

Part 1 General

1.1 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Allow Departmental Representative with access to source and processed material for sampling.
- .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.2 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.

1.3 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative Engineer of proposed source of aggregates and provide access to for sampling at least 4 weeks prior to commencing production.
- .2 If, in opinion of the Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.
- .4 Have testing completed at source by contractor-retained independent testing agency prior to commencing production. Forward results to Departmental Representative within 7 days of receiving results.

- .5 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 2 Products

NOT USED

Part 3 Execution

3.1 PREPARATION

- .1 Processing
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.
 - .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .2 Handling
 - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 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.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Max 1.5 m for coarse aggregate and base course materials.
 - .2 Max 1.5 m for fine aggregate and sub-base materials.
 - .3 Max 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 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .3 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 MEASUREMENT AND PAYMENT

- .1 Refer to Section 01 29 00 Payment Procedures for measurement and payment of items related to this Section.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling accordance with Waste Management Plan.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: any solid material in excess of 1.2 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material is not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 mm in any dimension.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
 - .2 Table:

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

- .3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .7 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .3 At least 2 weeks before beginning work the Contractor shall submit to the Departmental Representative for review a complete and detailed outline of the procedures and methods that will be employed for this section of work.
- .4 The Contractor shall not begin work until the Departmental Representative has reviewed the submittals
- .5 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of materials and provide access for sampling.

1.5 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .3 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .4 Keep design and supporting data on site.
- .5 Engage services of qualified professional Engineer who is registered or licensed in Provinces of Saskatchewan Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .6 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.
- .7 Do construction which follow occupational health and safety requirements.

1.6 EXISTING CONDITIONS

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

Part 2 Products

2.1 MATERIALS

- .1 Pipe Bedding and Surround Material
 - .1 Pipe bedding and surround materials shall be granular materials of crushed or screened gravel or sand as per the gradations as indicated.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
 - .3 Table

Sieve Designation	Gravel/Sand
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Sieve Designation	Gravel/Sand
12.5 mm	100
9.5 mm	85-100
4.75 mm	75-100
2.00 mm	55-90
0.425 mm	20-50
0.075 mm	0-10

- .4 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00.01 - Cast-in-Place Concrete – Short Form.
- .2 In-Situ Backfill:
 - .1 Common excavated or in-situ materials used for backfilling above the pipe surround will consist of acceptable earth material free from objectionable quantities of organic matter, frozen soil, cinders, sod, ashes, stumps, trees, moss, rocks or boulders larger than 100 mm or other deleterious materials.
- .3 Aggregates:
 - .1 Granular materials used for sub-base and base courses shall be composed of sound, hard, and durable particles of sand, gravel and rock free from significant quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
 - .2 For Gradation see related Section 32 11 16.01 - Granular Sub-Base and Section 32 11 23 - Aggregate Base Courses.
- .4 Coarse Stabilizing Gravel:
 - .1 Provide clean, crushed or screened rock material for stabilization of trench bottom.
 - .2 Gradation to the following:

Sieve Designation	Percent Passing
80 mm	100%
50 mm	95-100
25 mm	20-100
10 mm	0-10
5 mm	0-2

- .5 Unshrinkable fill shall be proportioned and mixed to provide:
 - .1 Maximum compressive strength of 0.5 MPa at 28 days.
 - .2 Maximum Portland cement content of 25 kg/m³ with 40% by volume fly ash replacement: to CSA-A3001, Type GV (10 – Normal).
 - .3 Minimum strength of 0.07 MPa at 24 h.
 - .4 Concrete aggregates: to CAN/CSA-A23.1 maximum aggregate.
 - .5 Portland cement: Type HS (50 – Sulphate Resistant).
 - .6 Slump: 160 to 200 mm.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

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

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

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

3.4 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as indicated or as directed by Departmental Representative after area has been cleared of trees, brush, weeds, and grasses and removed from site.
- .2 Strip topsoil to depths as indicated or as directed by Departmental Representative. Do not mix topsoil with subsoil.
- .3 Stockpile in locations as indicated or as directed by Departmental Representative. Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil to location as indicated or as directed by Departmental Representative.

3.5 STOCKPILING

- .1 Stockpile fill materials if required, in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Health and Safety Act for the Province of Saskatchewan.
 - .1 Where conditions are unstable, Departmental Representative to verify and advise methods.
- .2 Construct temporary Works to depths, heights and locations as directed by Departmental Representative.
- .3 During backfill operation:
 - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .4 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .5 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore watercourses as directed by Departmental Representative.

