herein specified that are a part of the sanitary pressure pipe system.

1.2 Related Sections

.1 Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Section 33 05 16 - Manholes and Catch basin Structures.

1.3 References

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .1 ANSI/AWWA C207-07, Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm).
- .2 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 D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12,400 ft-lbf/ft3) (600kN-m/m3)).
- .2 ASTM D2241-09, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- .3 ASTM D3034-08, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.

.4 CSA International
.1 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium.

1.4 Administrative Requirements

.1 Scheduling:
.1 Schedule Work to minimize interruptions to existing services.
.2 Submit schedule of expected interruptions and adhere to schedule approved by the Department Representative.
.3 Notify the Department Representative a minimum of 24 hours in advance of interruption in service.

1.5 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 Samples:
.1 Submit 4 weeks minimum before beginning Work, with proposed source of bedding materials and provide access for sampling.

.4 Certification to be marked on pipe.

.5 Test and Evaluation Reports: submit manufacturer's test data and

certification at least 2 weeks prior to beginning Work.

.6 Manufacturer's Instructions: submit to the Department Representative 1 copy of manufacturer's installation instructions.

1.6 Delivery, Storage and Handling

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

PART 2 - PRODUCTS

2.1 Materials

.1 Polyvinyl chloride (PVC) pipe: to CSA B137 and ANSI/AWWA C900.
- .1 Series 160 SDR: 26, white.
- .2 Pressure Class: 160
- .3 Gasket bell end.
- .4 Pipe joints: bell and spigot with rubber gaskets, solvent welded joints or mechanical joints to ANSI/AWWA C111/A21.11, with transition gaskets to pipe manufacturer’s specifications. This is a push-on joint and must be watertight. The bell will be an integral and homogeneous part of the pipe barrel with no reduction in the wall thickness.

.5 Rubber gaskets: to CSA B137.3 and ASTM D2241 ANSI/AWWA C111/A21.11. Gaskets for mechanical joints to be duck-tipped transition gaskets for PVC.

.2 Polyethylene pressure pipes: to CSA B137:
- .1 Type: DR26.
- .2 Joints:
  - .1 Thermal butt fusion
  - .2 Flanged with steel backing flanges.
  - .3 Flanged with stainless steel backing flanges in marine/submerged areas
- .3 Polyethylene fittings: to CSA B137, for pipe sizes 4" and less.
- .4 Pressure class 350 with cast iron outside diameter and integral bell gasketed joints, to ASTM D2992. Material: to ASTM D2310

.3 Fittings:
- .1 Ductile Iron to AWWA C153, 2415 kPa Class.
- .2 PVC pressure fittings to AWWA C907 and CSA B137.3.
  - .1 Class 160 (DR26).
  - .2 Push-on bell and spigot type.

.4 Joints:
- .1 Joints for iron fittings: mechanical type, complete with component parts, to latest AWWA Standard C111 for rubber-gasket joints ductile-iron fittings.
- .2 PVC pressure fittings: push-on bell and spigot type, unless otherwise indicated.

.5 Joint Restraints:
- .1 Iron fittings, joint restraint system components and couplings: ductile-iron with high strength low alloy steel tee bolts and nuts tightened using a torque wrench to the manufacturer’s specifications, completely

wrapped with 8-mil poly to AWWA C105.

.2 Mechanical joint restraint for ductile iron fitting: PVC Star Grip 4000 by Star Pipe Products, 2000 PV by EBAA Iron, 1300 S by Uniflange or approved equal.

.3 Mechanical joint restraint for PVC pressure fittings: 1360 S by Uniflange or approved equal.

.4 No extra payment will be made for the supply and installation of joints and fittings restrainers, this shall be considered incidental to the work.

.5 Joint restraint for PVC < 100mm shall be solvent welded joint with Schedule 80 PVC fittings.

.6 Marker Tape:

.1 50 mm wide metal marker tape, covered with tracer wire, carrying the message "CAUTION – FORCE MAIN BURIED"

.7 Pipe Penetration Seal

.1 As shown on the Contract Drawings, where cast in rubber gaskets cannot be installed and core drilling is required, suitable pipe penetrations seal is to be installed to ensure that the hole is watertight. All core drilling pipe perforations shall be sealed with Proco Pen-Seal or Link-Seal for a watertight seal. Size of the core drilling holes shall be in accordance with the manufacturer's recommendations.

2.2 Equipment

.1 Contractor is responsible in laying out the sewer pressure pipes, and will establish only the locations and elevations of discharge locations. The Contractor shall be responsible for all other field layout in accordance with Section 01 00 01 General Requirements.

.2 Utilize laser beam instrumentation and techniques to determine intermediate line and grade for all pipes except where and when the Department Representative may allow other methods to be used.

.3 Approved laser alignment equipment must be used to control line and grade during all laying of pipe. An approved laser sighting triangle or template must be used by the Contractor in setting each pipe.

2.3 Pipe Bedding and Surrounding Material

.1 Granular material to Section 31 05 16 - Aggregate Materials.

2.4 Backfill Material

.1 In accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 Examination

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

3.2 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 drawings. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Pipes and fittings to be clean and dry.

.3 Prior to installation, obtain the Department Representative's approval of pipes and fittings.

3.3 Trenching

.1 Do trenching Work, in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.2 Trench alignment and depth require approval from the Department Representative prior to placing bedding material or pipe.

3.4 Granular Bedding

.1 Place granular bedding in unfrozen condition.

.2 Place granular bedding material 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.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.

.6 Fill excavation below design elevation of bottom of specified bedding with common backfill.

3.5 Installation

.1 Load and unload pipe and accessories by lifting with hoists or skidding so as to prevent shock and damage.

.2 Pipe handled on skid-ways will not be skidded or rolled against pipe already on the ground. Pipe will not be dragged along the ground at any time. All material will be handled and stored in accordance with the manufacturer's requirements.

.3 Pipe will be so handled so that any coating will not be damaged. When handling PVC pipe, avoid severe impact blows, abrasion damage and gouging or cutting by metal surfaces or rocks. Avoid stressing bell joints and damage of bevel ends. If, however, any part of the pipe is damaged, the repair will be made by the Contractor in a manner satisfactory to the Department Representative.

.4 Thoroughly inspect pipe in the field before and after placement. Immediately remove any defective or damaged pipe from the site and replace with new sound material at the Contractor's expense.

.5 Lay pipes according to the sizes, types and in the locations as indicated on the drawings in accordance with manufacturer's recommendations and recognized good practice.

.6 Lay pipe with a minimum 1.8m cover. The Contractor is responsible for locating this line at the connection points.

.7 Lay pipe in prepared trenches commencing at lowest point with bell of pipe pointing upgrade.

.8 Use proper implements, tools and facilities for safe and efficient execution of the work.

.9 Join pipes in accordance with manufacturer's recommendations. Pipes may be pushed together by means of a crow-bar solidly wedged into the ground, or by using a suitable pipe puller at the joint, or in some instances by very carefully pushing with a backhoe, or by any other method that may be approved by the Department Representative. When pushing against the pipe, a block of wood must be used to prevent any damage to the pipe.

.10 Avoid damage to machined ends of pipes in handling and moving pipe. Do not drop pipe or fittings into trench.

.11 Maintain grade and alignment of pipes.

.12 Align pipes carefully before jointing.

.13 Joint deflection permitted within limits in accordance with pipe manufacturer's written recommendations.

.14 Support pipe firmly over entire length, except for clearance necessary at couplings.

.1 Suitable excavation shall be made to receive the bell, which shall not bear upon the sub-grade or bedding.

.2 Do not use blocks to support pipe.

.15 Lay pipe on dry bedding and keep trench dry during pipe laying.

.16 Keep pipe and pipe joints free from foreign material.

.17 Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Remove disturbed gaskets clean, lubricate and replace before jointing is attempted.

.18 Support pipes using hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.19 The ends of the pipe, rubber gaskets, fittings, etc., will be wiped clean immediately before joining the pipes to remove foreign matter from the joints. Apply lubricant to the spigot up to the reference mark and to the face of the gasket (MJ gaskets included).

.20 Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.

.21 Apply restraint to pipe to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by the Department Representative.

.22 Remove and re-lay any pipe which is not in alignment or shows undue settlement after laying.

.23 No length of pipe shall be laid until the preceding length has been thoroughly embedded and secured in place so as to prevent any movement or disturbance of the pipe.

.24 When stoppage of Work occurs, block pipe using a watertight plug as directed by the Department Representative to prevent creep during downtime.

.25 No pipe will be laid on a foundation into which frost has penetrated, or at any time when the Department Representative may deem that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.

.26 No walking on or working over the pipes after they have been laid will be allowed until there is at least 300 mm of cover

over them, except as may be necessary in refilling the trench and compacting the bedding material.

.27 Mechanical joint connections and tightening and torqueing of bolts shall be in accordance with the manufacturer's instructions and recognized good practice.

.28 Laser beam equipment shall be installed in the pipe, just above the pipe, or in the bottom of the manhole. Installation of the laser beam contrary to the aforementioned shall require approval of the Department Representative.

.29 Install 50 mm wide metal marker tape 600 mm above the top of the pipe, carrying the message "CAUTION – FORCE MAIN BURIED".

3.6 Thrust Blocks

.1 Restrain bends, tees, valves, and fittings using concrete thrust blocks as indicated.

.2 Keep pipe couplings free of concrete.

.3 Bearing area of thrust blocks to be as indicated.

3.7 Pipe Surround

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after the Department Representative has inspected pipe joints, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.

.3 Hand place surround material in uniform layers simultaneously on each side of pipe not exceeding 150 mm compacted thickness as indicated.

.1 Do not dump material within 1 m of pipe.

.4 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D698.

.5 When field test results are acceptable to the Department Representative, place surround material at pipe joints.

3.8 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 Compact backfill to at least 95% maximum density to ASTM D698.

.4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.9 Pipe Penetration Seal

.1 As shown on the Contract Drawings, where cast in rubber gaskets cannot be installed and core drilling is required, suitable pipe penetrations seal is to be installed to ensure that the hole is watertight. All core drilling pipe perforations shall be sealed with Proco Pen-Seal or Link-Seal for a watertight seal. Size of the core drilling holes shall be in accordance with the manufacturer’s recommendations.

3.10 Field Testing of Force Main

.1 Testing of force main to be carried out by Contractor in presence of the Department Representative.

.2 Test after backfilling sections of pipelines as directed by the Department Representative and prior to the placement of roadway base material or surface restoration wherever possible.

.3 Pipeline to be thoroughly flushed before applying the pressure test.

.4 Provide all necessary labour, materials and equipment for the test, including a suitable pump and measuring tank, pressure hoses and connections, plugs, caps, gauges, valves including pressure control valve and all other apparatus necessary for filling the pipe, pumping at the required test pressure, and recording the pressure and leakage losses.

.5 Supply at the Contractor's expense, a sufficient quantity of water for testing and flushing. Water will not be provided by Parks Canada.

.6 Test pipeline sections not exceeding 350 meters in length unless otherwise permitted by the Department Representative.

.7 Strut and brace caps, bends, tees, valves, and other parts to prevent movement when test pressure is applied.

.8 Expel air from force main, by slowly filling main with water.

.1 If air valves or other means of venting air are not provided, drill and tap high points and install suitable cocks to vent air and to be shut when pressure is applied. Provide a suitable saddle, main stop, valve, corporation stop or approved equal to vent air and which can be shut when pressure is applied.

.2 Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.

.3 This shall be considered incidental to the work.

.9 After completion of the preliminaries described above, apply pressure to the

pipeline using a suitable force pump equipped with a measuring tank.

.10 The test section will normally be subjected to a minimum hydrostatic pressure of 1000 kPa for 2 hours for sanitary pressure pipes but in any case, the test pressure will be limited to 50% above the operating pressure for the pipes in use.

.11 Apply pressure for 1 hour for pressure test and 2 hours for leakage test. Maintain pressure by pumping additional water into the pipe from the measuring tank.

.12 Examine exposed pipe, joints and fittings while system is under pressure.

.13 Remove defective joints, pipe and fittings and replace with new sound material.

.14 Define leakage as amount of water supplied from water storage tank meter in order to maintain test pressure for 2 hours.

.15 Do not exceed allowable leakage as determined by the following formula:

$$L = \frac{n * d * \sqrt{P}}{130,000}$$

Where:

L = allowable leakage in liters per hour

n = number of joints in section under test

d = nominal diameter of pipe in mm

P = test pressure in kPa

.16 Locate and repair defects if leakage is greater than amount specified.

