

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
- .2 Canadian Standards Association (CSA)
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 1004-12, Material Specification for Aggregates-Miscellaneous.
 - .2 OPSS SP 110F13-04, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.
- .4 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SUBMITTALS

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

Part 2 Products

2.1 MATERIALS

- .1 Granular A, Granular B Type I, Granular B Type II, and Granular M to OPSS SP 110F13. Sand to OPSS 1004.
- .2 Unshrinkable Fill: concrete to CSA A23.1/A23.2.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine soil report available at project tender documents.
 - .2 Before commencing work, establish locations of buried services on and adjacent to site.

.2 Evaluation and Assessment:

- .1 Arrange with appropriate authority for relocation of buried services that interfere with execution of work. Pay costs of relocating services.
- .2 Testing of materials and compaction of backfill and fill will be carried out by testing laboratory designated by Departmental Representative at the cost of Contractor.
- .3 Not later than 1 week before backfilling or filling, provide to designated testing agency 25-kg sample of fill material proposed for use.
- .4 Not later than 48 hours before backfilling or filling with approved material, notify Departmental Representative so that compaction tests can be carried out by designated testing agency.
- .5 Before commencing work, conduct, with Departmental Representative, condition survey of existing structures, trees and plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

- .1 Use 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, in accordance with sediment and erosion control plan, specific to site, to EPA 832/R-92-005 and requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Protection of In-Place Conditions:

- .1 Protect excavations from freezing.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative's approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are to remain undisturbed.

.3 Removal:

- .1 Remove obsolete buried services within 2 m of foundations if encountered and cap cutoffs.
- .2 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

- .3 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.
- .4 Remove stumps and tree roots below footings, slabs, and paving, and to 600 mm below finished grade elsewhere.

3.3 EXCAVATION

- .1 Shore and brace excavations, protect slopes and banks, and perform work in accordance with Provincial and Municipal regulations.
- .2 Do blasting in accordance with Provincial and Municipal regulations. Repair damage to approval of Departmental Representative. No blasting will be permitted within 3 m of any building and where damage would result.
 - .1 Topsoil stripping in accordance with Section 31 14 13 - Soil Stripping and Stockpiling
- .3 Excavate as required to carry out work, in all materials met.
 - .1 Do not disturb soil or rock below bearing surfaces. Notify Departmental Representative when excavations are complete.
 - .2 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
 - .3 Fill excavation taken below depths shown without Departmental Representative's written authorization with concrete of same strength as for footings.
- .4 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .5 Excavate for slabs and paving to subgrade levels.
 - .1 Remove topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

3.4 SITE QUALITY CONTROL

- .1 Fill material and spaces to be filled to be inspected and approved by Departmental Representative.

3.5 BACKFILLING

- .1 Start backfilling only after inspection and receipt of written approval of fill material and spaces to be filled from Departmental Representative.
- .2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.
- .3 Lateral Support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.
- .4 Compaction of Subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as specified for fill. Fill excavated areas with selected subgrade material compacted as specified for fill.

- .5 Placing:
 - .1 The following notes are only applicable where direct backfilling requirements are not directly addressed on drawings.
 - .1 Place backfill, fill and base course material in 150-mm lifts. Add water as required to achieve specified density.
 - .2 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.
- .6 Compaction: compact each layer of material to following densities for material to ASTM D698:
 - .1 To underside of base courses: 95%.
 - .2 Base courses: 100%.
 - .3 Elsewhere: 95%.
- .7 Under Slabs and Paving:
 - .1 Use 150 mm up to bottom of granular base courses.
 - .2 Use Granular A for base courses.
- .8 In Trenches:
 - .1 Up to 300 mm above pipe or conduit: sand placed by hand.
 - .2 Over 300 mm above pipe or conduit: native material approved by Departmental Representative.
- .9 Under Seeded and Sodded Areas: use site-excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.
- .10 Blown rock material, not capable of fine grading, is not acceptable; imported material must be placed on this type of material.
- .11 Against Foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200-mm diameter within 600 mm of structures.
- .12 Underground Tanks: use sand to bottom of granular base courses or to bottom of topsoil, as applicable.

3.6 GRADING

- .1 Grade to ensure that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by Departmental Representative. Grade to be gradual between finished spot elevations as indicated.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Dispose of cleared and grubbed material off site daily.
- .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.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate Quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .3 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel composed of naturally formed particles of stone.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Approval of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

- .1 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
 - .1 Use methods and equipment approved in writing by Departmental Representative.

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

3.2 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 Leave aggregate stockpile site in tidy, well-drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .5 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .6 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.
- .7 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 00 99 - Earthwork for Minor Works.

1.2 REFERENCES

- .1 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 DEFINITIONS

- .1 Clearing consists of cutting off trees 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.
- .5 Grubbing consists of excavation and disposal of stumps and roots, boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Submit three samples of each material listed below for approval prior to delivery of materials to project site.
 - .1 Tree wound paint: one litre can with manufacturer's label.
 - .2 Herbicide: one litre can with manufacturer's label.
- .3 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

- .2 Safety Requirements: worker protection.
 - .1 Workers must wear gloves, dust masks, eye protection, protective clothing when applying herbicide materials.
 - .2 Workers must not eat, drink or smoke while applying herbicide material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill.

1.6 STORAGE AND PROTECTION

- .1 Prevent damage to fencing, trees, natural features, and bench marks 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.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.
 - .1 Trim limbs and tops, and saw into saleable lengths.
 - .2 Stockpile adjacent to site.

Part 2 Products

2.1 MATERIALS

- .1 Bituminous-based paint of standard manufacture specially formulated for tree wounds.
- .2 Herbicide: effective for killing annual and perennial weeds, and bamboo grass, by being absorbed through roots and foliage.
 - .1 Spray applied on noncrop land areas.
- .3 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.
 - .2 Remove and store soil material for reuse.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Proceed in accordance with Section 31 00 99 - Earthwork for Minor Works.

3.2 PREPARATION

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

- .2 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 line(s) are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Departmental Representative in ample time to minimize interruption of service.
- .3 Notify utility authorities before starting clearing or grubbing.
- .4 Keep roads and walks free of dirt and debris.

3.3 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.4 CLEARING

- .1 Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.
- .2 Clear 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 Cut off branches overhanging area cleared as directed by Departmental Representative.
- .4 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.
- .5 Apply herbicide in accordance with manufacturer's label to top surface of stumps designated not to be removed.

3.5 CLOSE-CUT CLEARING

- .1 Close-cut clearing to ground level.
- .2 Cut off branches overhanging area cleared as directed by Departmental Representative.
- .3 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.6 ISOLATED TREES

- .1 Cut off isolated trees as indicated by Departmental Representative at height of not more than 300 mm above ground surface.
- .2 Grub out isolated tree stumps.
- .3 Prune individual trees as indicated.
- .4 Trim trees designated to be left standing within cleared areas of dead branches 4 cm or more in diameter; and trim branches to heights as indicated.

- .5 Cut limbs and branches to be trimmed close to bole of tree or main branches.
- .6 Paint cuts more than 3 cm in diameter with approved tree wound paint.

3.7 UNDERBRUSH CLEARING

- .1 Clear underbrush from areas as indicated at ground level.

3.8 GRUBBING

- .1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 200 mm below ground surface.
- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.9 REMOVAL AND DISPOSAL

- .1 Remove cleared and/or grubbed materials to disposal area approved by Departmental Representative.
- .2 Cut timber greater than 125-mm diameter and stockpile as indicated. Stockpiled timber becomes property of Departmental Representative.
- .3 Dispose of cleared and/or grubbed materials by burying.
- .4 Bury to approval of Departmental Representative by:
 - .1 Consolidating.
 - .2 Covering with minimum 500 mm of mineral soil.
 - .3 Finishing surface.
- .5 Stockpile cleared and grubbed vegetative material on site as directed by Departmental Representative.
- .6 Remove diseased trees identified by Departmental Representative and dispose of this material to approval of Departmental Representative.

3.10 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for immediate grading operations or stripping of topsoil to approval of Departmental Representative.

3.11 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 OF SECTION

Part 1 General

1.1 REFERENCES

- .1 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

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 sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Ensure that procedures are conducted in accordance with applicable Provincial requirements.
- .2 Remove topsoil before construction procedures commence to avoid compaction of topsoil.
- .3 Handle topsoil only when it is dry and warm.
- .4 Do not handle topsoil while in wet or frozen condition.
- .5 Remove vegetation from targeted areas by nonchemical means and dispose of stripped vegetation by alternative disposal.
- .6 Remove brush from targeted area by nonchemical means and dispose of through alternative disposal.
- .7 Strip topsoil to depths as approved by Departmental Representative.
 - .1 Avoid mixing topsoil with subsoil.

- .8 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.
- .9 Pile topsoil by mechanical hoe in berms in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m.
- .10 Dispose of unused topsoil off-site in location approved by Departmental Representative.
- .11 Protect stockpiles from contamination and compaction.
- .12 Cover topsoil that has been piled for long-term storage, with trefoil or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

- .1 Verify that grades are correct, and notify Departmental Representative if discrepancies occur; do not begin work until instructed.
 - .1 Grade area only when soil is dry to lessen soil compaction.
 - .2 Grade soil with scrapers establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.4 PLACING OF TOPSOIL

- .1 Place topsoil only after Departmental Representative has accepted subgrade.
- .2 Spread topsoil during dry conditions by mechanical hoe in uniform layers not exceeding 200 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.
- .4 Cultivate soil following spreading procedures.

3.5 SUBSOILING

- .1 Apply subsoil, following spreading and cultivating procedures to designated areas to improve drainage and agricultural potential of soil.
- .2 Work subsoil area following natural grade contour lines, with vibrating subsoiler to depth of 40 cm.
- .3 Cross subsoil the area following the first pass.
- .4 Cultivate the soil with a chain harrow to declod the soil.

3.6 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 OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 14 13 - Soil Stripping and Stockpiling.
- .2 Section 31 23 19 - Unwatering/Dewatering.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
- .2 Underwriters' Laboratories of Canada (ULC).

1.3 SUBMITTALS

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

1.4 EXISTING CONDITIONS

- .1 Subsurface investigation report is included in the specification at appendix A of this document.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.
- .3 Refer to dewatering in Section 31 23 19 - Unwatering/Dewatering.