3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Submit for Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved collection and/or runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.

- .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions as indicated or as directed by Departmental Representative.
- .2 Remove and dispose off site concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 For excavation near trees and shrubs:
 - .1 Excavation location and limits near trees should be reviewed and approved by Departmental Representative prior to excavation. Excavation should extend 2 m from the edge of the trunk.
 - .2 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .3 If excavating through roots, excavate by hand. Do not sever roots greater than 40 mm diameter except at greater than 500 mm below existing grade. Protect roots and cut roots cleanly with sharp disinfected tools and cut roots with sharp axe or saw.
 - .4 Directional drilling should occur under centre of tree trunk using methods and equipment approved by Departmental Representative.
 - .5 Backfill excavation to 85% Standard Proctor Density. Avoid damage to trunk and roots of tree.
 - .6 Complete tunneling and backfilling at tree within 2 weeks of beginning Work.
- .5 For trench excavation, unless otherwise authorized by Departmental Representative and/or Departmental Representative in writing, do not excavate more than 25 m of trench in advance of installation operations and do not leave any trench open at end of day's operation.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material in approved location off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify Departmental Representative when bottom of excavation is reached.
- .12 Obtain Departmental Representative approval of completed excavation.

- .13 Remove unsuitable material from trench bottom and replace with coarse stabilizing gravel including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Correct unauthorized over-excavation as follows:
 - .1 Fill with granular sub-base fill compacted to not less than 95% to ASTM D698.
- .15 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .16 Maintain all trench surfaces and all working surfaces adjacent to the trench or any areas affected by construction until completion or final project inspection.
- .17 Prevent any nuisance to the public such as blowing dust, any settlement or failures, potholes or wash board condition in all or any access roads. Correct irregularities as often as they occur.

3.9 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 100 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding.

3.10 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material directly on top of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from 100 mm below pipe bottom to a height 150 mm above pipe to at least 95% maximum density to ASTM D698.

3.11 BACKFILLING

- .1 Provide sufficient vibratory compaction equipment required to meet the density requirements as noted.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .3 Areas to be backfilled are to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.
- .5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .6 Compact backfill in traveled areas to a minimum 97% Standard Proctor Density to ASTM D698.
- .7 Compact backfill in non-traveled areas to a minimum 95% Standard Proctor Density to ASTM D698.
- .8 Backfilling around installations.
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 1.0 m.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 7 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative:
 - .2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.
- .9 Place unshrinkable fill in areas as indicated.
- .10 Consolidate and level unshrinkable fill with internal vibrators. Initial lift not to exceed 1.0 m in depth.
- .11 Install drainage filter system in backfill as indicated or as directed by Departmental Representative when required.

3.12 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative and in accordance with other sections of this specification.
- .2 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 19 – Construction/Demolition Waste Management and Disposal trim slopes, and correct defects as directed by Departmental Representative.
- .3 Replace topsoil as directed by Departmental Representative.
- .4 Reinstate landscaping to elevation which existed before excavation.
- .5 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .6 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .7 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .8 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

3.13 TESTING

- .1 Refer to Section 01 29 83 Testing Laboratory Services.
- .2 Testing will be performed by an independent laboratory as appointed by Departmental Representative. Payment for testing will be the responsibility of the Contractor.
- .3 Any backfill not meeting the density specification shall be reworked, re-graded and re-compacted until it is accepted. Any unsuitable material shall be removed and replaced. Sieve analysis shall be done for all granular backfill to assure uniformity and gradation and compliance to the specifications.
- .4 The minimum number of tests required is as follows:
 - .1 One compaction test per every 200 linear metres of trench for each 0.45 m of trench depth, or;
 - .2 One compaction test for every 500 m² of area backfilled for each lift as constructed.
- .5 Densities shall not be taken at locations less than 1.0 m away from retaining walls, buildings or rigid structures.

END OF SECTION

Part 1 General

1.1 SCOPE

- .1 This section specifies the requirements for the installation of pipe or conduit utilizing horizontal directional drilling methods.

1.2 DIRECTIONAL DRILLING METHOD

.1 Definitions

- .1 A horizontal directional drill rig is a mechanical drilling device used to create a horizontal borehole through which pipe or conduit is installed.
- .2 Returns and spoils are the drilling mud and cuttings collected in the entry and exit pits.
- .3 Returns and spoils which do not exit the borehole through either the entry or exit location are termed as inadvertent returns or frac-outs.