.17 Repeat test until leakage is within specified allowance for full length of force main.

3.11 Flushing of Force Main

.1 Thoroughly flush all sanitary pressure pipes using adequate volume and pressure to remove all loose material within the pipe.

.2 The Contractor must supply all labour, water, and facilities required to carry out the flushing.

.3 The Contractor must provide a screen or other acceptable apparatus at the lower end of the section being flushed to retain and dispose of all debris flushed from the pipe. The Contractor is responsible for removing any debris not so retained from adjacent sections. Under no circumstances shall dirt be flushed into existing pipes.

.4 The Contractor is to provide his own water incidental to the work as water will not be provided by Parks Canada.

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.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 23 33 – Excavating, Trenching, and Backfilling

Section 32 11 20 – Granular Base

1.2 References

.1 ASTM International
- .1 ASTM C117-[04], Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D698-[07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3(600 kN-m/m3)).

.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 CSA International
- .1 CSA A23.1/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CSA A23.4-[09], Precast Concrete-Materials and Construction.
- .3 CSA B66-[10], Design, Material and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks.

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 utility septic tanks 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 Ontario, Canada.
.2 Shop Drawings: to CSA A23.4.
.1 Indicate on drawings:
.1 Design calculations for items designed by manufacturer.
.2 Tables and bending diagrams of reinforcing steel.
.3 Camber.
.4 Formwork.
.5 Finishing schedules.
.6 Methods of handling and erection.
.7 Storage facilities.
.8 Openings, sleeves, inserts and related reinforcement.

1.4 Quality Assurance

.1 Manufacturers and erectors of precast concrete elements are to be certified by CSA as meeting requirements of CSA A23.4.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 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 septic tanks from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 Design Requirements

.1 The septic tank shall have a minimum working capacity of as noted on Drawings.

.2 The septic tank shall meet the requirements outlined in Part 8 of the Ontario Building Code.

2.2 Manufacture

.1 Manufacture units in accordance to CSA A23.4.

2.3 Finishes

.1 Finish tanks to CSA A23.4, commercial grade.

2.4 Access

.1 Include access holes to surface to facilitate cleaning and inspection.

.2 Access ports shall be in accordance with Part 8 of the Ontario Building Code.

2.5 Effluent Filter

.1 Effluent filter shall be sized in accordance with Design Flows as noted on drawings and in accordance with Part 8 of the Ontario Building Code.

2.6 Tank Bedding and Surrounding Materials

.1 Granular material in accordance with 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 C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.
.3 Table

Sieve Designation	% Passing
200 mm	-
75 mm	-
50 mm	-
37.5 mm	-
25 mm	-
19 mm	-
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	-
0.075 mm	0- 10

2.7 Backfill Material .1 As indicated.

.2 Select Backfill Material, in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 Examination .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for utility septic tank 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 and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation .1 Place bedding and surround material in unfrozen condition.

.2 Do excavation in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

.3 Place tank bedding material in accordance with details as indicated.
.1 Compact to 95% corrected maximum dry density maximum dry density to ASTM D698.

.4 Make inlet and outlet joints of septic tank watertight, using modular wall seals.

.5 Conduct leakage test on septic tank in presence of Departmental Representative before backfilling.
- .1 Fill tank to level of effluent pipe, and allow to stand for 24 hours.
- .2 Allowable leakage is zero.
- .3 If leakage occurs, remove seal materials and reseal as directed by Departmental Representative.

.6 Do backfilling in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .1 Compact to 95% corrected maximum dry density maximum dry density to ASTM D698.

3.3 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 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

PART 1 - GENERAL

1.1 Related Sections

.1 Section 33 36 01 – Utility Septic Tanks

.2 Section 33 36 33 – Utility Drainage Field

1.2 References

.1 NSF / ANSI
- .1 Standard 40 – Residential Onsite Systems
- .2 Standard 245 – Nitrogen Reduction

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 advanced sewage treatment systems 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 Ontario, Canada.
- .2 Shop Drawings: to CSA A23.4.
  - .1 Indicate on drawings:
    - .1 Design calculations for items designed by manufacturer.

1.4 Quality Assurance

.1 Use certified and licensed installers who comply with local authority having jurisdiction.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 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 septic tanks from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 Design Requirements

.1 Total system capacity to be able to handle peak sewage flows as noted on the drawings:

.2 Effluent quality shall not exceed level IV Treatment Unit Classification in accordance with Part 8 of the Ontario Building Code where $CBOD_5$ and TSS shall not exceed 10 mg/L on a monthly average basis.

.3 Units shall be Waterloo Biofilter Open-Bottom Shed unit (for all sites except for Blue Heron), or approved equal, sized in accordance with design flows as outlined on the drawings and shall come complete with the following:

.1 Concrete Pump Chamber
.1 Sized in accordance to manufacturers recommendation.
.2 Duplex Submersible Effluent Pump complete with piping, bends, etc.
.3 Float Tree in accordance to manufacturers recommendation.
.4 External Electrical Splice Box in accordance with manufacturer’s recommendation.

.2 Shed Treatment Unit
.1 Shed Enclosure.
.2 Spray Dosing manifold complete with nozzle.
.3 Proprietary Biofilter Medium.
.4 Sample Port.
.5 TSS = 10mg/L
.6 BOD_5 = 10mg/L

.3 Waterloo Smart Panel Duplex Timer Control Panel
.1 As per manufacturer's recommendation.
.2 Location of installation to be confirmed by Departmental Representative.

.4 Unit for Blue Heron Site shall be Waterloo Biofilter Basket Biofilter or approved equal, including Waterloo EC-P Electrodes (for phosphorus treatment) and WaterNOx-LS and Disposal Tank (for Nitrogen Treatment) sized in accordance with design flows as outlined on the drawings and shall come complete with the following:

.1 Concrete Pump Chamber
.1 Sized in accordance to manufacturers recommendation.
.2 Duplex Submersible Effluent Pump complete with piping, bends, etc.
.3 Float Tree in accordance to manufacturers recommendation.
.4 External Electrical Splice Box in accordance with manufacturer's recommendation.

.2 EC-P Electrode
.1 Two (2) EC-P Electrodes complete with electrical and control panel installed in existing septic tank as per

manufacturer's recommendations.

.2 90-99% Phosphorus removal.

.3 Basket Biofilter Unit

.1 Concrete Chamber complete with Two (2) Baskets w/ Proprietary Biofilter Medium.

.2 Spray Dosing manifold complete with nozzle.

.3 Air Fan Basin.

.4 Two Submersible Effluent Pumps with miscellaneous Plumbing, Float Tree and External Splice Boxes in accordance with manufacturer's recommendations.

.5 TSS = 10mg/L

.6 BOD_5 = 10mg/L

.4 WaterNox-LS and Disposal Tank

.1 Concrete Chamber complete with proprietary Denitrifying Medium.

.2 Two Submersible Effluent Pumps with miscellaneous Plumbing, Float Tree and External Splice Boxes in accordance with manufacturer's recommendations.

.3 80% - 95% Nitrogen Removal.

.5 Waterloo Smart Panel (Duplex Pumps)

.1 As per manufacturer's recommendation.

.2 Includes External Antenna and Shielded Cable.

.2 Location of installation to be confirmed by Departmental Representative.

4 Provide a written performance guarantee indicating that the system will meet the

design effluent quality for a period of 5 years from the date of start-up. In the event that the system is not meeting the required effluent quality, the Supplier shall, at his own cost, adjust, modify, or replace the units to bring the system within the design performance parameters. The evaluation of the system's performance shall be based on samples collected by the Owner's operating and maintenance staff and analyzed for BOD_5, TSS, P and N concentrations.

2.2 Access

.1 Include access holes to surface to facilitate cleaning and inspection, as required.

2.3 Unit Bedding and Surrounding Materials

.1 Granular material in accordance with 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 C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

.3 Table

Sieve Designation	% Passing
200 mm	-
75 mm	-
50 mm	-
37.5 mm	-
25 mm	-
19 mm	-
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	-
0.075 mm	0- 10

2.4 Backfill Material

.1 As indicated.

.2 Select Backfill Material, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for advanced sewage treatment 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 and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation

.1 Follow manufacturer’s instructions and recommendations for product installation.

3.3 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 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 23 33 – Excavating, Trenching, and Backfilling

.2 Section 32 11 25 – Bedding Material

.3 Section 33 31 13 – Public Sanitary Utility Sewerage Piping.

.4 Section 33 36 00 - Utility Septic Tank

.5 Section 33 36 01 - Advanced Sewage Treatment Units

1.2 References

.1 ASTM International
  .1 ASTM C117-04, Standard Test Method for Material Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing.
  .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  .3 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
  .4 ASTM D4318-10, Standard 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.
  .3 CSA International
    .1 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-B1800-11, Thermoplastic Non-Pressure Piping Compendium. (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).

.1 CAN/CSA-B182.2-11, PVC Sewer Pipe and Fittings (PSM Type).

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 drainage field materials and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit 20 kg sample of each granular materials 4 weeks minimum before beginning Work.

.4 Certificates:

.1 Submit copy of certification or licence of approved installers.

.5 Test Reports:

.1 Submit 2 certified copies of factory tests of pipe material.

1.4 Quality Assurance

.1 Use certified and licensed installers who comply with local authority having jurisdiction.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 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 drainage field materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 Granular Materials

.1 Granular material in accordance with Section 31 05 16 - Aggregate Materials and to requirements as follows:
- .1 Pit run crushed or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.

.3 Table

Sieve Designation	% Passing
	Washed Septic Stone (Part 8 of Ontario Building Code)
53 mm	100
25 mm	-
19 mm	0-5
12.5 mm	-
9.5 mm	-
4.75 mm	-
2.36 mm	-
1.18 mm	-
0.600 mm	-
0.300 mm	-
0.150 mm	-
0.075 mm	0-1

2.2 Imported Sand Material

.1 Sand conforming to requirements of Part 8 of the Ontario Building Code.

.2 Imported sand shall meet the following requirements, as outlined in the Ontario Building Code:
- .1 a percolation time of at least 6 and not more than 10 min, and
- .2 not more than 5% fines passing through a 0.074mm (No. 200) sieve.

2.3 Concrete Mixes and Materials

.1 Concrete mixes and materials: to CSA A23.1/A23.2.

.2 Use type 1 cement.

.3 Concrete exposure classification: A-3.

Part 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or

Contracts are acceptable for drainage field installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Department Representative.

.2 Inform the Department Representative 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 the Department Representative.

3.3 Type 'A' Dispersal Field and Installation

.1 Remove and dispose of existing septic field as noted on drawings.

.2 Conduct percolation tests to verify existing 'T' times with those noted on the drawings.

.3 Place imported sand material and septic stone in unfrozen condition as indicated and in accordance with the Ontario Building Code and advanced treatment unit manufacturer's recommendations.

.4 Under no circumstances should heavy equipment travel across the disposal bed for risk of compacting in-situ soils.

.5 After placement of type 'A' dispersal field fill, install advanced treatment unit in accordance with manufacturers recommendations.

.6 Cover disposal field as indicated.

.1 Use only material approved in writing by the Department Representative to backfill.

.2 Do not compact.

.3 Overfill to allow for settlement.

.8 Grade areas surrounding disposal field bed as indicated, to provide for diversion of surface run off waters.

.9 Follow all manufacturer's installation instructions.

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 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END

PART 1 – GENERAL

1.1 Related Sections

.1 Section 01 35 43 – Environmental Procedures

.2 Section 33 11 16 – Site Water Utility Distribution Piping

1.2 Environmental Requirements

.1 Operation of construction equipment in water is prohibited.

.2 Dumping excavated fill, waste material, or debris in watercourse or wetland is prohibited.

PART 2 - PRODUCTS

.1 (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Existing Conditions

.1 Maintain existing flow pattern in natural watercourse systems.

.2 In natural systems maintain existing riffle pool and step pool patterns.

.3 In wetland systems, maintain existing hydrological conditions.

3.2 Site Clearing and Plant Protection

.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 drawings. **Note that hay mulch or any other possible seed contaminant are not permitted on site.**

.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 Minimize disturbance to vegetated buffer zones and protect trees and plants on site and adjacent properties where indicated.

.3 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes.

.4 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.

.5 Leave cuttings from trees and other vegetation on site as brush piles to allow for natural degradation.
.1 Secure large piles with degradable materials to prevent interference with watercourse.