Part 2 Products

2.1 MATERIALS

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

Part 3 Execution

3.1 EXAMINATION

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

3.2 STRIPPING OF TOPSOIL

- .1 Proceed in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.

3.3 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to following depths below finish grades:
 - .1 50 mm for grassed areas.
 - .2 50 mm for flowerbeds.
 - .3 100 mm for shrub beds.
 - .4 100 mm for asphalt or gravel paving.
 - .5 100 mm for concrete paving walks.
- .3 Slope rough grade away from building 1.5H:1V minimum.
- .4 Grade ditches to depth as indicated.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:
 - .1 90% under landscaped areas.
 - .2 95% under paved and walk areas.
- .7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.4 TESTING

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid by Departmental Representative.
- .2 Submit testing procedure, frequency of tests, testing laboratory as designated by ULC or certified testing personnel to Departmental Representative for approval.

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

3.6 PROTECTION

- .1 Protect existing trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction-related debris on roads.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 00 99 - Earthwork for Minor Works.
- .2 Section 31 14 13 - Soil Stripping and Stockpiling.
- .3 Section 31 23 19 - Unwatering/Dewatering.

1.2 REFERENCES

- .1 Definitions:
 - .1 Common Excavation: excavation of materials that are not rock excavation or stripping.
 - .2 Unclassified Excavation: excavation of whatever character other than stripping encountered in the Work or rock excavation. The work to be done under this clause shall consist of supplying all labour, material and Contractor's equipment, and performing all work necessary to carry out the excavation of unclassified materials as shown on the Drawings, as required by the Departmental Representative, and as specified herein.
 - .3 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
 - .4 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.
 - .5 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .6 Excavation Limits: the lines and grades and dimensions shown on Drawings which define the extent of open cut excavation. Remove all materials within these limits.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600kN-m/m³).
- .3 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 1004-12, Material Specification for Aggregates-Miscellaneous.
 - .2 OPSS SP 110F13-04, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.
- .4 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SUBMITTALS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine soil report available in project tender documents.
 - .2 Before commencing work establish locations of buried services on and adjacent to site.
- .2 Evaluation and Assessment:
 - .1 During initial phase of the work, arrange with appropriate authority for relocation of buried services that interfere with execution of work. Pay costs of relocating services.
 - .2 Testing of materials and compaction of backfill and fill will be carried out by testing laboratory designated by Departmental Representative.
 - .3 Not later than 1 week before backfilling or filling, provide to designated testing agency, 25-kg sample of fill material proposed for use.
 - .4 Not later than 48 hours before backfilling or filling with approved material, notify Departmental Representative so that compaction tests can be carried out by designated testing agency.
 - .5 Before commencing work, conduct, with Departmental Representative, condition survey of existing structures, trees and plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .2 Protection of In-Place Conditions: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .3 Removal: in accordance with Section 31 00 99 - Earthwork for Minor Works.

3.3 EXCAVATION

- .1 Dispose excavated material unsuitable for use as fill or surplus to fill requirements in the locations shown on the Drawings, or as approved by the Departmental Representative. All such disposal shall be the full responsibility of the Contractor.
- .2 Prior to commencement of unclassified excavation, the Contractor shall submit, for review and approval by the Departmental Representative, details of his proposed methods, schedule and sequence of operations to be followed for the excavation to be carried out as specified herein.

- .3 Original ground elevations shall be established after the completion of clearing, grubbing and stripping, as specified herein, of these Specifications, and agreed by the Contractor and the Departmental Representative before starting excavation of any section of the work. The Contractor shall not commence unclassified excavation activities in any area of the Site without prior written approval from the Departmental Representative.
- .4 Perform unclassified excavation to the excavation limits shown on the Drawings or as directed by the Departmental Representative. Near the base of excavations, the neat lines may be adjusted by locally steeping the excavation slope, as approved by the Departmental Representative, to accommodate local variations in the foundation levels. In addition, overexcavation beyond the neat lines and grades shown on the Drawings may be required by the Departmental Representative to suit local field conditions, as shown on the Drawings, or for installation of the canal depressurization system, as described in Section 31 23 19 - Unwatering/Dewatering of these Specifications.
- .5 When additional excavation outside the lines and grades shown on the Drawings is required by the Contractor for his own convenience, or as a result of his excavation methodology, undertake all such additional excavation at no additional cost to the project. Such excavations may be required to be backfilled, and compacted with acceptable material to the neat excavation lines, and compacted in a manner satisfactory to the Departmental Representative, at no additional cost to the project. Such additional excavation shall not be undertaken without prior written permission of the Departmental Representative.
- .6 Adopt excavation procedures such that at no time during construction shall the stability of any slope be impaired. The approval by the Departmental Representative of excavation procedures shall in no way relieve the Contractor of his responsibility for safeguarding stability of all slopes excavated as part of the Works.
- .7 Finish the surfaces of all stockpiled excavated material to stable slopes in a careful and workmanlike manner. Stockpiling of materials shall be such that it will not interfere with natural drainage or, alternatively, drains shall be constructed to prevent ponding of water in or around the stockpile area.
- .8 Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial and Municipal regulations.
- .9 Topsoil Stripping in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.
- .10 Excavate as required to carry out work, in all materials met.
 - .1 Do not disturb soil or rock below bearing surfaces. Notify Departmental Representative when excavations are complete.
 - .2 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.
 - .3 Fill excavation taken below depths shown without Departmental Representative's written authorization with concrete of same strength as for footings.
- .11 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.

- .12 Excavate for slabs and paving to subgrade levels.
 - .1 Remove topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

3.4 SITE QUALITY CONTROL

- .1 Fill material and spaces to be filled to be inspected and approved by Departmental Representative.

3.5 CONTROL OF WATER

- .1 In accordance with Section 31 23 19 - Unwatering/Dewatering, surface flows shall be directed away from the works by means of ditches or other means and, in any case, all surface and subsurface flows entering the work area shall be satisfactorily controlled. No water to be pumped directly into any watercourse.

3.6 BACKFILLING

- .1 Proceed in accordance with Section 31 00 99 - Earthwork for Minor Works.

3.7 GRADING

- .1 Grade to ensure that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by Departmental Representative. Grade to be gradual between finished spot elevations as indicated.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Dispose of cleared and grubbed material off site daily.
- .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.

END OF SECTION

Part 1 General

1.1 UNIT PRICES

- .1 The quantities of additional rock excavation beyond the limits shown on the drawings, that are over and above as specified in the Contract Documents, and have been authorized in writing by Departmental Representative will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.

1.2 RELATED SECTIONS

- .1 Section 31 00 99 - Earthwork for Minor Works.
- .2 Section 31 14 13 - Soil Stripping and Stockpiling.
- .3 Section 31 23 19 - Unwatering/Dewatering.

1.3 REFERENCES

- .1 Definitions:
 - .1 Overhaul: authorized hauling in excess of free haul distance that excavated material is moved.
 - .2 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
 - .3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .4 Rock Excavation: removal and disposal of in-situ sound rock, wherever found except for in-situ sound rock which is required to be excavated in the wet.
 - .5 Drilling and Blasting: a recognized production blasting technique involving a regular pattern of blast holes.
 - .6 Controlled Perimeter Drilling and Blasting: any drilling and blasting activity in which controlled perimeter blasting, as defined herein, is performed to protect the final excavation surface. Controlled perimeter blasting includes, but is not limited to, presplitting (also known as preshearing) and line drilling. In all cases, special drilling and blasting methods shall be employed to produce rock faces conforming to the prescribed neat lines and to minimize any overbreak and blasting-induced fractures in the sound rock faces outside of the excavation lines. Controlled perimeter blasting shall be used for the removal of all sound rock where concrete is to be placed against the excavated surface.
 - .7 Excavation Limits: the lines and grades and dimensions shown on Drawings which define the extent of open-cut excavation. Remove all materials within these limits.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600kN-m/m³).
- .3 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 1004-12, Material Specification for Aggregates-Miscellaneous.

- .2 OPSS SP 110F13-04, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.
- .4 US Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.4 SAFETY PRECAUTIONS

- .1 Contractor shall assume full responsibility for the safety of all excavations. In addition to any special provisions resulting from the designs included in these Specifications, the work under this Contract shall comply with the latest versions of all government laws and regulations.
- .2 It is the responsibility of Contractor to adequately advise all persons in the area of any and all blasting activities and ensure the safety of all persons both on and off site. Any damage to existing structures which may result due to Contractor's blasting activities shall be made good by Contractor at his own charge.
- .3 Contractor shall regularly inspect all sloping, vertical and near-vertical faces in the excavations made under this Contract, and shall forthwith remove and dispose of any rock which is loose, unsound or disintegrated or in any way unsafe.
- .4 The removal of snow and ice, when necessary to ensure the safe and effective performance of the work, shall be performed by Contractor.
- .5 A standard blasting warning code shall be used in connection with all blasting.
- .6 Contractor's attention is drawn to the fact that one of the existing intake facilities will continue to operate throughout the construction period.
- .7 Detonators with protective bridging or other acceptable precautions shall be used in all blasting operations done by electric firing. Contractor should make a careful assessment of the possible presence of stray electrical currents associated with the operating generating station and transmission lines, prior to considering the use of electronic detonation.
- .8 Responsibility for the proper care of detonators and explosives shall be assigned to responsible employees of Contractor and these materials shall not be left unguarded unless secured in approved explosives magazines. Local authorities and police shall be advised of Contractor's security arrangements for storing and handling of all explosives.
- .9 When carrying out blasting operations, Contractor shall take all proper precautions for the protection of persons and property and shall be responsible for any mishap or damage resulting from the blasting operations.
- .10 Contractor shall provide experienced, licensed blasting personnel capable of, but not necessarily restricted to, the following: blast design, loading of the blast, inspecting freshly blasted areas, dealing with misfires and directing scaling operations in accordance with these Specifications.

1.5 PREBLAST SURVEY

- .1 Contractor shall conduct a preblast survey to document the preblast condition of structures.

- .2 The preblast survey shall be made by qualified specialists acceptable to and in the presence of Departmental Representative and retained by Contractor to observe the condition of existing structures and facilities in the vicinity of the work. The survey shall include inspections of all structures and facilities located entirely or partially within 200 m of areas to be blasted. The preblast survey shall include diagrams, sketches, photographs, videos of all foundations, walls, partitions, floors and ceilings showing existing cracks, or damage and other data as applicable to locate and define the amount and extent of existing structural deficiencies. The preblast survey shall be signed by those who witnessed and/or took part in the inspections. All existing structural deficiencies, major or minor, shall be shown.
- .3 As construction progresses, Contractor shall re-inspect as often as necessary in the opinion of Departmental Representative to verify the adequacy of its construction methods for prevention of damage. Contractor shall provide resurvey data from the re-inspections promptly to Departmental Representative.