.6 Remove only trees that may offer future blockage problems as instructed by the Department Representative.

.7 Leave roots mass and stumps in place.

.8 Maintain temporary erosion and pollution control features installed under this contract.

3.3 Drainage

.1 Pumping water containing suspended materials into watercourse is prohibited.

.2 Establish rock chute spillways to accommodate safe surface water entry to watercourse as directed by the Department Representative.

.3 Install drop pipe inlet system as directed by the Department Representative.

3.4 Restoration

.1 Establish vegetated buffer zones with suitable vegetation to minimum 3 m along edge of watercourse banks as determined by the Department Representative.

.2 Replace topsoil as soon as possible.

.3 Hay mulch or any other possible seed contaminant not to be used on this project for erosion control.

.4 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.5 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END

APPENDIX A – GEOTECHNICAL REPORT

DST, A Division of Englobe Corp.
550 Parkside Drive, Unit C1-B
Waterloo, ON, N2L 5V4
T: 877-300-4800 / F: 888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

May 21, 2021

DST Ref. No.: 02003072.001

Parks Canada Agency
Southwestern Ontario Field Unit
30 Victoria St., Gatineau, QC

Attn.: Ms. Annie Campeau
Project Manager

Re.: Geotechnical Test Pit Investigation and Percolation Testing Results
On-site Sewage Treatment and Site Facilities Upgrades
Point Pelee National Park, 1118 Point Pelee Drive, Leamington, ON

1. INTRODUCTION

DST, A Division of Englobe Corp. ("DST") was retained by Parks Canada Agency ("the Client") to carryout a geotechnical test pit investigation and percolation testing program. The purpose of this work is to support the design and construction of on-site sewage treatment and site facilities upgrades at Point Pelee National Park, located at 1118 Point Pelee Drive in Leamington, ON ("the Site").

The objectives of the geotechnical test pit investigation were to evaluate the subsurface soil and groundwater conditions at fourteen (14) locations at the Site where existing on-site sewage treatment and site facilities are located and to prepare a factual letter report summarizing the findings. The objective of the percolation testing was to obtain the necessary data to estimate percolation rates (T-times) for the test locations to support the design of the contemplated on-site sewage treatment and site facilities upgrades.

A statement of limitations for the contents of this report is included in **Appendix A**.

2. BACKGROUND AND SITE DESCRIPTION

DST understands from the Terms of Reference ("TOR") that Point Pelee National Park (PPNP), located at the western end of Lake Erie, was established as a Federal Park in 1918 due to its biological significance. PPNP is a triangular land mass extending approximately 14 km into Lake Erie, approximately 70% of which consists of marsh lands. The remaining land mass is heavily vegetated with mostly sandy soils.

PPNP utilizes seventeen (17) on-site systems to manage its wastewater at fourteen (14) separate locations. The sites generally consist of either septic systems with disposal fields or secondary treatment with soils-based disposal. Two (2) sites at either end of PPNP are identified as dependent on holding tanks for storage of waste prior to its removal and subsequent disposal by pumper truck at the Leamington wastewater treatment plant north of the Park.

DST understands the existing on-site wastewater collection and treatment systems and the associated site buildings may require rehabilitation and/or replacement.

3. LOCAL GEOLOGICAL SETTING

Based on publicly available Ontario Geological Survey ("OGS") datasets, soil conditions at the locations of the seventeen wastewater systems at the Site were expected to generally comprise coarse-textured lacustrine (littoral) deposits of sand and gravel, with minor amounts of silt and clay associated with the Erie Spits physiographic region. Localized areas were also identified by the OGS as containing eolian deposits of fine to very fine sand and silt and modern alluvial deposits of clay, silt, sand, gravel and organics at the outlets of Sturgeon Creek. Based on the existing developed condition of the sites, the presence of reworked fill materials was also expected near surface.

A brief review of the available Ministry of Environment, Conservation and Parks (MECP) Water Well Records (WWR) database shows dozens of monitoring wells at the Site. A sample of the available historical monitoring well

records agrees with the stratigraphy reported by the OGS, with fine to coarse sand reported along the study area. Historical water levels were reported between 1.2 and 1.5 m below ground surface (mbgs).

4. INVESTIGATION METHODOLOGY

DST's recent geotechnical field investigation scope consisted of advancing a total of fourteen (14) geotechnical test pits at the approximate locations depicted in **Appendix B, Figure 2**. The test pits were advanced on May 11 and May 12, 2021 and were designated TP21-01A, TP21-01B, TP21-02 through TP21-06, TP21-07B, TP21-08, TP21-09A, TP21-09B, and TP21-10 through TP21-12.

4.1 Topographic Survey, Test Pit Locations and Elevations

A topographic site survey was conducted with a Network RTK enabled survey instrument from April 26 to April 29, 2021, in advance of test pitting, during which time the coordinates and elevations of the finalized test pit locations were measured. RTK survey accuracy was confirmed against COSINE vertical control monument 0011970U674 within Pint Pelee National Park. The approximate test pit locations are depicted in **Appendix B, Drawings A-01 to A-04**.

4.2 Test Pitting, Sampling and Guelph Permeameter Tests

One test pit at each designated Site was advanced immediately adjacent to the septic field with a rubber tire backhoe to a depth of up to approximately 1.8 mbgs, or to just below the water table, whichever came first. To evaluate the condition of the existing septic tile beds, additional test pits, labelled TP21-1A, TP21-2, TP21-5A, TP21-9A, and TP21-12, were excavated within the footprint of the beds. Further details of these test pits can be found in our Englobe report "Titled Condition Assessment and Preliminary Design Report" Dated May 14, 2021.

All fourteen (14) of DST's recent test pits were advanced under the full-time supervision of a DST Geotechnical Field Technician. Detailed summaries of the subsoils and groundwater conditions observed in each of the test pits advanced for this investigation are provided in **Section 6** of this report.

Saturated hydraulic conductivity values were obtained through infiltration testing using a Guelph Permeameter test instrument. The Guelph Permeameter test is an in-hole constant-head permeameter test. This test method involves measuring the steady-state rate of water recharge into unsaturated soil from a cylindrical borehole, in which a constant depth (head) of water is maintained by the instrument. All of the Guelph Permeameter tests were conducted in native sand within shallow auger holes dug inside the open test pits. All tests were conducted at least 0.3 m above the groundwater table. A representative sample was obtained from the infiltration test depth at each location and submitted for grain size analysis and moisture content.

Each test pit was backfilled with the excavated soils which were tamped in place using the excavator bucket.

4.3 Geotechnical Laboratory Testing

Upon completion of the above-noted field investigation activities, geotechnical soil samples were transported to the DST (Englobe) Kitchener laboratory for testing. Laboratory tests included moisture content tests on all recovered soil samples and gradation analyses by sieve and hydrometer on nine (9) selected representative soil samples. Geotechnical laboratory test results are presented on the detailed interpreted test pit logs in **Appendix C**, and the full geotechnical laboratory reports are included in **Appendix D**.

5. GEOTECHNICAL LABORATORY TESTS

A geotechnical laboratory testing program was completed to aid in the confirmation of soil descriptions and the characterization of the recovered samples from the fill materials and native subsoils at the Site. Gradation analyses were performed on a total of nine (9) selected soil samples. The gradation results are summarized in **Table 5-1**. Complete grain size distribution test results are provided in **Appendix D**.

Table 5-1 Summary of grain size analyses results for all tested soil samples

Sample ID	Soil Description	% Particle Size Content*				Unified Soil Classification System (USCS) Soil Type
		Gravel	Sand	Silt	Clay	
TP21-01B, GS1 (0.3 mbgs)	Sand, trace Silt, occasional Gravel	<1	98	2		SP
TP21-03, GS1 (0.6 mbgs)	Sand, trace Silt, occasional Gravel	<1	99	1		SP
TP21-04, GS1 (0.7 mbgs)	Sand, trace Silt	0	99	1		SP
TP21-05, GS1 (0.5 mbgs)	Sand, trace Silt	0	98	2		SP
TP21-06, GS1 (0.6 mbgs)	Sand, trace Gravel, trace Silt	8	92	1		SP
TP21-07, GS1 (0.3 mbgs)	Sand, some Gravel, trace Silt, trace Clay	11	79	7	3	SP-SM
TP21-09, GS1 (0.8 mbgs)	Sand, trace Silt, trace Gravel, trace Clay	9	77	9	5	SM
TP21-10, GS1 (0.5 mbgs)	Sand, some Gravel, trace Silt	16	82	1		SP
TP21-11, GS1 (0.8 mbgs)	Sand, some Gravel, trace Silt	19	80	1		SP

* Percentages may not add to 100% due to rounding.

6. DESCRIPTION OF SUBSURFACE CONDITIONS

6.1 Stratigraphy of On-site Subsoils

Details of the subsurface conditions encountered in the fourteen (14) geotechnical test pits advanced as part of DST's recent investigation are presented on the test pit logs in **Appendix C** and are summarized in **Table 6-1** below. A general overview of the soil stratigraphy is provided in this section.

It should be noted that the boundaries between strata have been inferred from observations made during excavation. The strata boundaries generally represent a *transition* from one soil type to another and should not be inferred to represent an exact plane of geological change. Conditions may vary between and beyond the test pit locations.

Table 6-1 Summary of observed subsoils stratigraphy at discrete test pit locations

Test Pit ID	Top of Test Pit Elevation (masl)*	Stratigraphic Unit Depths (m, unless otherwise indicated)				
		Topsoil	FILL: Sand	FILL: Gravel	FILL: Clay	Native: Sand
TP21-01A	178.862	–	0.00 – 0.67	0.67 – 0.70 (BOH)	–	–
TP21-01B	N.M.	0.00 – 0.20	–	–	–	0.20 – 0.53 (BOH)
TP21-02	176.954	0.00 – 0.30	0.30 – 0.84	–	0.84 – 0.90 (BOH)	–
TP21-03	176.665	0.00 – 0.40	–	–	–	0.40 – 1.80 (BOH)
TP21-04	176.733	0.00 – 0.13	–	–	–	0.13 – 1.70 (BOH)
TP21-05	N.M.	0.00 – 0.13	–	–	–	0.13 – 1.70 (BOH)
TP21-06	175.627	0.00 – 0.20	0.30 – 0.43	–	–	0.43 – 1.00 (BOH)
TP21-07B	175.397	0.00 – 0.15	–	–	–	0.15 – 0.80 (BOH)
TP21-08	176.437	–	0.00 – 0.80	0.80 (BOH)	–	–
TP21-09A	176.743	–	0.00 – 0.80	0.80 (BOH)	–	–
TP21-09B	175.943	–	0.00 – 1.30	–	–	1.30 – 1.80 (BOH)
TP21-10	175.958	0.00 – 0.10	0.10 – 0.75	–	–	0.75 – 1.40 (BOH)
TP21-11	176.045	0.00 – 0.30	0.30 – 0.40	–	–	0.40 – 1.30 (BOH)
TP21-12	175.909	–	0.00 – 0.90 (BOH)	–	–	–

BOH = Bottom of Hole
N.M. = Could not be measured
masl = meters above sea level

Considering the results of the field and laboratory investigations, the following descriptions provide a generalized overview of the different subsoils and groundwater conditions encountered in the test pits:

Topsoil: The ground surface at nine of the test pit locations consisted of a thin layer of brown to dark brown topsoil ranging in thickness from 100 to 400 mm. The topsoil layer generally contained an abundance of roots and other organics, within a sand-dominated matrix. The topsoil also typically contained some to trace silt.

FILL Materials – Sand, Gravel, Clay: A layer of FILL consisting of reworked sand was encountered in many of the test pits either at surface or underlying the topsoil layer. The FILL layer varied in thickness, extending to depths ranging from 0.40 to 1.30 mbgs. The sand was generally fine-grained, light brown in colour and damp to moist. At some locations, crushed gravel was observed surrounding existing septic pipes, with or without geotextile fabric. Variable amounts of gravel were also noted, ranging from gravelly to trace amounts and sometimes in seams, though it is not clear whether these correspond to the septic beds. Three of the test pits were terminated in or on gravel. A layer of clay was encountered at the bottom of TP21-02. The clay was very stiff and dark brown in colour. This layer was not encountered in any of the other test pits advanced for this investigation.

Native Sand: A native deposit of sand was encountered underlying the topsoil and/or FILL materials in most test pits. The native sand was generally fine-grained closer to surface, becoming coarse-grained at greater depth. The sand was also generally coarser around TP21-09 through TP21-12 than the other test pit locations.

Groundwater Conditions: Short-term groundwater levels and seepage were monitored in each of the test pits during excavation and upon completion. Groundwater was observed pooling at the bottom of the test pit at TP21-06 (0.98 mbgs), TP21-07B (0.70 mbgs), TP21-09B (1.74 mbgs), TP21-10 (1.30 mbgs), and TP21-11 (1.22 mbgs).

It should be noted that groundwater levels may vary considerably over time, fluctuating seasonally (potentially up to 2 m or more) and in response to climatic conditions. The groundwater levels summarized above were all recorded in May 2021. As such, the summarized groundwater levels may not be representative of water levels during construction and through the rest of the year.

7. PERCOLATION TESTING RESULTS

Infiltration testing was carried out in the open test pits using a Guelph Permeameter. The infiltration test data was using to calculate saturated hydraulic conductivity, which was then used to estimate percolation rates (T-times) for the tested soils.

The tests were conducted in native sand within shallow auger holes dug inside the open test pits. All tests were conducted at least 0.3 m above the water table. A representative sample was obtained from the infiltration test depth at each location and submitted for grain size analysis and moisture content.

A summary of the calculated saturated hydraulic conductivity values from the recently performed Guelph Permeameter infiltration tests is presented below in **Table 7-1**. The T-times estimated based on the calculated saturated hydraulic conductivity values are presented alongside the corresponding tests. The full calculations for saturated hydraulic conductivity are presented in **Appendix E**. The approximate relationship that was applied to estimate percolate rate using saturated hydraulic conductivity is presented in **Appendix F**.

Table 7-1 Summary of saturated hydraulic conductivity values and estimated percolation rates from Guelph Permeameter testing carried out in test pits

Test Location	Soil Description at Test Depth	USCS	Saturated Hydraulic Conductivity, K_{sat} (cm/s)	Estimated Percolation Rate, T-Time (min/cm)
TP21-01A (0.53 mbgs)	Sand (FILL)	SP	6.83×10^{-3}	2 – 8
TP21-01B (0.34 mbgs)	Sand, trace Silt, occasional Gravel	SP	6.41×10^{-3}	2 – 8
TP21-03 (0.63 mbgs)	Sand, trace Silt, occasional Gravel	SP	5.98×10^{-3}	2 – 8
TP21-04 (0.80 mbgs)	Sand, trace Silt	SP	4.55×10^{-3}	2 – 8
TP21-05 (0.72 mbgs)	Sand, trace Silt	SP	4.17×10^{-3}	2 – 8
TP21-06 (0.60 mbgs)	Sand, trace Gravel, trace Silt	SP	9.85×10^{-3}	2 – 8
TP21-07 (0.40 mbgs)	Sand, some Gravel	SP-SM	6.30×10^{-3}	2 – 8
TP21-09 (0.86 mbgs)	Sand, trace Silt, trace Gravel, trace Clay	SM	1.13×10^{-3}	8 – 20
TP21-10 (0.91 mbgs)	Sand, some Gravel, trace Silt	SP	8.55×10^{-3}	2 – 8
TP21-11 (0.50 mbgs)	Sand, some Gravel, trace Silt	SP	2.16×10^{-2}	2 – 8

8. CLOSURE

We thank you for the opportunity to assist you with this project. If you have any questions about the contents of this report, please do not hesitate to contact the undersigned.

Best regards,

DST, A Division of Englobe Corp.:

Hugh Gillen, M.Sc., P.Eng., P.Geo.
Geotechnical Engineer

Brennan Bailey, M.A.Sc., P.Eng.
Senior Project Manager, Geotechnical Engineer

ATTACHED: APPENDIX A – LIMITATIONS OF REPORT

APPENDIX B – FIGURES

APPENDIX C – TEST PIT LOGS

APPENDIX D – GEOTECHNICAL LABORATORY RESULTS

APPENDIX E – K-SAT CALCULATIONS USING GUELPH PERMEAMETER DATA

APPENDIX F – TABLE 2: APPROXIMATE RELATIONSHIP OF COARSE GRAINED SOIL TYPES TO PERMEABILITY AND PERCOLATION TIME, MMAH SUPPLEMENTARY STANDARD SB-6

APPENDIX A
LIMITATIONS OF REPORT

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the test pits and test locations may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the Site investigation. Conditions can also change with time. It is recommended practice that DST be retained during construction to confirm that the subsurface conditions throughout the Site do not deviate materially from those encountered in the test pits.

The factual content and recommendations given in this report are intended only for the guidance of the designer. The number of test pits may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil, fill layers, bedrock depth, groundwater levels, and presence of boulders/cobbles may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the Client.

APPENDIX B
FIGURES

NOTES

NO.	DATE	REVISIONS	BY	APPR.
1	MAY 21/21	ISSUED FOR REPORT	KW	KKM

DST
a division of Englobe

PROJECT TITLE

POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT
AND SITE FACILITIES UPGRADES

POINT PELEE ON

DRAWING TITLE

OVERALL
LOCATION PLAN

Scale	Drawn By	Design By
NOT TO SCALE	KW	
	Checked By	Cadd Check
	Sheet 1 of 4	

File Name

Drawing No.

A-01

Q:\2020\2003072.001 - POINT PELEE ONSITE SEWAGE\CADD\DESIGN\CURRENT SHEETS\TEST PIT LOCATION\2003072 - 11X17_LOCATION PLAN.DWG, 21/05/2021 8:00 AM

SANCTUARY SITE
SCALE 1:500

BLUE HERON SITE
SCALE 1:500

DUNES SITE
SCALE 1:500

SLEEPY HOLLOW SITE
SCALE 1:500

LEGEND

- LOCATION OF TEST PIT AND INFILTRATION TEST
- LOCATION OF TEST PIT
- EXISTING TILE BED

NO.	DATE	REVISIONS	BY	APPR.
1	MAY 21/21	ISSUED FOR REPORT	KW	KKM

DST a division of Englobe

PROJECT TITLE

POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT
AND SITE FACILITIES UPGRADES

POINT PELEE ON

DRAWING TITLE

TEST PIT LOCATIONS FOR SANCTUARY, BLUE HERON, DUNES AND SLEEPY HOLLOW SITE

Scale	Drawn By	Design By
AS SHOWN	KW	
	Checked By	Cadd Check
	Sheet 2 of 4	

File Name

Drawing No.

A-02

MADBIN JINA SITE
SCALE 1:500

BLACK WILLOW SITE
SCALE 1:500

WHITE PINES SITE
SCALE 1:500

CAMP HENRY EAST SITE
SCALE 1:500

LEGEND

- LOCATION OF TEST PIT AND INFILTRATION TEST
- LOCATION OF TEST PIT
- EXISTING TILE BED

NO.	DATE	REVISIONS	BY	APPR.
1	MAY 21/21	ISSUED FOR REPORT	KW	KKM

DST a division of Englobe

PROJECT TITLE

POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT
AND SITE FACILITIES UPGRADES

POINT PELEE ON

DRAWING TITLE

TEST PIT LOCATIONS FOR
MADBIN JINA, BLACK WILLOW,
WHITE PINES, AND
CAMP HENRY EAST SITE

Scale	Drawn By	Design By
AS SHOWN	KW	
	Checked By	Cadd Check
	Sheet 3 of 4	

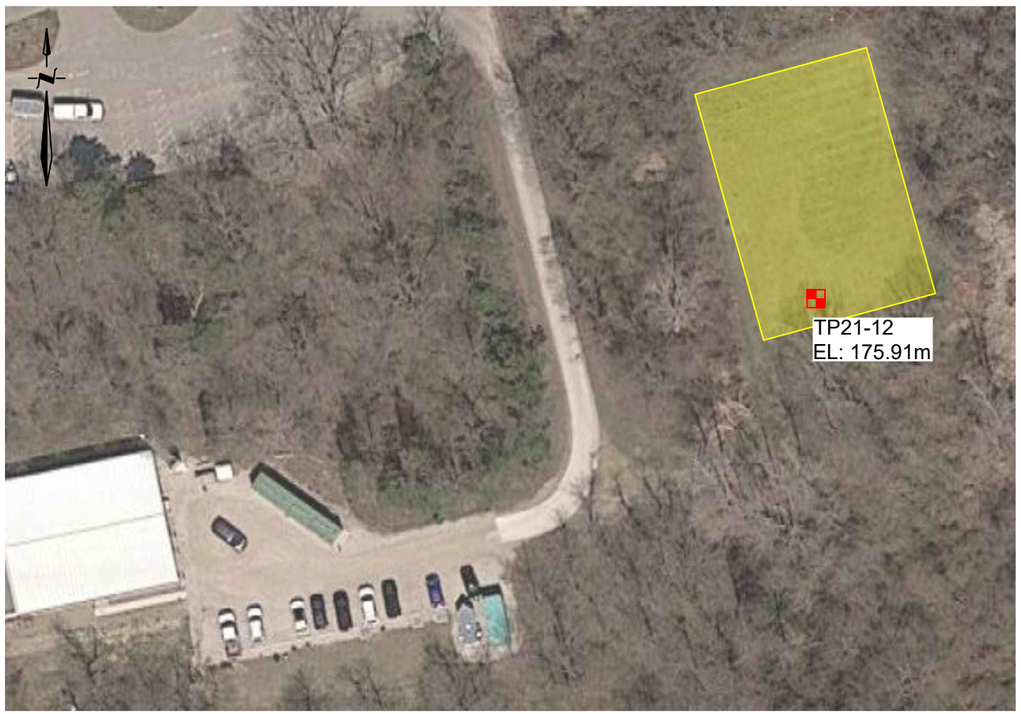
File Name

Drawing No.
A-03

CAMP HENRY WEST SITE
SCALE 1:500

WEST BEACH #1 SITE
SCALE 1:500

WEST BEACH #2 SITE
SCALE 1:500



VISITORS CENTER SITE
SCALE 1:750

LEGEND

- LOCATION OF TEST PIT AND INFILTRATION TEST
- LOCATION OF TEST PIT
- EXISTING TILE BED

NO.	DATE	REVISIONS	BY	APPR.
1	MAY 21/21	ISSUED FOR REPORT	KW	KKM

a division of Englobe

PROJECT TITLE

POINT PELEE NATIONAL PARK
ON-SITE SEWAGE TREATMENT
AND SITE FACILITIES UPGRADES

POINT PELEE ON

DRAWING TITLE

TEST PIT LOCATIONS FOR CAMP HENRY WEST, WEST BEACH #1, WEST BEACH #2 AND VISITORS CENTER SITE

Scale	Drawn By	Design By
AS SHOWN	KW	
	Checked By	Cadd Check
	Sheet 4 of 4	

File Name

Drawing No.