1.6 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to the commencement of excavation, the Contractor shall submit, in writing, his overall plan of proposed methods and sequence of excavation for rock excavation. Details of the plan must meet all the requirements as outlined under these Specifications. The plan shall include the location and depth of blast holes; the type, strength, amount, and distribution of explosives to be used per hole, per delay and per blast; the sequence and pattern of delays, the blast monitoring program and the description and purpose of any special methods to be adopted by the Contractor. Within 15 days of receipt of the plan, the Department Representative reserves the right to reject the proposed plan if, in his opinion, undesirable damage to permanent rock surfaces or existing structures will result from carrying out the blasting as proposed. In such cases, a new plan, in whole or in part, shall be submitted.
- .3 A minimum of 24 hours prior to commencing the preparatory work for each blast, the Contractor shall submit, in writing, a blasting proposal containing details of his intended blasting procedures to the Department Representative for review. Such details shall include:
 - .1 Location of the blast and average depth.
 - .2 Blast layout and sequence.
 - .3 Loading details, including column load and toe load.
 - .4 Average spacing, burden and stemming.
 - .5 Depth of subdrill.
 - .6 Anticipated volume of blast.
 - .7 Total weight of explosive to be used.
 - .8 Maximum load per delay.
 - .9 Powder factor.
 - .10 Details of the blast seismograph location.
- .4 Following each blast, the Contractor shall provide the results of the blast monitoring to the Department Representative.

- .5 The Department Representative reserves the right to reject any blast proposal which does not conform to the requirements of these Specifications.
- .6 In addition to the overall blasting plan, the Contractor shall submit separate blasting plans, as specified herein, for removal of the upstream and downstream plugs, if drilling and blasting or limited blasting is found to be required for excavation of the plugs, and for any other area where blasting could reasonably be expected to affect existing structures.
- .7 If, at any time, a plan which has regularly produced rock surfaces meeting the requirements for controlled perimeter blasting and satisfying the protection from blasting requirements specified herein ceases to produce results meeting these requirements, the Contractor shall submit a revised plan to the Departmental Representative, as specified herein.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine soil report available in project tender documents.
 - .2 Before commencing work establish locations of buried services on and adjacent to site.
- .2 Evaluation and Assessment:
 - .1 Arrange with appropriate authority for relocation of buried services that interfere with execution of work. Pay costs of relocating services.
 - .2 Testing of materials and compaction of backfill and fill will be carried out by testing laboratory designated by Departmental Representative at the cost of the Contractor.
 - .3 Not later than 1 week before backfilling or filling, provide to designated testing agency, 25-kg sample of fill material proposed for use.
 - .4 Not later than 48 hours before backfilling or filling with approved material, notify Departmental Representative so that compaction tests can be carried out by designated testing agency.
 - .5 Before commencing work, conduct, with Departmental Representative, condition survey of existing structures, trees and plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .2 Protection of In-Place Conditions: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .3 Removal: in accordance with Section 31 00 99 - Earthwork for Minor Works.

3.3 EXCAVATION

- .1 Proceed in accordance with Section 31 00 99 - Earthwork for Minor Works and Section 31 14 13 - Soil Stripping and Stockpiling.

3.4 SITE QUALITY CONTROL

- .1 Fill material and spaces to be filled to be inspected and approved by Departmental Representative.

3.5 BLASTING TIME LIMITATION

- .1 Blasting activities should be minimized or avoided during bird and turtle nesting, and denning periods which is March to July.

3.6 PROTECTION OF THE WORK

- .1 Blasting shall be performed in a manner such that the particle velocities induced by the detonations do not damage or disturb Institution's existing structures or facilities, new structures or facilities whether under construction or complete, surrounding site.
- .2 Precedent experience on similar structures indicates that maximum particle velocities should not be allowed to exceed the following.

	Maximum Particle Velocity (mm/s)
Existing mass concrete structures	50.0
New concrete, grout more than 12 hours old	20.0
New concrete, grout less than 12 hours old	2.5
Completed or partly completed fill structures	100.0
Existing transformers/generating equipment	10.0

- .3 Maximum particle velocity means the maximum instantaneous vector sum of three components measured in three mutually perpendicular directions (vertical, transverse and longitudinal).
- .4 Limiting particle velocities shall be reviewed by a blasting specialist and reduced/increased, if necessary, to achieve the intent of these Specifications.
- .5 Blasting mats shall be used as necessary to control fly rock.

3.7 MONITORING OF BLASTING

- .1 Contractor shall monitor blasting operations as required for the protection of the work as set out in Protection of the Work using seismographic equipment to determine the magnitude and intensity of blast-induced vibrations. Contractor shall supply and operate

equipment for measuring particle velocities. The equipment shall be of the three-component type for measuring vertical, transverse and longitudinal wave forms. A record of each seismographic measurement shall be delivered to Departmental Representative promptly following each monitoring operation, accompanied by a detailed diagram of the blast showing the total number of holes, delay sequences, total quantity of explosives and the quantity of explosive in each hole. Blast monitoring shall be performed in all initial blasts to establish data on rock properties with respect to particle velocity at site. Blast monitoring shall be used when blasting in the vicinity of any structure to demonstrate that particle velocities are within the specified limits.

- .2 Prior to the commencement of blasting operations, Contractor shall provide Departmental Representative with a certificate from the manufacturer or approved testing authority verifying the accuracy of the apparatus.
- .3 Copies of all seismographic measurements shall be provided to Departmental Representative in a timely manner. Copies of all blasting documentation and monitoring results shall be included with the record drawings submitted to Departmental Representative.

3.8 CONTROL OF WATER

- .1 In accordance with Section 31 23 19 - Unwatering/Dewatering, surface flows shall be directed away from the works by means of ditches or other means and, in any case, all surface and subsurface flows entering the work area shall be satisfactorily controlled. No water shall be pumped directly into any watercourse.

3.9 SCALING

- .1 Scale down and remove immediately following blasting, and at any time during the Contract, all loose material which appears to be unsafe. The fact that such scaling and removal may enlarge the excavation beyond the neat lines shall not relieve the Contractor from the necessity of performing the work. All material loosened during scaling shall be removed from the work area. Such material shall either be used as fill, transported to stockpile or transported to the disposal area.
- .2 Dental excavation beyond the neat lines shall be performed only where directed by the Departmental Representative. The work shall include cleaning with hand tools and air/water jets. Following dental excavation, the exposed seam or cavity shall be filled and sealed with concrete or fill materials as required by the Departmental Representative. The application of concrete will generally be performed as part of the adjoining main concrete, but may be undertaken separately if directed by the Departmental Representative. Dental and backfill concrete for dental excavation shall be as specified in Section 03 30 00 - Cast-In-Place Concrete.

3.10 CONTROLLED PERIMETER BLASTING

- .1 Controlled perimeter blasting techniques shall be used on all faces with a slope of 1H:1V or steeper and which are greater than 1 m in height.
- .2 Contractor shall develop controlled perimeter drilling and blasting techniques which will result in a minimum of overbreak and a minimum of fracturing of the rock beyond the neat lines, thereby producing sound and reasonably uniform excavated surfaces.

- .3 Contractor shall make its own assessment of the possibility of overbreak and shall incorporate such an allowance in its design.

3.11 EXCAVATION TOLERANCES

- .1 The controlled perimeter drilling and blasting techniques shall be developed by Contractor at the start of excavation and shall then be applied and improved, if required, to maintain the tolerances specified herein throughout the open-cut excavation. Contractor's controlled perimeter drilling and blasting techniques shall be deemed acceptable, and in conformity with these Specifications for controlling the completed rock surfaces if:
 - .1 For open-cut excavations, at least 80% of the drill hole traces of each lift are visible in the final rock surface, distributed uniformly, after the scaling down of all loose and shattered rock that is liable to fall before or during rock reinforcement installation
 - .2 For open-cut excavations, at least 80% of the surface in any single rectangular area of 50 m² is within a 200-mm deep zone outside the neat lines.
- .2 In order to effectively control perimeter blasting as defined herein, Contractor shall be required to drill perimeter holes in such a manner as to meet the following tolerances with respect to length, collar location and alignment.
 - .1 Perimeter holes for open-cut excavations shall not exceed the lift height.
 - .2 Perimeter holes for areas where neat lines are shown on Contractor's drawings shall be aligned to achieve the tolerances specified.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Dispose of cleared and grubbed material off site daily.
- .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.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 “Unwatering” refers to all work necessary to drain out the water from areas behind the cofferdam(s) for the first time.
- .2 “Dewatering” refers to all work necessary for controlling water inflow at all construction areas, complete in every respect and as specified herein. Control of water inflow at all construction areas will be carried out in a manner such that the construction areas are maintained in a dry state.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit a dewatering plan complete with risk and emergency procedures.
- .3 Submit proof to check pumps conformity to specifications and requirements as per Section 2.2.2.

Part 2 Execution

2.1 RESPONSIBILITY

- .1 The Contractor will be responsible for maintaining dry work areas and keeping the cofferdams in good repair. The Contractor will make good, at its own expense, any damage whatsoever caused by flooding of the work area due to failure of equipment, improper maintenance of the cofferdams and protective works, and acts of negligence in its performance of the Work.
- .2 The Contractor is responsible for design and construction of all cofferdams, other than South Channel Upstream Cofferdam.
- .3 The Contractor to provide to the Departmental Representative copies of the methodology for dewatering/unwatering of the Site and control of water.
- .4 Dewatering system will be designed and constructed in accordance with the Environmental Assessment Evaluation requirements and mitigation measures.
- .5 Unwater the area behind the cofferdams and maintain the cofferdam structures throughout the unwatering period. Should the Contractor notice a sudden increase in seepage through a cofferdam, or significant damage or deterioration of a cofferdam, notify the Departmental Representative immediately and take immediate action to correct the condition.
- .6 Keep a certain number of spare pumps and spare parts on site.
- .7 Assign a pump watch keeper for overnight hours.