A-04

APPENDIX C
TEST PIT LOGS

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-01A**
Project Number:	**2003072.001**	**Ground Surface Elevation[1] (m):**	**178.862**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Hand Shovel**
Location:	**Sanctuary Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4647910.027 m N, 372645.326 m E** / **Geologic Profile**
0.00	0.67	FILL: SAND - fine, light brown, loose, directly under 5 cm root layer, attracting swarms of small flies	GS1	0.5	5.0	
0.67	0.70	Drainage gravel over septic pipe				
		Test pit terminated at 0.7 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-01B**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**178.86**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Auger**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Matt Ducak**	**Equipment:**	**Hand Auger**
Location:	**Sanctuary Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**Location: 4647913.28 m N 372636.91 m E** Geologic Profile
0.00	0.20	TOPSOIL: SAND -fine, some silt, fine, dark brown, some rootlets and organics				
0.20	0.40	NATIVE: SAND, some to trace silt, brown				
0.40	0.53	SAND - fine, light brown				
		Test pit terminated at 0.53 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeologiclal Investigation**			**Test Pit Designation:**	**TP21-02**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**176.954**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Shovel**
Location:	**Blue Heron Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4647432.212 m N, 373003.859 m E** / **Geologic Profile**
0.00	0.30	TOPSOIL: Silty SAND - dark brown with rootlets				
0.30	0.84	FILL: SAND - fine, reddish brown, no odours or staining				
0.35	0.70	Drainage Gravel - crushed gravel surrounding septic pipe, no staining or odour				
0.84	0.90	CLAY - very stiff, dark brown				
		Test pit terminated at 0.9 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-03**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**176.665**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**Dunes Picnic Area**			**DST Supervisor:**	**Matt Ducak**

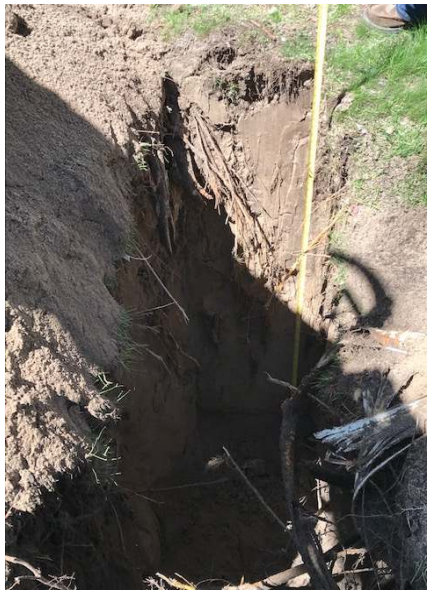
Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4646013.155 m N, 373530.160m E** / **Geologic Profile**
0.00	0.40	TOPSOIL: SAND - some silt, dark brown with rootlets				
0.40	1.80	NATIVE: SAND - fine, light brown, damp, becoming moist at 1.6 m	GS1	0.6	5.3	
1.00	1.30	Occasional gravel seams				
		Test pit terminated at 1.8 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-04**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**176.733**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**Sleepy Hollow Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4645667.782m N, 373705.330m E** / **Geologic Profile**
0.00	0.13	TOPSOIL: SAND - some silt, dark brown with rootlets				
0.13	1.70	NATIVE: SAND - trace silt, fine, light brown, damp	GS1	0.7	5.8	
		Test pit terminated at 1.7 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-05**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**176.68**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**Madbin Jina Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	UTM Coordinates: 4645243.00 m N 373900.00 m E / Geologic Profile
0.00	0.13	TOPSOIL: SAND - Some Silt, dark brown with rootlets				
0.30	0.55	NATIVE: SAND - Some Silt, some Gravel	GS1	0.5	6.5	
0.55	1.70	SAND - fine, trace Silt, light brown, occasional tree roots				
		Test pit terminated at 1.7 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-06**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**175.627**	**Date Started:**	**12-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**21-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Shovel and Hand Auger**
Location:	**Black Willow Beach**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4644836.973m N, 373867.001m E** / **Geologic Profile**
0.00	0.20	SOD and TOPSOIL: SAND - Some Silt and Gravel, dark brown with rootlets				
0.30	0.43	FILL: SAND - Some Silt, some Gravel, brown				
0.43	1.00	NATIVE: SAND - fine, light brown	GS1	0.6	5.6	
0.98	1.00	Groundwater pooling at bottom of Auger hole				
		Test pit terminated at 1.0 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-07B**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**175.397**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**White Pine Picnic Area**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4644286.679m N, 374125.295m E** / **Geologic Profile**
0.00	0.15	SOD and TOPSOIL: SAND - some silt, dark brown with rootlets				
0.15	0.70	NATIVE: SAND - some gravel	GS1	0.3	11.4	
0.70	0.80	Groundwater pooling at bottom of pit				
		Test pit terminated at 0.8 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeologiclal Investigation**			**Test Pit Designation:**	**TP21-08**
Project Number:	**2003072.001**	**Ground Surface Elevation(m):**	**176.437**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Shovel**
Location:	**Camp Henry - East Field**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4643846.450m N, 374447.075m E** / **Geologic Profile**
0.00	0.80	SAND - fine, light brown				
0.30	0.60	Drainage Stone surrounding septic pipe, no staining or odour				
	0.80	GRAVEL - dense				
		Test pit terminated at 0.8 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-09A**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**176.743**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Shovel**
Location:	**Camp Henry - West Field**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4643798.597m N, 374383.277m E** / **Geologic Profile**
0.00	0.35	FILL: SAND - some Gravel, brown				
0.30	0.60	Geotextile and Drainage Stone surrounding septic pipe, no staining or odour				
	0.80	GRAVEL - dense				
		Test pit terminated at 0.8 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-09B**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**175.943**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**Camp Henry - West Field**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	UTM Coordinates: 4643801.753m N, 374370.177m E / Geologic Profile
0.00	0.35	FILL: SAND - some Gravel, brown, old cable at 0.3 m				
0.60	1.20	FILL: SAND - Some Silt, Some Gravel	GS1	0.8	10.4	
1.20	1.30	Dark brown, Possible original topsoil layer				
1.30	1.50	NATIVE: SAND - trace silt, fine, light brown				
1.50	1.74	SAND - Coarse				
1.74	1.80	Groundwater pooling at bottom of test pit				
		Test pit terminated at 1.8 m bgs				

DST consulting engineers a division of Englobe

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-10**
Project Number:	**2003072.001**	**Ground Surface Elevation (m):**	**175.958**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**West Beach No. 1**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4643596.888m N, 374260.869m E** / **Geologic Profile**
0.00	0.10	TOPSOIL: SAND - some Silt, trace organics, brown				
0.10	0.75	FILL: SAND - some Gravel, trace Silt, dull brown	GS1	0.5	4.5	
0.75	1.30	NATIVE: SAND - Very Coarse, trace Gravel				
1.30	1.40	Groundwater pooling at bottom of test pit				
		Test pit terminated at 1.4 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-11**
Project Number:	**2003072.001**	**Ground Surface Elevation:**	**176.045**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Trench**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Backhoe**
Location:	**West Beach No. 2**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4643396.549m N, 374325.687m E** / **Geologic Profile**
0.00	0.30	TOPSOIL: SAND - some Silt, roots, trace organics, brown				
0.30	0.40	FILL: Gravelly SAND				
0.40	0.60	NATIVE: SAND - fine, trace silt, greyish brown				
0.60	0.90	Light brown	GS1	0.8	8.0%	
0.90	0.95	Gravel Seam				
0.95	1.22					
1.22	1.30	Groundwater pooling at bottom of test pit				
		Test pit terminated at 1.3 m bgs				

Elevation in metres (m) above mean sea level

DST CONSULTING ENGINEERS INC.
550 Parkside Drive, Unit C1-B
Waterloo ON, N2L 5V4
Ph: 1-877-300-4800
Fax: 1-888-979-6772
waterloo@dstgroup.com
www.dstgroup.com

TEST PIT STRATIGRAPHY LOG

Project Name:	**Point Pelee Hydrogeological Investigation**			**Test Pit Designation:**	**TP21-12**
Project Number:	**2003072.0001.0002**	**Ground Surface Elevation (m):**	**175.909**	**Date Started:**	**11-May-21**
Client:	**Parks Canada**	**Test Pit Method:**	**Hand Dug**	**Date Completed:**	**11-May-21**
Excavating Agency:	**Landshark**	**Operator:**	**Tyler**	**Equipment:**	**Shovel**
Location:	**Visitors Center**			**DST Supervisor:**	**Matt Ducak**

Depth From (m)	Depth To (m)	*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	Sample No.	Sample Depth (m)	Moisture Content (%)	**UTM Coordinates: 4643321.966m N, 374673.051m E** / **Geologic Profile**
0.00	0.30	FILL: Gravelly SAND - some silt, dark brown, moist				
0.30	0.30	Geotextile				
0.30	0.90	SAND - Coarse, trace gravel, no staining, free water or odours				
0.30	0.70	Drainage gravel surrounding 100mm diam. septic pipe				
		Test pit terminated at 0.9 m bgs				

Elevation in metres (m) above mean sea level

APPENDIX D
GEOTECHNICAL LABORATORY RESULTS

GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-547 **SAMPLE ID:** TP21-1B, GS1 **SAMPLE DEPTH:** 0.3 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

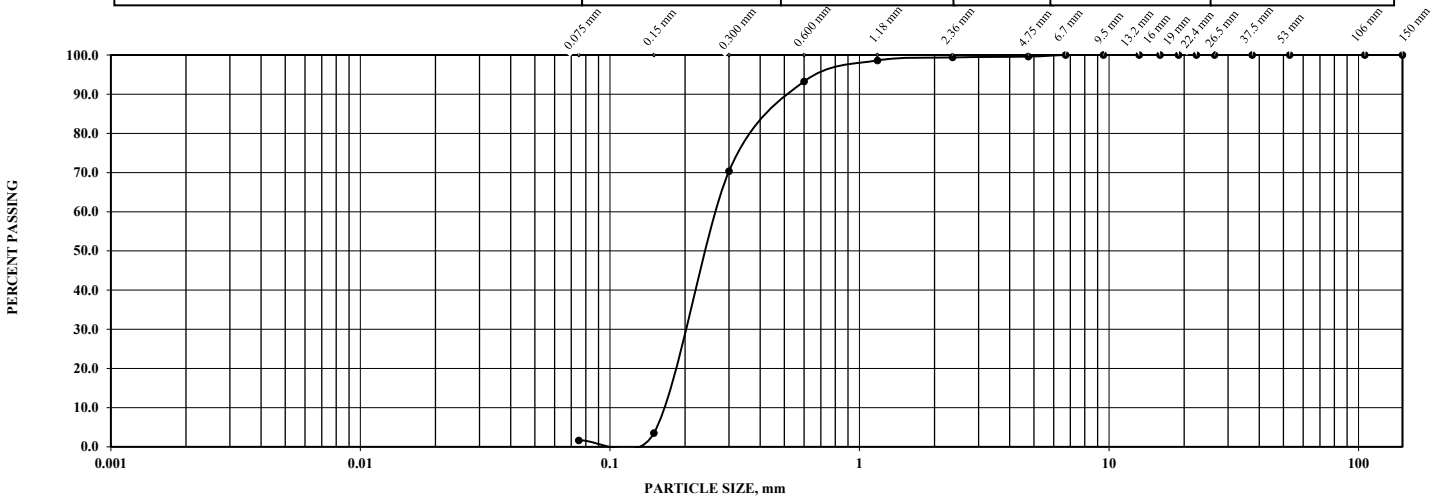
PARTICLE SIZE DISTRIBUTION, MTO LS-602

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM	COARSE	FINE	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS

D60	0.277	D30	0.209	D10	0.165	Cc	0.963	Cu	1.68

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	**% PASSING**
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	99.6
2.36	99.4
1.18	98.6
0.6	93.3
0.3	70.3
0.15	3.5
0.075	1.6

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	0.4
% SAND (75 µm to 4.75 mm):	98.0
% SILT (2 µm to 75 µm):	1.6
% CLAY (<2 µm):	-

SOIL DESCRIPTION: SAND, trace Silt

REMARKS

Figure: 1

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

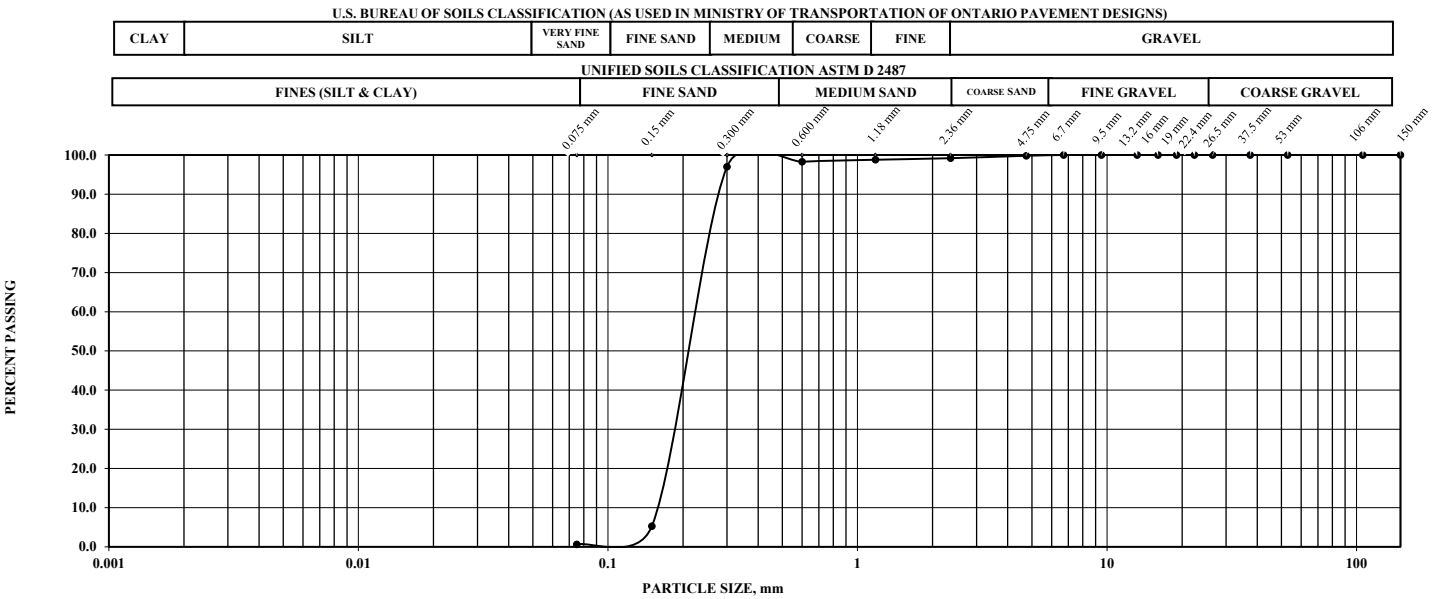
GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-548 **SAMPLE ID:** TP21-3, GS1 **SAMPLE DEPTH:** 0.6 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

PARTICLE SIZE DISTRIBUTION, MTO LS-602



COEFFICIENTS

D60	0.239	D30	0.190	D10	0.158	Cc	0.960	Cu	1.52

GRAIN SIZE ANALYSIS

SIEVE SIZE mm	% PASSING
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	99.8
2.36	99.2
1.18	98.8
0.6	98.3
0.3	97.0
0.15	5.3
0.075	0.6

GRAIN SIZE PROPORTIONS, %

% GRAVEL (> 4.75 mm):	0.2
% SAND (75 µm to 4.75 mm):	99.2
% SILT (2 µm to 75 µm):	0.6
% CLAY (<2 µm):	-

SOIL DESCRIPTION:		SAND

REMARKS

Figure: 2

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

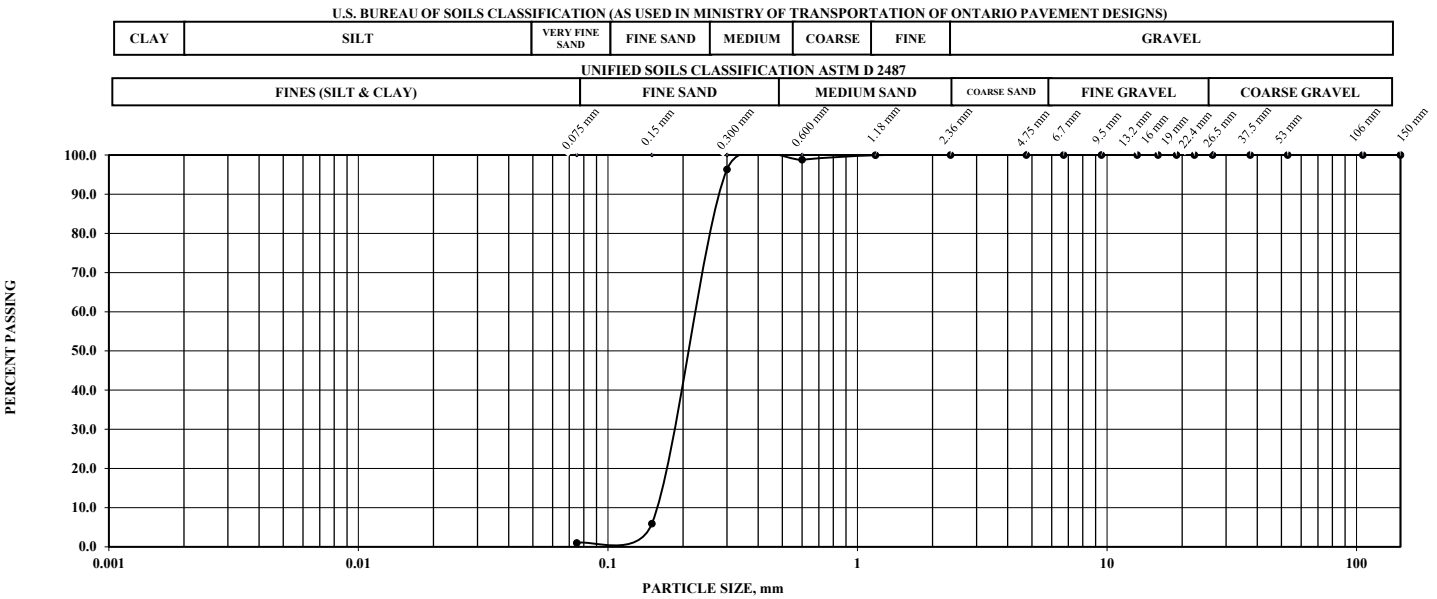
GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-549 **SAMPLE ID:** TP21-4, GS1 **SAMPLE DEPTH:** 0.7 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

PARTICLE SIZE DISTRIBUTION, MTO LS-602



COEFFICIENTS								
D60	0.240	D30	0.190	D10	0.157	Cc	0.960	Cu	1.53

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	% PASSING
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2.36	100.0
1.18	99.9
0.6	98.8
0.3	96.3
0.15	5.9
0.075	1.0

GRAIN SIZE PROPORTIONS, %		
% GRAVEL (> 4.75 mm):		
% SAND (75 µm to 4.75 mm):	99.0	
% SILT (2 µm to 75 µm):	1.0	
% CLAY (<2 µm):	-	
SOIL DESCRIPTION:		SAND, trace Silt

REMARKS

Figure: 3

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

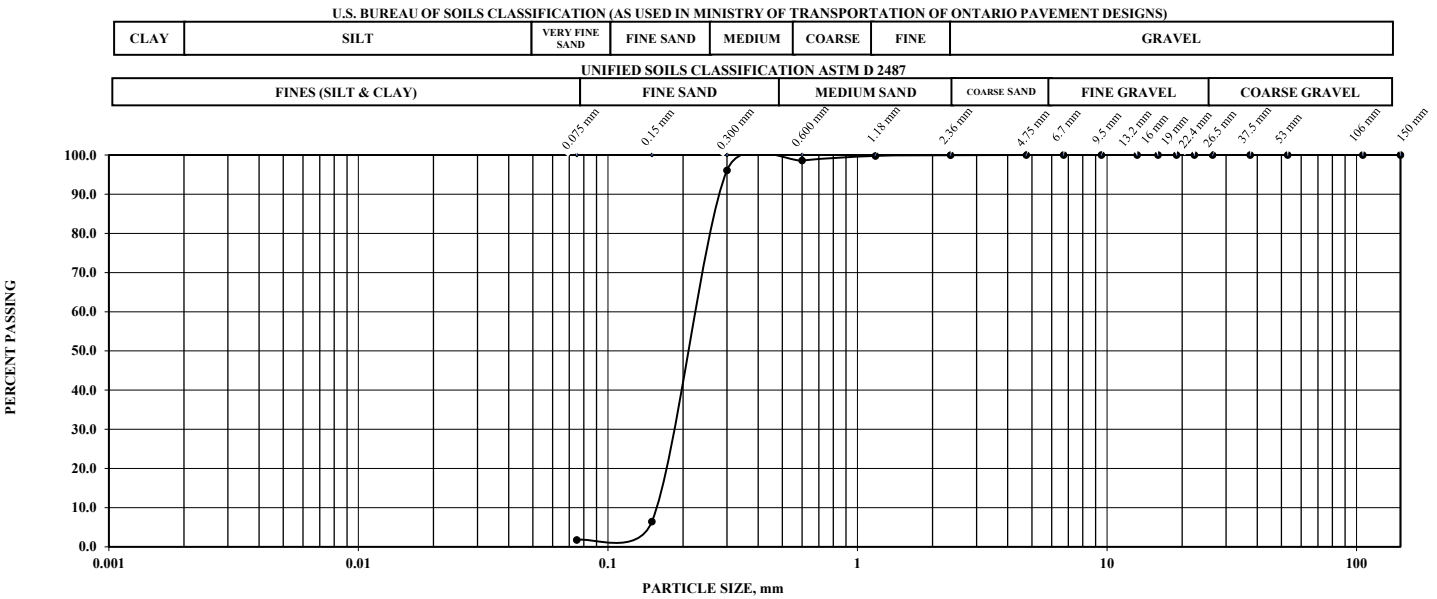
GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-550 **SAMPLE ID:** TP21-5, GS1 **SAMPLE DEPTH:** 0.5 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

PARTICLE SIZE DISTRIBUTION, MTO LS-602



COEFFICIENTS								
D60	0.240	D30	0.189	D10	0.156	Cc	0.960	Cu	1.54

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	% PASSING
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2.36	99.9
1.18	99.8
0.6	98.6
0.3	96.1
0.15	6.4
0.075	1.7

GRAIN SIZE PROPORTIONS, %		
% GRAVEL (> 4.75 mm):		
% SAND (75 µm to 4.75 mm):	98.3	
% SILT (2 µm to 75 µm):	1.7	
% CLAY (<2 µm):	-	
SOIL DESCRIPTION:		SAND, trace Silt

REMARKS

Figure: 4

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-551 **SAMPLE ID:** TP21-6, GS1 **SAMPLE DEPTH:** 0.6 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

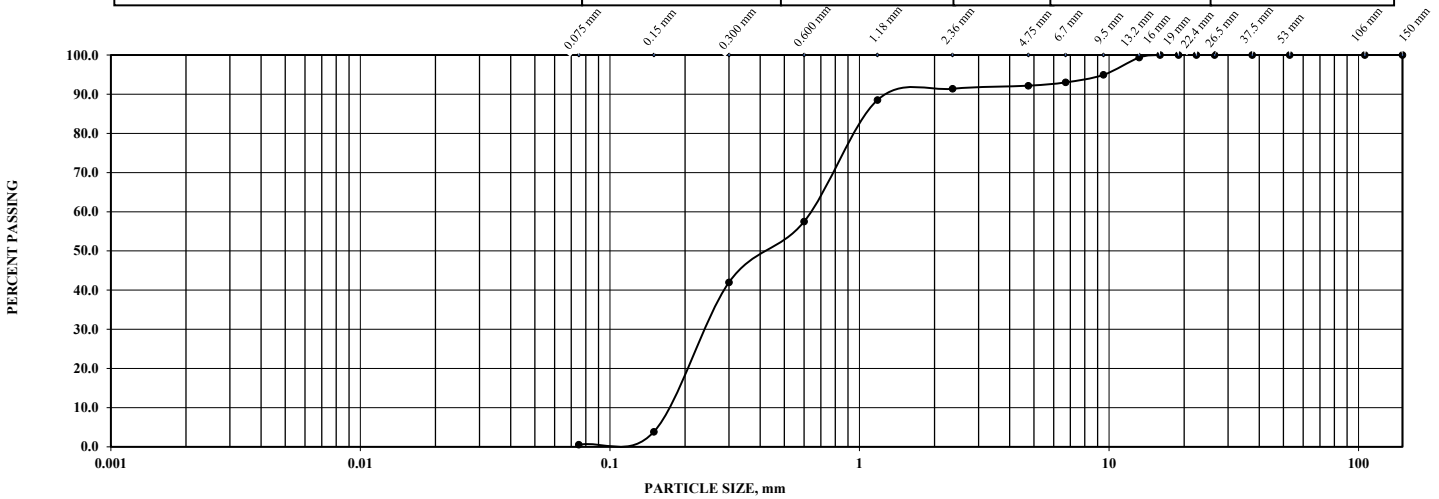
PARTICLE SIZE DISTRIBUTION, MTO LS-602

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM	COARSE	FINE	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS

D60	0.647	D30	0.253	D10	0.174	Cc	0.567	Cu	3.71

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	**% PASSING**
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	100.0
19	100.0
16	100.0
13.2	99.3
9.5	94.9
6.7	93.0
4.75	92.2
2.36	91.4
1.18	88.5
0.6	57.5
0.3	42.0
0.15	3.8
0.075	0.5

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	7.8
% SAND (75 µm to 4.75 mm):	91.7
% SILT (2 µm to 75 µm):	0.5
% CLAY (<2 µm):	-

SOIL DESCRIPTION:		SAND, trace Gravel

REMARKS

Figure: 5

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-554 **SAMPLE ID:** TP21-10, GS1 **SAMPLE DEPTH:** 0.5 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