2.2 PUMPS

- .1 The Contractor to provide pumps, complete with diesel- or electric-powered motors or prime movers, power connections and supply as necessary at all ditches, sumps, flumes, suction lines and discharge lines.
- .2 All pumps provided by the Contractor for the Work to be new or have recently been completely overhauled prior to delivery to the Site. Each pump to meet the rating requirements specified by the manufacturer for that model.

2.3 STANDBY PUMPS

- .1 Make available sufficient standby pumping capacities to supplement installed unwatering capacities at the site. Standby pumps, complete with motors and controls, to be in first-class working condition and be stored in a secure, dry enclosure until required for unwatering work.

2.4 MAINTENANCE

- .1 Maintain the pumps in good operating condition at all times. When it is necessary to remove a pump from the sump for maintenance, a pump or pumps of equal capacity will first be substituted.
- .2 Maintain all pumping systems complete in every respect, and replace any materials or equipment which are damaged or deteriorated before it causes interruption to the dewatering operation.
- .3 The Contractor to maintain all sumps, trenches and discharge lines to ensure proper containment and free flow of water to and from the pumps at all times.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 14 13 - Soil Stripping and Stockpiling.
- .2 Section 32 11 23 - Aggregate Base Courses.

1.2 REFERENCES

- .1 Definitions:
 - .1 Rock Excavation: excavation of:
 - .1 Material from solid masses of igneous, sedimentary or metamorphic rock which, prior to removal, was integral with parent mass. Material that cannot be ripped with reasonable effort with a Caterpillar D9 crawler bulldozer or equivalent to be considered integral with parent mass.
 - .2 Boulder or rock fragments measuring in volume 1 m³ or more.
 - .2 Common Excavation: excavation of materials that are not rock excavation or stripping.
 - .3 Unclassified Excavation: excavation of whatever character other than stripping encountered in the Work.
 - .4 Free Haul: distance that excavated material is hauled without compensation. Free haul distance to be 0.5 km or less.
 - .5 Stripping: excavation of organic material covering original ground.
 - .6 Overhaul: authorized hauling in excess of free haul distance that excavated material is moved.
 - .7 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.
 - .8 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
 - .9 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.
 - .10 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Reference Standards:
 - .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft³) (600 kN-m/m³).
 - .2 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO T99-10, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and 305 mm (12 in.) Drop.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

Part 2 Products

2.1 MATERIALS

- .1 Embankment materials require approval by Departmental Representative.
- .2 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.
- .3 Borrow Material:
 - .1 Obtain from sources such as quarry, or borrow pit as approved or as designated by Departmental Representative.
 - .1 Earth embankment materials to consist of acceptable earth material and processed rock material.
 - .2 Rock embankment material to consist of fragmented rock produced by drilling and blasting operations, and boulders which cannot be placed in layers as specified for earth embankments.
 - .1 Rock embankment to conform to gradation as follows:

Sieve Designation	Percent Passing by Weight
150 mm	100
100 mm	85 - 100
75 mm	10 - 50
No. 200	* 0 - 3
 - .2 * Gradation is determined by that portion passing 75-mm screen.
- .4 Road Topping Material:
 - .1 Material for road topping to conform to Granular Base material in accordance with Section 32 11 23 - Aggregate Base Courses.

Part 3 Execution

3.1 EXAMINATION

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

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 COMPACTION EQUIPMENT

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

3.3 WATER DISTRIBUTORS

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

3.4 STRIPPING

- .1 Proceed in accordance with Section 31 14 13 - Soil Stripping and Stockpiling.
- .2 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.5 EXCAVATING

- .1 General:
 - .1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.
 - .2 Subexcavate 300 mm below subgrade in cut sections unless otherwise directed by Departmental Representative.
 - .1 Compact top 150 mm below subexcavate to minimum 95% maximum dry density, to ASTM D698.
 - .2 Replace with approved embankment material and compact to specified embankment density.
 - .3 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as directed by Departmental Representative.
 - .4 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points in accordance with standard plans for "Cut and Fill Construction Methods at Grade Points" as indicated by Departmental Representative.
- .2 Drainage:
 - .1 Maintain profiles, crowns and cross slopes to provide good surface drainage.
 - .2 Provide ditches as work progresses to provide drainage.

- .3 Construct interceptor ditches as indicated or as directed before excavating or placing embankment in adjacent area.
- .3 Rock Excavation:
 - .1 Notify Departmental Representative, when material appearing to conform to classification for rock is encountered, to enable measurements to be made to determine volume of rock. Provide 12-hour notification.
 - .2 Submit blasting program to Departmental Representative, for approval 48 hours minimum before start of Work.
 - .1 Do not proceed without written approval of blasting program from Departmental Representative.
 - .3 Shatter rock to 150 mm below subgrade elevation as indicated.
 - .4 Reduce overbreak and increase stability of rock faces by using smooth blasting techniques.
 - .5 Use smooth blast and excavate short sections in rock cuts to determine optimum spacing of holes when requested by Departmental Representative.
 - .6 Stem holes as necessary to contain blast.
 - .7 Do not use prilled type ammonium nitrate and fuel oil (ANFO) explosives within 4 m of final cut line.
 - .8 Form back wall by presplitting at least 10 m in advance of production blasting.
 - .1 Smooth wall blast just prior to or just after production blast as determined by approved blast program.
 - .9 Scale rock backslopes to achieve smooth, stable face, free of loose rock and overhangs to design backslope.
 - .10 Control blasting to minimize flying particles.
- .4 Borrow Excavation:
 - .1 Completely use in embankments suitable materials removed from right-of-way excavations before taking material from borrow areas.
 - .2 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.
 - .1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.
 - .2 Remove waste and stripping material from borrow pits to designated locations.
 - .3 Slope edges of borrow areas to minimum 2:1 and provide drainage as directed.
 - .4 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.6 EMBANKMENTS

- .1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.
 - .1 Method used to be preapproved in writing by Departmental Representative.
- .2 Break up or scarify existing road surface prior to placing embankment material.

- .3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized by Departmental Representative.
- .4 Maintain crowned surface during construction to ensure ready runoff of surface water.
- .5 Drain low areas before placing materials.
 - .1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments larger than 100 mm.
- .6 Where material consists of rock:
 - .1 Place to full width in layers of sufficient depth to contain maximum-sized rocks, but in no case is layer thickness to exceed 1 m.
 - .2 Distribute rock material to fill voids with smaller fragments to form compact mass.
 - .3 Fill surface voids at subgrade level with rock spalls or selected material to form earth-tight surface.
 - .4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of pavement subgrade elevation.
- .7 Deductions from excavation will be made for overbuild of embankments.
- .8 Road topping in accordance with Section 32 11 23 - Aggregate Base Courses.

3.7 COMPACTION

- .1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.
- .2 Deposit, spread, and level embankment material in layers of 200 mm maximum thickness before compaction.
 - .1 Compact each layer of embankment until compaction equipment achieves no further significant consolidation.
 - .2 Ensure required compaction for each layer before placing any material for next layer.
- .3 Use specialized compaction equipment supplemented by routing, hauling, and levelling equipment over each layer of fill.
- .4 Obtain written approval from Departmental Representative before using specialized compaction equipment such as tamping rollers, vibratory rollers, or other alternate compaction equipment that produces the required results.
 - .1 For tamping rollers, use equipment that exerts 1000 kPa minimum of pressure on tamping surface of each tamping foot in transverse row.
- .5 Compact each layer to minimum 98% maximum dry density: ASTM D698 except top 150 mm of subgrade.
 - .1 Compact top 150 mm to 100% maximum dry density.
- .6 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.

3.8 FINISHING

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

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

3.10 PROTECTION

- .1 Maintain finished surfaces in condition conforming to this section until approval by Departmental Representative.
- .2 Provide silt fences and erosion protection as required to mitigate and prevent impacts to adjacent properties. The silt fencing must be biodegradable and should be designed to minimize animal entrapment.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 This specification covers flotation silt curtain used for containing suspended sediment in an area of open water.

1.2 SUBMITTALS

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

Part 2 Products

2.1 PROTECTIVE BALES AND STAKES

- .1 Protective bales shall be hay or straw, contain approximately 0.14 m³ of material, weigh not less than 16 kg and be twine tied. Stakes for bales shall be wood with a minimum 50-mm x 50-mm section or steel rebar.

2.2 SILT FENCE FABRIC

- .1 The silt fence fabric shall be a woven geotextile.
- .2 Geotextile shall be uniform in texture and appearance and shall have no defects, flaws, or tears that would affect its physical properties. It shall contain sufficient ultraviolet (UV) ray inhibitors and stabilizers to provide a minimum 2-yr service life from outdoor exposure.
- .3 All erosion and sediment control materials supplied by the Contractor shall be of such condition and quality as to provide reliable performance. If any erosion and sediment control materials fail due to poor quality, they shall be replaced by the Contractor at no additional cost.

2.3 SILT FENCE POSTS

- .1 The silt fence posts shall be wood with a minimum 50-mm x 100-mm section, or steel with a standard T or U section weighing a minimum of 1.5 kg per linear metre.

2.4 FLOATING SILT CURTAINS

- .1 Floating silt curtain comprises of impermeable vinyl-coated nylon and is strong enough to resist tearing against water in all conditions at the Big Chaudière Dam site.

Part 3 Execution

3.1 PROTECTIVE BALES

- .1 Protective bales shall be installed as detailed and located on the Drawings and as necessary to protect from erosion.

3.2 SILT FENCE

- .1 Silt fences shall be installed as detailed and located on the Drawings and as necessary to protect from erosion.

3.3 FLOATING CURTAIN INSTALLATION

- .1 Floation silt curtain shall be constructed of fabric fastened to a flotation carrier and weighted along the bottom edge. Depth of curtain shall be as indicated in the Plans. Depth of curtain shall refer to the dimension of the curtain fabric extending below the flotation, i.e., hanging in the water. Upon completion of the work, the curtain shall be removed in a manner that will prevent resuspension of sediment into the water.

3.4 QUALITY CONTROL OF INSTALLATION

- .1 It is the responsibility of the Contractor to monitor the quality of the workmanship. If any erosion and sediment control devices fail due to improper installation, they shall be replaced by the Contractor at no additional cost.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D4632-08, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .2 ASTM D4833-07, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - .3 ASTM D3786-09, Standard Test Method for Bursting Strength of Textile Fabrics.
 - .4 ASTM D4533-11, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - .5 ASTM D4355-07, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 - .6 ASTM D4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - .7 ASTM D4491-99a(2009), Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .8 ASTM D4873-02(2009), Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents (ASTM D4873).