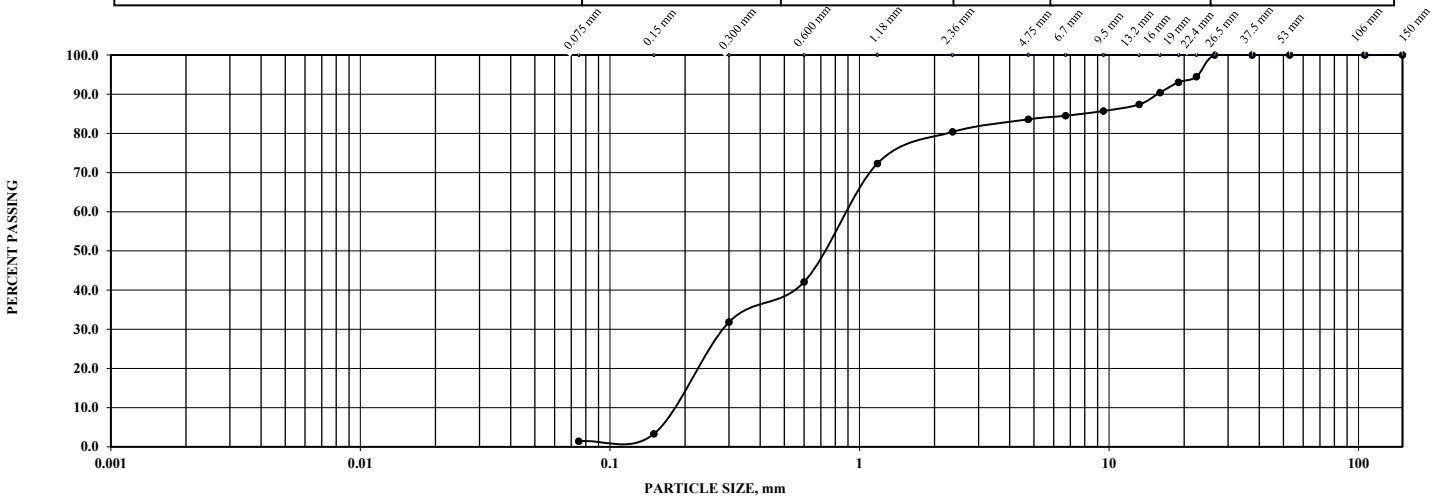
PARTICLE SIZE DISTRIBUTION, MTO LS-602

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM	COARSE	FINE	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS

D60	0.944	D30	0.290	D10	0.185	Cc	0.482	Cu	5.09

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	**% PASSING**
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	100.0
22.4	94.5
19	93.0
16	90.4
13.2	87.4
9.5	85.7
6.7	84.5
4.75	83.6
2.36	80.4
1.18	72.3
0.6	42.1
0.3	31.8
0.15	3.3
0.075	1.4

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	16.4
% SAND (75 µm to 4.75 mm):	82.2
% SILT (2 µm to 75 µm):	1.4
% CLAY (<2 µm):	-

SOIL DESCRIPTION:		SAND, some Gravel trace Silt

REMARKS

Figure: 6

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

GRAIN SIZE ANALYSIS REPORT
LS-602

PROJECT NUMBER: 02003072.0001.0002 **PROJECT NAME:** Point Pelee Geotech Investigation **CLIENT:** Parks Canada

LAB NUMBER: S-555 **SAMPLE ID:** TP21-11, GS1 **SAMPLE DEPTH:** 0.8 m

SAMPLED BY: M. Ducak, C.Tech **DATE RECEIVED:** May 14, 2021 **DATE COMPLETED:** May 20, 2021

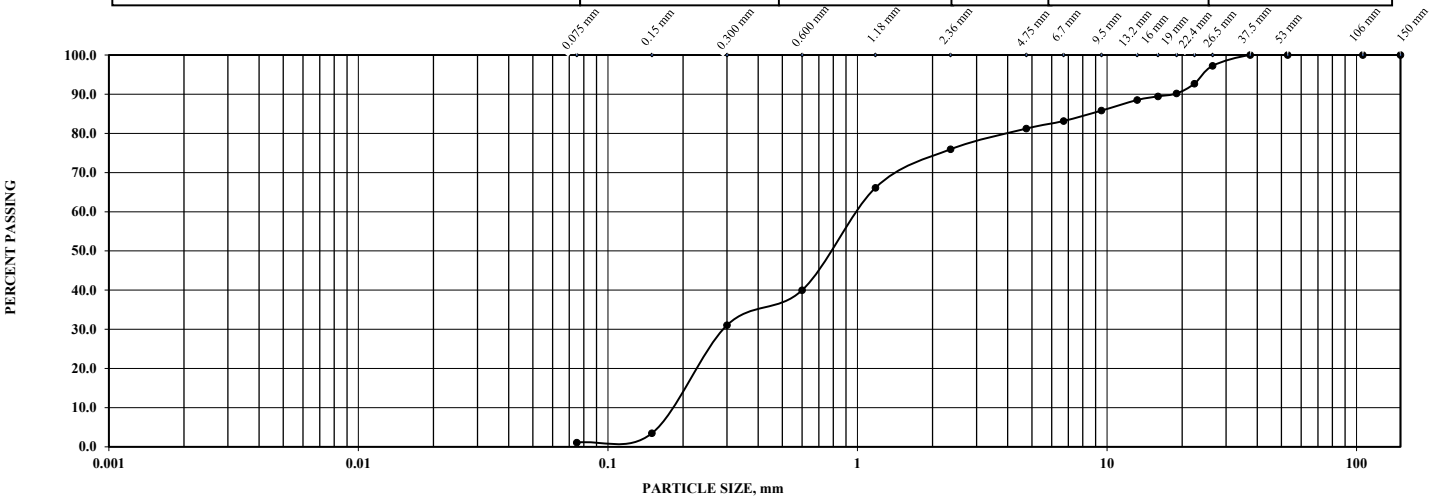
PARTICLE SIZE DISTRIBUTION, MTO LS-602

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM	COARSE	FINE	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS

D60	1.044	D30	0.294	D10	0.186	Cc	0.447	Cu	5.63

GRAIN SIZE ANALYSIS	
SIEVE SIZE mm	**% PASSING**
150	100.0
106	100.0
53	100.0
37.5	100.0
26.5	97.2
22.4	92.7
19	90.2
16	89.4
13.2	88.5
9.5	85.8
6.7	83.2
4.75	81.2
2.36	75.9
1.18	66.1
0.6	40.0
0.3	31.0
0.15	3.5
0.075	1.1

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	18.8
% SAND (75 µm to 4.75 mm):	80.1
% SILT (2 µm to 75 µm):	1.1
% CLAY (<2 µm):	-

SOIL DESCRIPTION: SAND, some Gravel trace Silt

REMARKS

Figure: 7

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

GRAIN SIZE AND HYDROMETER ANALYSIS REPORT
LS-602, 702 & 703/704

PROJECT NUMBER:	02003072.0001.0002	**PROJECT NAME:**	Point Pelee Geotech Investigation	**CLIENT:**	Parks Canada
LAB NUMBER:	S-552	**SAMPLE ID:**	TP21-7, GS1	**SAMPLE DEPTH:**	0.3 m
SAMPLED BY:	M. Ducak, C.Tech	**DATE RECEIVED:**	May 14, 2021	**DATE COMPLETED:**	May 20, 2021

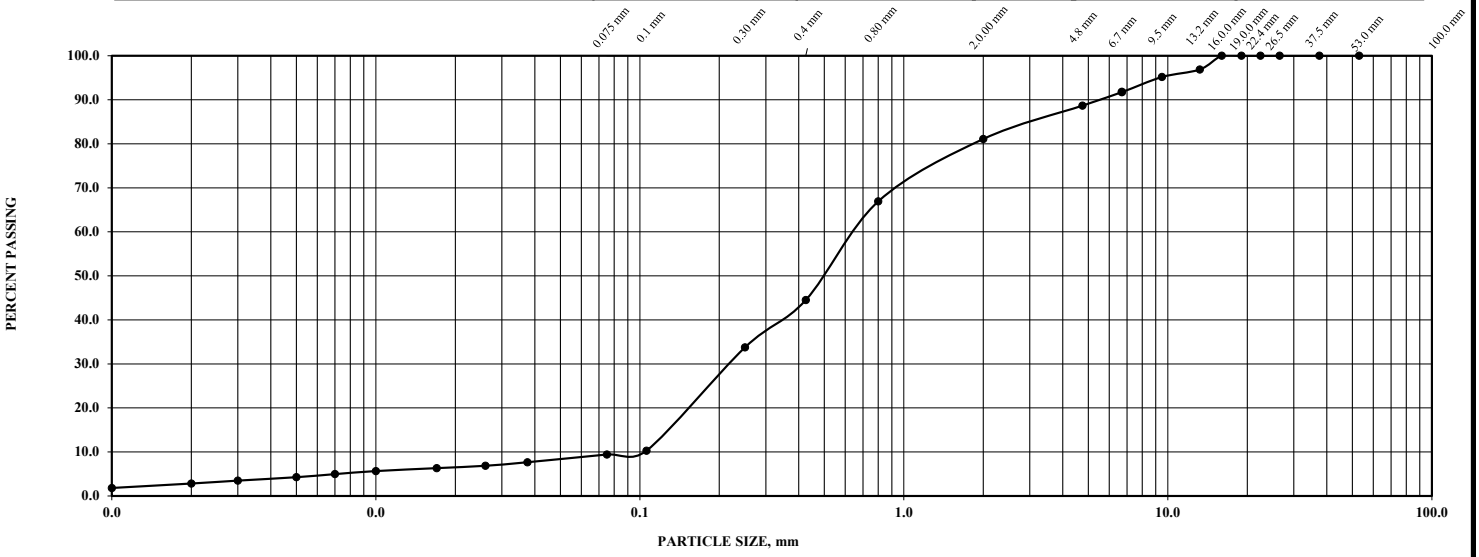
PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS								
D60	0.684	**D30**	0.227	**D10**	0.095	**Cc**	0.789	**Cu**	7.17

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	**% PASSING**	**DIAMETER mm**	**% PASSING**
53	100.0	0.038	7.7
37.5	100.0	0.026	6.9
26.5	100.0	0.017	6.3
22.4	100.0	0.010	5.7
19	100.0	0.007	5.0
16	100.0	0.005	4.3
13.2	96.9	0.002	2.8
9.5	95.2	0.001	1.8
6.7	91.7	**ATTERBERG LIMITS**	
4.75	88.7		
2.00	81.1	Liquid Limit	
0.800	66.9		
0.425	44.5	Plastic Limit	
0.250	33.7		
0.106	10.3	Plastic Index	
0.075	9.4		

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	11.3
% SAND (75 µm to 4.75 mm):	79.3
% SILT (2 µm to 75 µm):	6.6
% CLAY (<2 µm):	2.8
SOIL DESCRIPTION:	SAND, some Gravel trace Silt and Clay
SUSCEPTIBILITY TO FROST HEAVING:	LOW

REMARKS

Figure: 1

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

GRAIN SIZE AND HYDROMETER ANALYSIS REPORT
LS-602, 702 & 703/704

PROJECT NUMBER:	02003072.0001.0002	**PROJECT NAME:**	Point Pelee Geotech Investigation	**CLIENT:**	Parks Canada
LAB NUMBER:	S-553	**SAMPLE ID:**	TP21-9, GS1	**SAMPLE DEPTH:**	0.8 m
SAMPLED BY:	M. Ducak, C.Tech	**DATE RECEIVED:**	May 14, 2021	**DATE COMPLETED:**	May 20, 2021

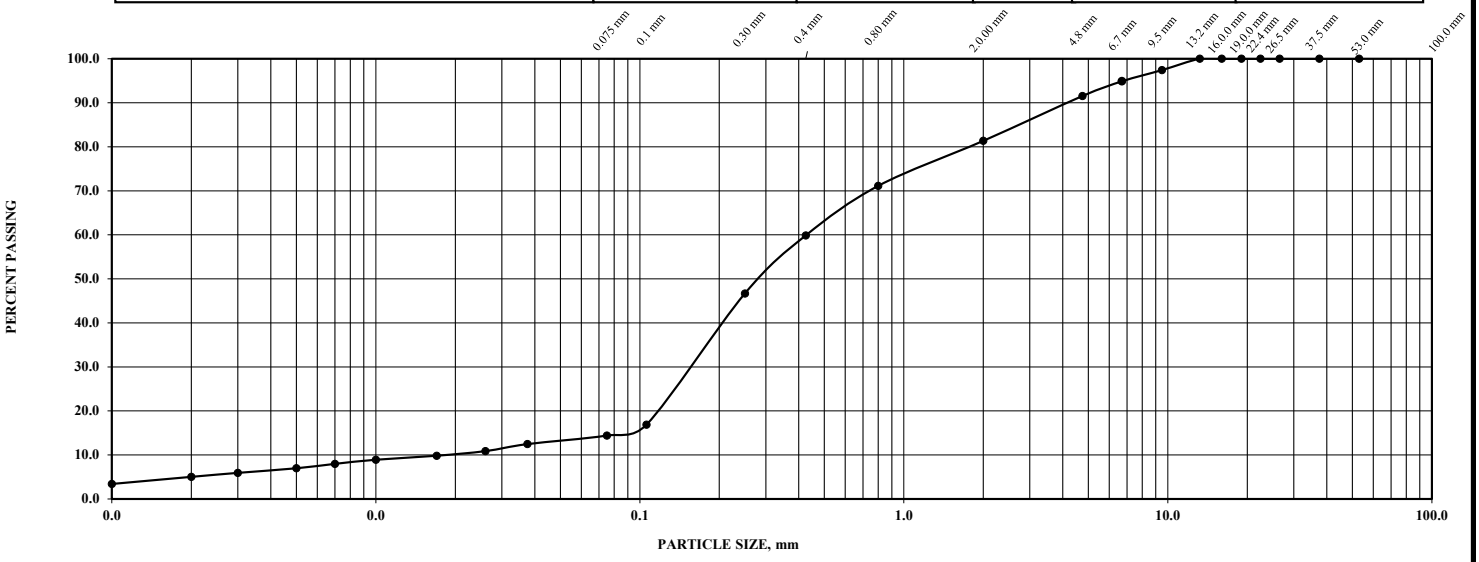
PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



COEFFICIENTS

D60	0.429	**D30**	0.169	**D10**	0.019	**Cc**	3.605	**Cu**	23.18

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	**% PASSING**	**DIAMETER mm**	**% PASSING**
53	100.0	0.038	12.5
37.5	100.0	0.026	10.9
26.5	100.0	0.017	9.8
22.4	100.0	0.010	8.9
19	100.0	0.007	8.0
16	100.0	0.005	7.0
13.2	100.0	0.002	5.0
9.5	97.4	0.001	3.4
6.7	94.9	**ATTERBERG LIMITS**	
4.75	91.5		
2.00	81.4	Liquid Limit	
0.800	71.1		
0.425	59.9	Plastic Limit	
0.250	46.7		
0.106	16.9	Plastic Index	
0.075	14.4		

GRAIN SIZE PROPORTIONS, %	
% GRAVEL (> 4.75 mm):	8.5
% SAND (75 µm to 4.75 mm):	77.1
% SILT (2 µm to 75 µm):	9.4
% CLAY (<2 µm):	5.0
SOIL DESCRIPTION:	SAND, trace Gravel, Silt and Clay
SUSCEPTIBILITY TO FROST HEAVING:	LOW

REMARKS

Figure: 1

TESTED BY: Kevin Frank
Laboratory Technician

REVIEWED BY David Soanes CET rcca
Project Manager / Team Leader - Kitchener

APPENDIX E
K-SAT CALCULATIONS USING GUELPH PERMEAMETER DATA

Guelph Permeameter Calculations

Input

Result

TP21-01A

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 6.4000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	6.400
Q	3.757
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154

$Q =$ 3.7568

$K_{fs} =$ 6.83E-03 *cm/sec*
4.10E-01 *cm/min*
6.83E-05 *m/sec*
1.61E-01 *inch/min*
2.69E-03 *inch/sec*

$\Phi_m =$ 5.69E-02 (cm^2/min)

TP21-01B

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 6.0000

Res Type	35.22
H	5
a	3
H/a	1.66667
a*	0.12
C0.01	0.80949
C0.04	0.84206
C0.12	0.80315
C0.36	0.80315
C	0.80315
R	6.000
Q	3.522
pi	3.1415

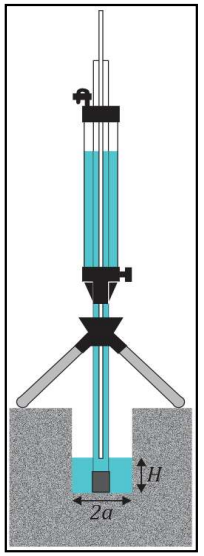
$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154

$Q =$ 3.522

$K_{fs} =$ 6.41E-03 *cm/sec*
3.84E-01 *cm/min*
6.41E-05 *m/ses*
1.51E-01 *inch/min*
2.52E-03 *inch/sec*

$\Phi_m =$ 5.34E-02 (cm^2/min)



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$

Guelph Permeameter Calculations

Input

Result

TP21-03

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	5.6000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	5.600
Q	3.287
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154

$Q =$ 3.2872

$K_{fs} =$ 5.98E-03 *cm/sec*
3.59E-01 *cm/min*
5.98E-05 *m/sec*
1.41E-01 *inch/min*
2.35E-03 *inch/sec*

$\Phi_m =$ 4.98E-02 (cm^2/min)

TP21-04

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	4.8000

Res Type	35.22
H	5
a	3.5
H/a	1.42857
a*	0.12
C0.01	0.73608
C0.04	0.76319
C0.12	0.72043
C0.36	0.72043
C	0.72043
R	4.800
Q	2.8176
pi	3.1415

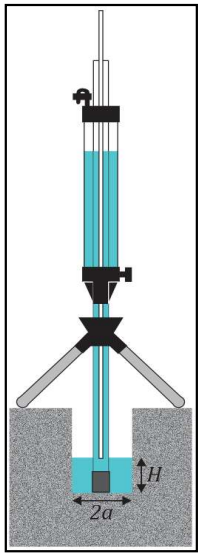
$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.720428

$Q =$ 2.8176

$K_{fs} =$ 4.55E-03 *cm/sec*
2.73E-01 *cm/min*
4.55E-05 *m/ses*
1.07E-01 *inch/min*
1.79E-03 *inch/sec*

$\Phi_m =$ 3.79E-02 (cm^2/min)



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$

Guelph Permeameter Calculations

Input

Result

TP21-05

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	4.4000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.12
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	4.400
Q	2.583
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.720428

$Q =$ 2.5828

$K_{fs} =$ 4.17E-03 *cm/sec*
2.50E-01 *cm/min*
4.17E-05 *m/sec*
9.84E-02 *inch/min*
1.64E-03 *inch/sec*

$\Phi_m =$ 3.47E-02 (cm^2/min)

TP21-06

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	10.4000

Res Type	35.22
H	5
a	3.5
H/a	1.42857
a*	0.12
C0.01	0.73608
C0.04	0.76319
C0.12	0.72043
C0.36	0.72043
C	0.72043
R	10.400
Q	6.1048
pi	3.1415

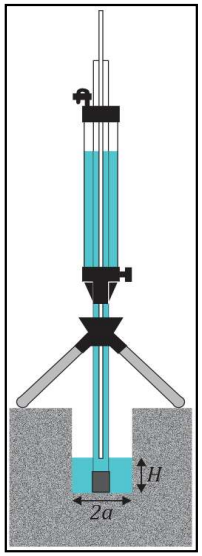
$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.720428

$Q =$ 6.1048

$K_{fs} =$ 9.85E-03 *cm/sec*
5.91E-01 *cm/min*
9.85E-05 *m/ses*
2.33E-01 *inch/min*
3.88E-03 *inch/sec*

$\Phi_m =$ 8.21E-02 (cm^2/min)



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$

Guelph Permeameter Calculations

Input

Result

TP21-07

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	10
Enter the Borehole Radius ("a" in cm):	3

Enter the soil texture-structure category (enter one of the below numbers): **4**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **7.0000**

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.36
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	7.000
Q	4.109
pi	3.142

$\alpha^* =$ **0.36** (cm^{-1})

$C =$ **1.287543**

$Q =$ **4.109**

$K_{fs} =$ **6.30E-03** *cm/sec*
3.78E-01 *cm/min*
6.30E-05 *m/sec*
1.49E-01 *inch/min*
2.48E-03 *inch/sec*

$\Phi_m =$ **1.75E-02** (cm^2/min)

TP21-09

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	15
Enter the Borehole Radius ("a" in cm):	3.5

Enter the soil texture-structure category (enter one of the below numbers): **4**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **2.2000**

Res Type	35.22
H	15
a	3.5
H/a	4.28571
a*	0.36
C0.01	1.39928
C0.04	1.49355
C0.12	1.51395
C0.36	1.51395
C	1.51395
R	2.200
Q	1.2914
pi	3.1415

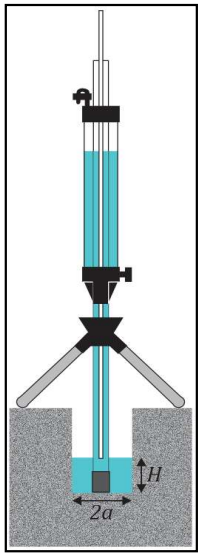
$\alpha^* =$ **0.36** (cm^{-1})

$C =$ **1.513949**

$Q =$ **1.2914**

$K_{fs} =$ **1.13E-03** *cm/sec*
6.77E-02 *cm/min*
1.13E-05 *m/ses*
2.66E-02 *inch/min*
4.44E-04 *inch/sec*

$\Phi_m =$ **3.13E-03** (cm^2/min)



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$

Guelph Permeameter Calculations

Input

Result

TP21-10

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	5.5000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	5.500
Q	3.229
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.720428

$Q =$ 3.2285

$K_{fs} =$ 8.55E-03 *cm/sec*
5.13E-01 *cm/min*
8.55E-05 *m/sec*
2.02E-01 *inch/min*
3.37E-03 *inch/sec*

$\Phi_m =$ 2.37E-02 (cm^2/min)

TP21-11

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):	13.9000

Res Type	35.22
H	5
a	3.5
H/a	1.42857
a*	0.36
C0.01	0.73608
C0.04	0.76319
C0.12	0.72043
C0.36	0.72043
C	0.72043
R	13.900
Q	8.1593
pi	3.1415

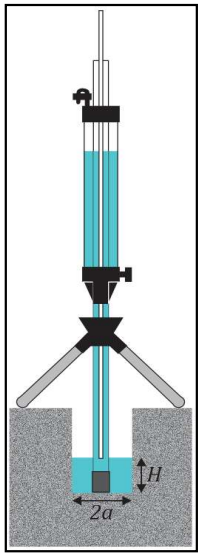
$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.720428

$Q =$ 8.1593

$K_{fs} =$ 2.16E-02 *cm/sec*
1.30E+00 *cm/min*
2.16E-04 *m/ses*
5.10E-01 *inch/min*
8.51E-03 *inch/sec*

$\Phi_m =$ 6.00E-02 (cm^2/min)



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$

APPENDIX F

TABLE 2: APPROXIMATE RELATIONSHIP OF COARSE GRAINED SOIL TYPES TO PERMEABILITY AND PERCOLATION TIME, MMAH SUPPLEMENTARY STANDARD SB-6

Table 2
Approximate Relationship of Coarse Grained Soil Types to Permeability and Percolation Time

Soil Type (Unified Soil Classification) Coarse Grained More than 50% Larger than #200	Coefficient of Permeability, K - cm/sec	Percolation Time, T - mins/cm	Comment
G.W. - Well graded gravels, gravel-sand mixtures, little or no fines.	10^{-1}	<1	very permeable unacceptable
G.P. - Poorly graded gravels, gravel-sand mixtures, little or no fines.	10^{-1}	<1	very permeable unacceptable
G.M. - Silty gravels, gravel-sand-silt mixtures.	10^{-2} - 10^{-4}	4 - 12	Permeable to medium permeable depending on amount of silt.
G.C. - Clayey gravels, gravel-sand-clay mxtures.	10^{-4} - 10^{-6}	12 - 50	Important to estimate amount of silt and clay
S.W. - Well graded sands, gravelly sands little orno fines.	10^{-1} - 10^{-4}	2 - 12	medium permeability
S.P. - Poorly graded sands, gravelly sand, little or no fines.	10^{-1} - 10^{-3}	2 - 8	medium permeability
S.M. - Silty sands, sand-silt mixtures.	10^{-3} - 10^{-5}	8 - 20	medium to low permeability
S.C. - Clayey sands, sand-clay mixtures.	10^{-4} - 10^{-6}	12 - 50	medium to low permeability depending on amount of clay
Column 1	2	3	4

APPENDIX B – Basic Impact Assessment

(To be provided as Supplementary Information)