1.3 QUALITY CONTROL AND TESTING

- .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

Part 2 Products

2.1 MATERIALS

- .1 Geotextile to consist of a nonwoven synthetic fibre fabric, supplied in rolls with a minimum width of 4.5 m and a minimum length of 90 m.
- .2 Geotextile composed of: minimum 85% by mass of polyolefins, polyesters, or polyamides, with inhibitors added to the base polymer to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure.
- .3 Geotextile to be a 100% continuous filament, resistant to freeze-thaw and soil chemicals. The geotextile shall equal or exceed the following minimum average roll values.

- .1 Physical Properties:
 - .1 Grab tensile strength and elongation (in any principal direction): to ASTM D4632.
 - .1 Grab tensile strength: 800 N.
 - .2 Grab elongation: 50%.
 - .2 Mullen burst to ASTM D3786: 2400 kPa.
 - .3 Puncture strength to ASTM D4833: 485 N.
 - .4 Trapezoidal tear to ASTM D4533: 355 N.
 - .5 Ultraviolet resistance to ASTM D4355: 70% at 500 hours.
- .2 Hydraulic Properties:
 - .1 Apparent opening size (AOS) to ASTM D4751: 150 μm .
 - .2 Permittivity to ASTM D4491: 1.4 sec^{-1} .
 - .3 Flow rate to ASTM D4491: 54 L/s/m².

Part 3 Execution

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated on the Drawings or as directed by the Departmental Representative. Remove all snow and ice prior to placing material.
- .2 Geotextile will be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacturing, transportation, storage, handling or installation. Replace damaged geotextile to the approval of the Departmental Representative.
- .3 Prepare the surface on which the geotextile is placed to a smooth surface and remove obstruction, debris, depressions, erosion features, or vegetation. Remove any irregularities to ensure continuous contact of the geotextile with the entire surface.
- .4 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .5 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .6 Overlap each successive strip of geotextile 500 mm over previously laid strip.
- .7 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of fill material layers.
- .8 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D792-08, Standard Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
 - .2 ASTM D1004-09, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
 - .3 ASTM D1204-08, Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - .4 ASTM D1505-10, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - .5 ASTM D1603-06, Test Method for Carbon Black in Olefin Plastics.
 - .6 ASTM D4833-07, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
 - .7 ASTM D5199-12, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
 - .8 ASTM D5397-07, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
 - .9 ASTM D5641-94, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
 - .10 ASTM D5596-03, Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
 - .11 ASTM D6392-08, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
 - .12 ASTM D6693-04(2010), Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 22 00 - Submittal Procedures.
- .2 Submit shop drawings to the Departmental Representative indicating installation details, including fabricated and field seams, anchor trenches and protrusion details.
- .3 Submit to the Departmental Representative copies of manufacturer's mill test data at least 2 weeks prior to start of work.
- .4 Submit to the Departmental Representative certificates, including test results, at least 2 weeks prior to delivery to job site.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 During delivery and storage, protect geomembrane liners from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.4 QUALITY CONTROL TESTING

- .1 Vacuum box joint inspection on installation per ASTM D5641 (6.9 to 13.8 kN/m² maximum).
- .2 Any discontinuities detected by any test method to be repaired utilizing the same material as the geomembrane and extend a minimum of 100 mm beyond the defect.

Part 2 Products

2.1 MATERIALS

- .1 This section covers the required physical, chemical, and mechanical properties of geomembranes used for primary containment applications, e.g., earth dams.
- .2 Liner to be capable of being sealed to itself using standard heat sealing techniques.
- .3 Nominal Thickness (ASTM D5199): 1.5 mm.
- .4 Density (ASTM D792): 0.94.
- .5 Tensile Strength/Strain Properties (ASTM D6693):
 - .1 Strength at yield: 22 kN/m.
 - .2 Strength at break: 40 kN/m.
 - .3 Strain at yield: 12%.
 - .4 Strain at break: 700%.
- .6 Tear Resistance (ASTM D1004): 187 N.
- .7 Dimensional Stability (ASTM D1204): $\pm 2\%$.
- .8 Stress Cracking (ASTM D5397): 300 hours.
- .9 Puncture Resistance (ASTM D4833): 480 N.
- .10 Black Content (ASTM D1603): 2.0% to 3.0%.
- .11 Black Dispersion (ASTM D5596): CAT 1 or 2.
- .12 Field Seam Strength (ASTM D6392):
 - .1 Bonded seam strength: 21 kN/m.
 - .2 Peel adhesion test: 14 kN/m.
- .13 The surface should be smooth with no striations, gels, pinholes or bubbles.

Part 3 Execution

3.1 INSTALLATION

- .1 Store the rolls in a way that prevents sliding or rolling from stacks.
- .2 Minimize the extent to which membranes are dragged on the ground.
- .3 Place the panels parallel to the direction of the slope.
- .4 Maintain area of installation free of water, ice and snow accumulations.

- .5 Repair excessively soft-supporting material as directed by the Departmental Representative.
- .6 Do not proceed with panel placement and seaming when ambient temperatures are below 5°C or above 40°C, during any precipitation, in presence of excessive moisture (e.g., fog, dew), nor in presence of high winds.
- .7 Place and seam panels in accordance with manufacturer's recommendations on graded surface in orientation and locations indicated. Minimize wrinkles, avoid scratches and crimps to geomembranes and avoid damage to supporting material.
- .8 Protect installed membrane from displacement, damage or deterioration before, during, and after placement of material layers.
- .9 Replace damaged, torn or permanently twisted panels to the approval of the Departmental Representative. Remove rejected damaged panels from site.
- .10 Keep field seaming to a minimum. Locate field seams up and down dyke wall, with no horizontal field seam less than 1.5 m beyond toe of the dyke.
- .11 Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.
- .12 Test field seams as seaming work progresses by vacuum box testing over their full length. Repair seams which do not pass test. Reconstruct seam between failed location and any passed test location, until vacuum box testing is successful.
- .13 Repair minor tears and pinholes by patching until vacuum testing is successful. Patches to be round or oval in shape, made of the same geomembrane material, and extend to a minimum of 100 mm beyond the edge of the defect. Repaired areas to be recorded and submitted to the Departmental Representative.
- .14 Do not permit passage of any vehicle directly on the membrane at any time. Vehicular traffic will be permitted on the liner only after the full granular base materials are provided.

END OF SECTION

Part 1 General

1.1 UNIT PRICES

- .1 The work for this section will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.
 - .1 Drilling of holes including washing
 - .2 Water-pressure testing from the time injection of water begins until injection is terminated
 - .3 Supply and setting of packer assemblies and making connections for water-pressure testing
 - .4 Grout injection including supply, mixing and injecting of cement grout mixes complete – per number of 50-kg normal Portland cement bags
 - .5 Dry sand incorporated in cement grout mixes.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA A3000-2008, Cementitious Materials Compendium.
 - .2 CSA A23.1/A23.2-2009, Concrete Materials and Methods of Concrete Construction.
 - .3 CSA A82.56M-1976, Aggregate for Masonry Grout.

1.3 DEFINITIONS

- .1 “Grout holes” consist of holes drilled into the rock from the bedrock surface or through concrete, and subsequently injected with grout.
- .2 “Curtain grouting” consists of drilling and grouting one or more lines of holes to a specified depth in rock to produce an impervious barrier against seepage.
- .3 “Contact grouting” is the process of injecting grout at the contact or interface of concrete structures and rock surfaces for the purpose of preventing leakage along the contact.
- .4 “Stop grouting” consists of the drilling of a hole to its full length in one continuous operation and subsequently washing and grouting the hole in sections from the bottom upward by means of setting packers at intervals at progressively lower depths.
- .5 “Spilt spacing” will mean the procedure of progressively closing a grout curtain by drilling and grouting additional grout holes midway between holes that have been previously drilled and grouted.
- .6 “Washing” is the process of cleaning drill cuttings and other debris or sludge from a drill hole by injecting water or water mixed with air at the bottom of the hole and returning the flush water with suspended matter to the surface or top of holes.
- .7 “Foundation grouting” is synonymous with “curtain grouting”.
- .8 “Grouting pressure” will mean the pressure of grout as measured at the collar of the hole while grout is being injected.

- .9 “Effective pressure” will mean the grout pressure while being pumped at the point of absorption in the hole as calculated from the grouting pressure at the collar plus the head of grout in the hole.
- .10 “Stage” consists of a section of hole, isolated by packers, in which grouting is performed.
- .11 “Successful connection” consists of all operations necessary to achieve grout-tight seating of the packer assembly that can sustain the required pressures for grouting without leakage or loss of pressure during grouting to refusal.
- .12 “Grout take” is the quantity of grout injected into the hole measured as the number of bags of cement.
- .13 “Water-cement ratio” is the ratio of the mass of water to cement or cement plus pozzolan in grout mixes.
- .14 “Refusal” will be defined as insignificant grout adsorption within a stage at the pressures being utilized to grout the rock mass.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review by Departmental Representative a complete list of the drilling and grouting equipment planned to be used for the work.
- .3 Submit manufacturers’ literature on the proposed retarding and expanding additives, if any.

1.5 TECHNICAL DIRECTION

- .1 The work to be done under this Section consists of the supply of all Labour, Material and Construction Plant and the performance of all work necessary for
 - .1 Drilling and washing grout holes up to 14 m in length
 - .2 Water pressure testing of grout holes
 - .3 Supply, assembly and setting of packer assemblies
 - .4 Supply, mixing and injecting cement grout mixes
 - .5 Drilling and washing of test holes for the purpose of verifying the effect of grouting on the rock mass permeability
 - .6 Conducting water pressure tests in grout and test holes
- .2 Drilling and pressure grouting will be performed under the technical direction and supervision of the Departmental Representative. This may include, but not be limited to, detailed design and establishment of procedures to be adopted; determination of grout hole locations; orientation and sequence of drilling and washing holes; materials, additives, properties, pressures and pumping rates to be used for grouting; mixture modifications to be made in all aspects of grouting procedures. Such adjustments and modifications required by Departmental Representative will be executed by Contractor without cause for delay in the construction program.
- .3 The number, spacing and orientation of grout holes are approximate. Departmental Representative reserves the right to increase or decrease any part of the drilling and grouting program as required to suit actual rock conditions encountered during grouting.

- .4 Grout mixes, pressures, pumping rates, and the locations and sequence in which holes are drilled, washed, tested and grouted will be as specified herein and as modified by Departmental Representative to suit actual rock conditions and grout takes encountered in the field during construction.
- .5 Foundation grouting will be performed in the bedrock foundation of the concrete structures as shown on the drawings and as directed by the Departmental Representative.
- .6 Contractor to keep sufficient records to document the work done in any period for measurement purposes and will be signed each day by representative of the Contractor and Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 Acceptable Equipment and Materials:
 - .1 Equipment items or material, which in the opinion of Departmental Representative, do not meet such requirements, must be replaced forthwith by Contractor with satisfactory equipment or materials.
 - .2 Perform quality assurance/quality control tests, as required by the Departmental Representative, on grout mixes proposed for use in the Work to establish the consistencies of mixes, practical mixing ratios, initial and final setting times and such other properties as may affect the quality of the grout.
 - .3 Provide rods, hoses, valves, joints and couplings that can withstand pressures 50% greater than those specified in the grouting plan.
- .2 Acceptable Procedures:
 - .1 Carry out drilling and grouting operations in accordance with procedures given on Drawings and as specified herein.
 - .2 Supply sufficient labour, equipment and spare parts to carry out each phase of the Work properly, expeditiously and without interruption until refusal is achieved in any grouting operation.
 - .3 Employ competent and experienced drilling and grouting supervisors who will execute field direction and supervision of the Work.

1.7 STORAGE AND HANDLING

- .1 Storage:
 - .1 Store each shipment of cement so that it may be readily distinguished from other shipments. To prevent undue ageing of cement, use the cement in the chronological order in which it is delivered to the Site. If stored outside, protect it from weather and do not allow to freeze.
- .2 Handling:
 - .1 Supply, handle, maintain, operate, dismantle and protect from the weather all equipment, materials and facilities for the performance of the Work covered by this Section, other than those specifically excepted herein.

Part 2 Products

2.1 MATERIALS

.1 Cement:

- .1 Cements used in the grout mixes will conform to the requirements of CSA A5 and will comprise normal Portland cement Type 10.

.2 Sand:

- .1 The sand used in the grout mixes will conform to the requirements of CSA A82.56. Only use sand in grout mix if there is excessive grout absorption.
- .2 Whenever sand is added to the grout, it will conform to the following gradation limits:

US Standard Sieve Size	Percent Passing by Weight
No. 8 (2.36 mm)	100
No. 16 (1.18 mm)	95 – 100
No. 30 (600 microns)	60 – 85
No. 50 (300 microns)	30 – 50
No. 100 (150 microns)	10 – 30
No. 200 (75 microns)	0 – 5

.3 Admixtures:

- .1 Use appropriate retarding and expanding admixtures for cement grout as specified and modify them as required by Departmental Representative.
- .2 Bentonite, if incorporated in the grout mix, will be of a type that disperses easily in water and will be of a quality approved by the Departmental Representative.
- .3 Bentonite, where employed, will satisfy a dry 200 mesh particle size.

.4 Water:

- .1 The water used for all drilling and washing and as an ingredient of grout mixtures will be fresh water, clean and free from deleterious amounts of silt, organic matter, alkali, acids, salts or other impurities in conformance with CSA A23.1.
- .2 Use water having a temperature less than 25°C and greater than 5°C.

2.2 GROUT MIXES

- .1 Use approved proportions of materials in grout mixture and any adjustments thereto during grouting operations. Vary proportions to suite actual conditions encountered at Site. Use grout consisting of a mixture of neat cement, 1% by weight of retarding and expanding admixtures, and water, unless otherwise specified. Dispose of grout that has started to set before it has been injected.

2.3 EQUIPMENT

.1 Drilling Equipment for Grout Holes:

- .1 All drilling and grouting equipment will be of a type and capacity and in satisfactory mechanical condition to suitably perform the Work in an efficient and workmanlike manner.

- .2 Supply all valves, flowmeters, pressure gauges, pipes, pressure hose, gauge savers, grout nipples, packers, fittings and all tools necessary to provide a continuous supply of grout and an accurate pressure volume control.
 - .3 Provide standard percussion or rotary drills for drilling of grout holes.
 - .4 If rotary drills are selected for this work, "rod dope", grease or other lubricants on drill rods or in grout or drainage holes will not be permitted. Flush holes until the return water is clear and free of significant debris.
 - .5 Drills will be capable of drilling grout holes having minimum 51-mm diameter as produced by standard commercial drill bits.
 - .6 All drilling will be done wet with sufficient water flow to remove all drill cuttings. Contractor will provide all water required for drilling, water-pressure testing and grouting operations.
- .2 Grouting Equipment:
- .1 Sufficient grouting equipment will be available at the site at all times throughout the course of the Work to meet the construction schedule. Each grouting Plant will be capable of supplying, mixing, agitating and pumping grout to the satisfaction of the Departmental Representative.
 - .2 The type, capacity and mechanical condition of all grouting equipment will be suitable for the Work specified and shown on the Drawings.
 - .3 Provide the following grouting equipment:
 - .1 Pumping equipment capable of operating up to the maximum pressures shown on Drawings.
 - .2 A mechanically operated mixer capable of mixing at least 120 L/min of grout mixture with facilities for accurate measurement of grout materials so that mix proportions can be carefully controlled.
 - .3 Two mechanically agitated sumps or holding tanks each having a minimum capacity of 150 litres to keep grout in suspension and equipped with screens to remove hardened grout not passing a No. 4 US standard screen (4.75 mm) and graduated in 10-L units so that the volume of grout injected into a hole can be measured accurately.
 - .4 Valves, water meters, pressure gauges, including protection gauges, pressure hoses, pipes, grout nipples, packers, fittings, and tools as may be necessary to provide a continuous supply of grout and accurate pressure control. Also, a high-precision gauge will be supplied for checking the accuracy of all gauges used in the grouting system.
 - .5 A double-lined circulating pumping system, one line for grout from tank to header at collar for hole, other line for return of grout from header to sump, inside diameter of minimum 25 mm of all lines, distance of pump less than 45 m from the hole being grouted.
 - .6 Grouting header supply connection with a valve to hole and a return connection with a valve, one 15-cm Bourdon type pressure gauge for appropriate pressure range located at the grout pump and another located at the manifold connection to hole to indicate pressure of supply of grout at the header and back pressure of grout in the hole.
 - .7 Suitable packer types including single-packer type and double-packer assemblies with expandable tubes capable of sealing the hole at any

setting and to withstand, without leakage, pressures up to and including those specified herein.

- .3 Pressure Testing Equipment:
 - .1 The washing and water-pressure testing plant will include pumps, piping, pressure gauges, valves, fittings, packers and all other accessories required to perform water-pressure tests.
 - .2 The pumps furnished will have an output of not less than 0.28 m³/min at 1050 kPa translates to 150-psi gauge pressure and will be capable of maintaining constant pressure.
 - .3 Contractor will supply water storage tanks sufficient for the pumps in addition to two sets of flowmeters and Bourdon gauges for calibration and checking purposes.
 - .4 Provide single-packer type and double-packer type water-pressure test assemblies separated by perforated pipe. There will be sufficient perforations in the pipe to provide negligible obstruction to water flow. The diameter of pipes used for separating the packers and for placing packers in holes will be the maximum possible for the hole size.
 - .5 Packers will be of the multiple leather cup, mechanically expanded rubber ring, or pneumatically expanded rubber sleeve types and will be capable, water storage facilities, flowmeters, pressure gauges including protective gauges, valves, hoses, fittings and pumps capable of operating at maximum specified pressures and maintaining constant pressure. Use the type of packer best suited to rock conditions.

Part 3 Execution

3.1 GENERAL

- .1 Arrange grouting equipment so that the grout supply line connects the pump to the hole and returns to the mixer in one continuous circuit controlled for pressure with a pressure gauge placed at the outlet of the pump and one placed slightly downstream of the collar and upstream of the bypass valve to facilitate pressure control at the collar. Use the return line for flushing of hoses and for emergency pressure relief. The return line may discharge into the mixer or to waste. Provide an adequate supply of grout mixture to assure continuity of grouting operations. Select a mixer that operates at a speed sufficient to maintain grout in suspension.
- .2 Do not perform grouting when the temperature of the rock, cement, water, concrete, steel or grout slurry is less than 5°C or greater than 25°C without written approval of Departmental Representative.

3.2 DRILLING GROUT HOLES

- .1 Drill 50.8-mm diameter minimum grout holes into rock in accordance with Drawings showing the locations, depths, spacing, alignment and sequence of drilling holes and as directed by Departmental Representative.

- .2 If percussion drills are used, thoroughly wash all grout holes with clean water to ensure holes are clean and free from obstructions to the satisfaction of Departmental Representative.
- .3 The drill collar orientation will be established to within 1 degree of the orientation specified. The orientation of every hole will be measured by acceptable methods to ensure correct orientation.
- .4 Protect grout holes from clogging or obstruction by means of a temporary cap or other suitable means at the collar. Any hole that becomes clogged or otherwise obstructed before completion of grouting will be cleaned out in a manner acceptable to the Departmental Representative or another hole will be provided by Contractor at no additional cost.
- .5 Grout holes will not be drilled within 12 m of another hole which is being grouted or which has been grouted within the previous 24 hours.

3.3 WASHING AND WATER-PRESSURE TESTING

- .1 On completion of drilling, all drill holes will be thoroughly washed to remove any accumulated fines, sludge or foreign materials. In addition, grout holes will be thoroughly washed under pressure immediately before pressure testing or pressure grouting is started. Water used for washing the grout holes will be between 7°C and 20°C.
- .2 Holes will be washed out for a minimum of 5 minutes or until the return water is clear by injecting water or water and air through a wash pipe inserted at the bottom of the holes. Protect cleaned holes from plugging until the holes are completely grouted.
- .3 Carry out water-pressure tests at the intervals and applied pressures required by Departmental Representative.
- .4 Conduct water-pressure tests in sections. Isolate each section for pressure testing by means of two packers, spaced a maximum distance of 3 m apart. Apply water pressure in three increments up to a maximum specified grouting pressure continuously and in turn to each isolated section for a minimum period of 2 minutes per increment. Measure any water loss to an accuracy of 1 litre.
- .5 For each water-pressure test section, back pressure will be measured at the collar of the hole with the hole full of water.
- .6 Water-pressure tests will not be carried out until grout injection has been completed and the grout has been allowed to set for a minimum of 48 hours.

3.4 GROUTING PROCEDURES

- .1 Equipment Arrangement and Operation:
 - .1 Arrange grouting equipment so as to provide a continuous circulation of grout throughout the system and to permit accurate pressure control by operation of valves on grout pumps, on grout connections at the holes, and on grout return lines. It may be necessary to use a single-line system directly into a grout hole. Locate grout pump as close as practicable to hole being grouted using minimum length of line.

- .2 Prevent fouling of equipment and lines by maintaining a continuous flow of grout and by periodic flushing with water. Operate pressure gauges and valves for bypass and shutoff by experienced operators.
- .2 Mixing and Handling:
 - .1 Proportion mix in accordance with ratios specified in this Section. Mix for a minimum of 3 minutes prior to injection. Agitate grout mix held in a holding tank to prevent settlement between time of mixing and injection. Dispose of grout not injected within 2 hours of mixing.
 - .2 Provide sufficient supplies of sand and cement at the work location before commencing grouting to ensure that the grouting operation can be completed without shutdown.
 - .3 All grout that cannot be injected within 2 hours of mixing will be wasted at no additional cost unless its use is authorized for backfilling grouted holes or for slush grout.
 - .4 Grout will be mixed in batches of suitable volume and in such a way as to enable water-cement ratio and the composition of suspension grouts to be changed to ensure continuous flow and minimum wastage.
- .3 Contact Grouting – Concrete/Rock Interface:
 - .1 For contact grouting of the concrete/rock interface, no grouting will be done until the concrete has reached a minimum age of 7 days.
 - .2 Carry out contact grouting operation to fill the gap between the concrete and rock resulting from shrinkage of concrete to fill cracks opened up by blasting and to provide a measure of precompression of the concrete surround.
 - .3 Carry out grouting through a packer located in the concrete or through embedded piping provided for that purpose.
 - .4 The initial grout mix proportion may be modified during the course of the work depending on the rate of consumption of the grout and subject to approval of Contractor and Departmental Representative.
 - .5 Carry out grouting operations sequentially to ensure the complete filling of the gap between concrete and rock and to allow entrapped air to connect each hole to the grout supply or plug as indicated by the appearance of grout flows from adjacent holes. Depending on the rate of consumption observed, conditions may require the grouting of several holes to be carried out simultaneously.
 - .6 Grouting pressure will be as approved by Departmental Representative but in general will be 35 kPa.
 - .7 Continue grouting operations until grout take is negligible over a 10-minute period.
- .4 Foundation Grouting:
 - .1 The majority of the grouting will be done by the stop grouting method according to the split-spacing principle.
 - .2 The exposed bedrock foundation appears to indicate vertical, or near-vertical jointing. Grout holes will generally be drilled on an incline angle to 30° off vertical or more.

- .3 Curtain grouting will generally be carried out in a single line. However, in areas of high grout take, additional lines may be required.
- .4 For contact and curtain grouting, grout mixes, pressures and procedures to be used in the Work will be varied by the Departmental Representative according to conditions encountered in the field.
- .5 Thoroughly wash all grout holes prior to grout injection.
- .6 Grout the holes from bottom up and in stages as shown in Table 1 and on drawings, using the gauge grouting pressures indicated.
- .7 Table 1 - Grouting Stages and Grout Pressures:

Depth of Grouting Hole (m)	No. of Stages for Grouting	Length of Each Grout Stage (m)	Approx. Grouting Pressure (kPa)			
			Stage 1 (bottom stage)	Stage 2	Stage 3	Stage 4 (shallowest stage)
3	1	3	70			
6	2	3	140	70		
9	3	3	210	140	70	
up to 12	4	3	280	210	140	70

- .8 In general, injection will start using a thin mix with an initial water-to-cement ratio in the order of 3:1. The starting grout mix will be injected at the required pressure for a 10-minute period with the grout pump operating as nearly as possible to constant speed. If the rate of adsorption is observed to drop steadily, the starting mix will be continued until refusal is reached. If the adsorption of grout is high during the initial period, then the water-cement ratio will be gradually decreased and successively thicker mixes will be used until the grout consumption stabilizes or begins to decrease.
- .9 If the absorption of the 3:1 grout mix is high, gradually decrease the water-cement ratio to 2:1 and 1:1. All 2:1 and thicker mixes will have no plasticizer but will have bentonite added equal to 3% by weight of cement. Inject each of the successive thicker mixes for 10 minutes, continue with the same mix if absorption is decreasing but thicken the mix if the absorption is not decreasing.
- .10 If mixes thicker than 3:1 were used, gradually make the grout thinner such that the finishing mix is again 3:1.
- .11 In areas of high grout absorption, it may be necessary to add sand in the mix. The proportion of sand permitted will not exceed 2 parts sand to 1 part cement. All sanded mixes and grout mixes with a water-cement ratio less than 2:1 will include a fluidizer to facilitate pumping.
- .12 If the grout absorption rate drops suddenly, the mix will be immediately thinned or water may be introduced into the grout system to prevent the hole from becoming plugged.
- .13 When the absorption of thicker mixes begins to decrease or causes the pressure to rise above the desired value, the water-cement ratio will be increased until the refusal criteria are achieved.
- .14 Refusal criteria for grouting will be provided by the Departmental Representative. In general, the grouting of any hole in which a water-cement ratio of less than 3:1 is being used will be continued until the hole refuses to take

grout at the minimum effective pressure required for that stage of the hole. The grouting of any hole in which the water-cement ratio of 3:1 or higher is being used will not be considered complete until the hole takes grout at the rate of less than 3 litres of grout per metre of hole in 20 minutes if effective pressures of 350 kPa or less are being used; in 15 minutes if effective pressures of 350 to 700 kPa are being used.

- .15 If the grout consumption of a hole being grouted is such that it is not possible to reach the required pressure after pumping a reasonable volume of grout at the minimum workable water-cement ratio, then the speed of pumping will be reduced or the pumping stopped temporarily and intermittent grouting performed allowing sufficient time between injections for any injected grout to stiffen. If this procedure is not successful, grouting will be discontinued, the solids allowed to set, and additional drilling and grouting will be done in the hole or in adjacent holes until the desired resistance is built up.
- .16 During the grouting of a hole, adjacent ungrouted holes will be left uncapped to facilitate escape of air and water. If sufficient grout flows from these holes to interfere with grouting, these holes should be temporarily capped and grout pressures reduced accordingly. Surface leaks will be sealed by suitable means to prevent an excessive seepage of grout. Should sealing not be feasible, an accelerator may be added to the thick mix and grouting will be terminated when the treated mix is flowing to the surface.
- .17 If a back pressure exists after grouting of a hole is complete, the hole will be capped until the pressure falls to a negligible amount.
- .18 Grouting and water-pressure testing pressures will be as directed by Departmental Representative. In general, in essentially vertical holes in fully confined rock, pressures will correspond to 75 kPa plus 25-kPa/m distance to the nearest rock or concrete face. Where grouting is performed near bedrock cliffs or within 2 m of the underground surface, pressures will, in general, be limited to low values as required by Departmental Representative, consistent with the rock conditions and may be in the order of 10-kPa/m distance to the nearest rock face.
- .19 During grouting operations in freezing weather, sufficient steam capacity will be available for grouting and the operation of the grout plant. The use of salt or other thawing additives will not be permitted.
- .20 For grouting the last section of any hole through concrete, place the packer a minimum distance of 1500 mm from the rock/concrete interface, or as specified by Departmental Representative.
- .21 Carry out grouting hole by hole (concrete grouting) and continue until the refusal criteria defined by previous items is achieved.
- .22 Drill secondary grout holes midway between the primary holes where the cement absorption in the primary holes exceeds 12 kg/300 mm (25 lbs of cement per ft) of grout hole. Tertiary and quaternary holes will also be required if the cement absorption in the secondary and tertiary holes exceeds 12 kg per 300 mm (25 lbs of cement per ft) of hole.

.5 Grouting Leaks:

- .1 If during grouting, grout flows from points in permanent structures, rock fissures, or from other grout holes, Departmental Representative may specify that such flows be plugged. Alternatively, leave ungrouted holes open during grouting of

other holes. Before grout has set in any hole, connect grout pump to adjacent capped holes and to other holes from which grout flow was observed, and complete grouting of all such holes at pressures specified for grouting.

- .6 Completion of Holes:
 - .1 Carry out grouting as a continuous, nonstop operation until refusal is obtained, unless directed otherwise by Departmental Representative.
 - .2 After grouting, each hole will be backfilled by injection of a heavily sanded grout (grout having a typical water-cement ratio of 0.75:1 by volume). Injection will be through a grout tube inserted to the end of the hole.

3.5 FIELD QUALITY CONTROL

- .1 Carry out all grouting in presence of Departmental Representative.
- .2 Use cleaned and recalibrated pressure gauges at the start of each working shift.
- .3 Keep a progress record of the work.
- .4 Keep records as to the number, location, size, and depth of all holes, date of drilling, water testing, grouting, redrilling and regrouting, the type of grouting, mix proportions, grout consumption, pressures used, time and duration of injection, interconnection, observation of liner deformations, and any other particulars, on forms approved by Contractor's Quality Manager.
- .5 All grouting records will be signed by the Contractor's Quality Manager. Submit copies of all such records to Manager.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 32 19.01 - Geotextiles.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .2 ASTM C618-12a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging, and corrugated cardboard in accordance with Waste Management Plan.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Divert left-over aggregate materials from landfill to local quarry for reuse as approved by Departmental Representative.
- .6 Divert left-over hardened cement materials from landfill to local quarry for reuse as approved by Departmental Representative.
- .7 Divert left-over geotextiles to local plastic recycling program as approved by Departmental Representative.

Part 2 Products

2.1 STONE

- .1 Hard, dense with relative density (formally specific gravity) not less than 2.65, durable quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended:
 - .1 Armour Rip-Rap:
 - .1 Not more than 10% of total volume of stones with individual volume less than 30 dm³.
 - .2 Not less than 50% of total volume of stones with individual volume of 225 dm³ or more.

- .3 Remaining percentage of total volume to have uniform distribution of stones between 30 and 225-dm³ size.
- .2 Heavy Rip-Rap:
 - .1 Not more than 10% of total volume of stones with individual volume less than 30 dm³.
 - .2 Not less than 50% of total volume of stones with individual volume of 140 dm³ or more.
 - .3 Remaining percentage of total volume to have uniform distribution of stones between 30 and 140-dm³ size.
- .3 Random Rip-Rap:
 - .1 Not more than 10% of total volume of stones with individual volume less than 15 dm³.
 - .2 Not less than 50% of total volume of stones with individual volume of 85 dm³ or more.
 - .3 Remaining percentage of total volume to have uniform distribution of stones between 15 and 85-dm³ size.
- .4 Hand-Placed Rip-Rap:
 - .1 Minimum size of individual stones 10 dm³.
 - .2 Not less than 75% of total volume of stones with individual volume of 25 dm³ or more.
 - .3 Supply rock spalls or cobbles to fill open joints.

2.2 CEMENT MORTAR

- .1 Cement: to CAN/CSA-A3000, type 10.
- .2 Sand for Mortar: to ASTM C144.
- .3 Mortar Mix: 1 part by volume of cement to 3 parts sand, to consistency approved by Departmental Representative.
- .4 Fly-Ash Cement with 40% Fly-Ash Replacement: to ASTM C618.

Part 3 Execution

3.1 PLACING

- .1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.
- .2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.
- .3 Place geotextile on prepared surface in accordance with Section 31 32 19.01 - Geotextiles and as indicated. Avoid puncturing geotextile. Vehicular traffic over geotextile not permitted.
- .4 Place rip-rap to thickness and details as indicated.
- .5 Place stones in manner approved by Departmental Representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.

.6 Hand Placing:

- .1 Use larger stones for lower courses and as headers for subsequent courses.
- .2 Stagger vertical joints and fill voids with rock spalls or cobbles.
- .3 Finish surface evenly, free of large openings and neat in appearance.

.7 Mortar:

- .1 Use mortar within one hour after water has been added. Do not add additional water after initial mixing.
- .2 Begin applying mortar at bottom courses and work upwards completely filling voids except for subdrainage relief holes as indicated, and leaving outer faces of stones exposed. Remove excess mortar to expose faces of stones.
- .3 Cure and protect mortar in accordance with CAN/CSA-A23.1 by keeping fabric continuously wet.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Contractor is responsible for designing all cofferdams, other than South Channel Upstream Cofferdam.
- .3 Cofferdams must be constructed to be nonerodible and must be designed, constructed and removed recognizing the requirements as shown on drawings and specifications.
- .4 Provide to the Departmental Representative copies of all documentation submitted to the Ministry of Natural Resources for approval of the Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 RESPONSIBILITY

- .1 Contractor is fully responsible for the design, construction, maintenance and removal of all cofferdams, other than South Channel Upstream Cofferdam as shown on drawings, and the acquisition of all approvals prior to proceeding with the installation of said structures.
- .2 Contractor is fully responsible for the construction, maintenance and removal of the South Channel Upstream Cofferdam as shown on drawings, and the acquisition of all approvals prior to proceeding with the installation of said structure.
- .3 Use the historical data provided and carry out Contractor's calculations and set the crest levels necessary to provide an acceptable level with respect to overtopping.

3.2 COFFERDAM MAINTENANCE

- .1 Maintain the cofferdam structures throughout the unwatering period. Should the Contractor notice a sudden increase in seepage through a cofferdam, or significant damage or deterioration of a cofferdam, it shall notify the Departmental Representative immediately and take immediate action to correct the condition.

3.3 COFFERDAM REMOVAL

- .1 Remove all cofferdams and dispose of cofferdam materials by the approval of the Departmental Representative.

- .2 Remove the cofferdams in such a manner that will result in acceptable water discharges free of suspended sediment to the extent of water discharge prior to the construction of the cofferdam.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 00 99 - Earthwork for Minor Works.
- .2 Section 31 05 16 - Aggregate Materials.
- .3 Section 31 23 16.16 - Unclassified Excavation.
- .4 Section 31 23 16.26 - Rock Excavation.

1.2 DEFINITIONS

- .1 Rock surfaces shall be defined as 'horizontal to near-horizontal' if the sound rock surface area, projected onto planes of not less than 1 m² and lying generally parallel to the surface to be measured, is 44° or less as measured to the horizontal.
- .2 Rock surfaces shall be defined as 'vertical to near-vertical' if the sound rock surface area, projected onto planes of not less than 1 m² and lying generally parallel to the surface to be measured, is greater than 44° as measured to the horizontal.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).

1.4 SUBMITTALS

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

Part 2 Products

2.1 MATERIALS

- .1 Refer to Section 31 05 16 - Aggregate Materials for requirements relevant to cement, sand and water.

Part 3 Execution

3.1 PLANNING

- .1 Planning and execution shall be carried out for providing all labour, construction plant and material, and the performance of all work necessary for the final preparation of rock and earth surfaces prior to placing granular fill, rock fill and impervious fill materials, complete in every respect and as specified herein.
- .2 Planning and execution shall be carried out for providing all labour, material and Contractor's equipment and performing all work necessary for the final preparation of

rock surfaces prior to placing concrete, as shown on the Drawings, as required by the Departmental Representative, and as specified herein.

3.2 FOUNDATION PREPARATION FOR EARTH-FILL MATERIAL

- .1 Granular fill shall not be placed on any part of a foundation surface until each section has been prepared in accordance with these specifications. Final preparation of earth foundations shall be performed immediately prior to fill placement.
- .2 For areas other than the east bank slope and subsequent to unclassified excavation specified in Section 31 23 16.16 - Unclassified Excavation, the earth foundation surfaces shall be drained and cleaned of loose or wetted materials and debris or other weak and objectionable materials and compacted as required before fill materials are placed.
- .3 To assess the quality of overburden foundations, the Contractor shall take a sufficient number of samples and make a sufficient number of in-place density tests on the prepared foundation surfaces to adequately define the characteristics of the foundation materials.
- .4 In order to achieve a reasonably sound and planar rock foundation surface, the Departmental Representative may require the removal of local rock protrusions and unsound areas from natural rock surfaces by blasting or other accepted methods of solid rock excavation prior to foundation preparation.

3.3 FOUNDATION PREPARATION FOR CONCRETE

- .1 Rock surfaces against which concrete is to be placed shall be clean, solid and free from oil, mud, grout, loose, semidetached or unsound fragments of rock, objectionable coatings and debris, and shall be sufficiently rough to assure satisfactory bond with the concrete.
- .2 Concrete shall not be placed on any part of the sound rock foundation surface until each section of the foundation has been prepared by the Contractor in accordance with these Specifications and approved in writing by the Departmental Representative.
- .3 Initial cleanup of rock surface shall be performed using a backhoe equipped with a scraping bucket or other suitable equipment approved by the Departmental Representative. The Departmental Representative may also require the Contractor to remove or check the stability of loose blocks by hand, using scaling bars or similar hand tools.
- .4 After the removal of loose materials from the sound rock foundations for concrete structures, the sound rock foundations shall be thoroughly cleaned by sluicing or by compressed air/water jets, with a minimum pressure of 50 MPa, and all materials shall be removed from cavities, potholes and exposed open joints and cracks. Where seams of sand or clay or other soft or undesirable materials occur, they shall be cleaned out to the depths required by the Departmental Representative, with the aid of trowels, bars, stiff wire brooms and air, and water jets as required to perform the Works. Such dental excavation shall be carried out as specified in Section 31 23 16.26 - Rock Excavation. The surface shall then be washed to remove all loose material.
- .5 In areas where grouting is to be performed prior to concrete placement, sound rock surfaces shall be prepared immediately before placement of concrete and after completion of all grouting operations in the area. The methods employed shall include the use of high-velocity air/water jets, wet sandblasting, stiff wire brooms, picks or other

effective means satisfactory to the Departmental Representative. Sound rock surfaces shall then be washed to remove all loose material.

- .6 All pools of water shall be removed from depressions to ensure proper bonding of the fresh concrete to the sound rock surfaces.
- .7 Where water flows from rock or other sources against which concrete is to be placed and that water cannot be sealed off, the water shall be excluded from the area by caulking, or diverted by pipes, pans or other means acceptable to the Departmental Representative in such a manner that the concrete will be unaffected by action of the water through percolation, by hydrostatic pressure or erosion.
- .8 The sound rock surfaces shall be kept moist for a continuous period of at least 24 hours prior to placement of concrete.

3.4 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine soil report available at project tender documents.
 - .2 Before commencing work establish locations of buried services on and adjacent to site.

3.5 GENERAL PREPARATION

- .1 Temporary Erosion and Sedimentation Control: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .2 Protection of In-Place Conditions: in accordance with Section 31 00 99 - Earthwork for Minor Works.
- .3 Removal: in accordance with Section 31 00 99 - Earthwork for Minor Works.

3.6 FOUNDATION TREATMENT FOR CONCRETE STRUCTURES

- .1 Fill surface cracks, fractures and other openings in rock foundations with slush grout, or a cement grout with a suitable nonshrink additive.
- .2 Moisten all surfaces immediately before placing concrete or mortar.
- .3 Slush grout shall have a water/cement ratio of 0.57 and shall consist of 490 kg of Type 10 Portland cement and 1280 kg of concrete sand per cubic metre. Mix the grout in mechanical mixer for at least 2 minutes and apply to the surface and boom into the joints and rocks within 40 minutes of mixing. Take care to avoid the accumulation of grout and concrete on surfaces where such materials are not required.
- .4 Cap zones of badly fractured rock with concrete. Fill potholes and cavities with concrete or with the same impervious fill to be placed over area, and compact by suitable power tampers to the same degree of compaction. Excavate any sheared or weak rock zones or narrow deep cavities to a depth equal to 3 times their width and fill with concrete. Work shall be performed so as to present a regular surface on which to place concrete or impervious fill. The Departmental Representative may designate the particular treatment required at any location after inspection of the cleared foundation. For badly fractured zones, use concrete of high fluidity with a nonshrink additive, minimum thickness of 300 mm.

- .5 Where abrupt topographical changes occur in the bedrock foundation, use appropriate methods to smooth out the foundation. Ensure that no feathered edges exist in the finished product. Correct overhangs, steep slopes, depressions or divergent abutments by concreting or rock removal to maximum slope of 70° from horizontal.

3.7 APPROVAL OF FOUNDATIONS

- .1 Do not place fill on foundation surfaces without written confirmation signed by the Departmental Representative that all of the requirements specified herein have been satisfied.
- .2 The Contractor to ensure that the Departmental Representative has had the opportunity to take pictures of all foundation surfaces prior to the placement of fill.

END OF SECTION