.2 General Description

- .1 Horizontal directional drilling is the installation of a pipe by drilling a pilot bore from the entry pit to a predetermined exit location. The drilling head is then replaced with the reamer and the drilling string is pulled back to the entry hole, enlarging the hole while simultaneously pulling the pipeline product into place.

.3 Contractor Submittal

- .1 Submit methodology, specific to each crossing, complete with design and construction details for the proposed directional drilling operation.

1.3 WORK CONTENT

- .1 Include all construction services, plant, labour, material, and services for all of the following:
 - .1 Preparation of the site including removal of vegetation, location of all existing utilities along the proposed path, excavation of all utility crossings, excavation of entry and exit pits, any slurry containment pits and disposal of drilling slurry as required.
 - .2 Installation of new pipe by directional drilling method.
 - .3 Testing of installed section and restoration of all affected surfaces to their pre-construction conditions.

1.4 CONSTRAINTS

- .1 Schedule work to minimize interruption to existing services and local traffic.
- .2 Obtain all necessary permits or authorizations to conduct construction activities and to disturb ground near or across all existing buried utilities, pipelines, services, and conduits.
- .3 Submit for approval proposed methods to control, collect, transport, and dispose of drilling fluids and spoils.

1.5 SUBMITTALS

- .1 Provide within twenty-five (25) working days of the award of the contract:
 - .1 Complete methodology, specific to each borepath or crossing, including:
 - .1 equipment specifications and capabilities,
 - .2 size of pilot hole,
 - .3 number and sizes of pre-reams,
 - .4 method of support for product during pullback,
 - .5 the number of sections in which the product is to be installed,
 - .6 type and capabilities of tracking system, and
 - .7 calculations of the appropriate backream rate for each pre-ream and pullback based on equipment capabilities and soil conditions.
 - .2 Schedule of work including installation sequence for projects requiring multiple borepaths.
 - .3 Drawing of work site, including location and footprints of equipment, and the locations of the entry, exit, and slurry containment pits. For each installation, indicate product layout areas during pullback, identify potential conflicts with traffic, and indicate duration of any road closures required.
 - .4 Drilling fluid management plan, including drilling fluid containment, recycling/transport, and approved disposal site.
 - .5 MSDS and related technical information for all drilling muds, polymers, and admixtures that are intended to be used during drilling, reaming, or pullback. Contractor shall not deviate from the submitted list of materials unless approved by the Departmental Representative.
 - .6 Emergency procedures for inadvertent utility strikes, including: power, natural gas, water, sewer, or telecommunication lines. Procedures must comply with regulations.
 - .7 Method of dealing with inadvertent returns of surface seepage of drilling fluids and spoils.
 - .8 Data from the product pipe manufacturer indicating the tensile strength and minimum bend radius.

Part 2 Products

- .1 Equipment
 - .1 The Contractor shall be responsible for the directional drilling method and equipment. The Contractor shall confirm that the drill rigs and mud mixing systems will be of sufficient capacity to successfully complete the installation taking into consideration the installation length, product type and diameter, and ground and ground water conditions that can be reasonably foreseen.

.2 Mud mixing and or mud recycling systems should be of sufficient capacity as to not impede the installation process. Contractor should plan installation to take into consideration mud production and pumping rates.

.3 Tracking and locating system should have appropriate operating range and degree of accuracy to meet project conditions. Tracking and steering equipment shall allow for continuous monitoring of the drill head along the entire proposed alignment. If it is anticipated that the drill head may not be tracked along the entire length of the installation, this should be communicated to the Departmental Representative prior to commencement of construction.

.4 Drill rig must be equipped with an electrical strike safety package. Prior to commencement of the pilot bore the rig's electrical strike alert system must be tested. The package should include warning sound alarm, grounding mats, and protective gear.

.5 Breakaway connector must be placed between reamer and pipe. Breakaway connector to be set to manufacturer's maximum recommended tensile strength.

Part 3 Execution

3.1 PRE-COMMENCEMENT

- .1 All subsurface utilities within 25 m of the proposed drill path must be identified and location marked on the surface. Owners of subsurface utilities within 25 m of the proposed borepath must be notified of the impending work through the Sask 1st Call program or directly if not a member of the service.
- .2 All utility crossings shall be exposed using hydro-excavation, hand excavation, or another approved method to confirm depth. Contractor must acquire appropriate permits to cross, expose, and backfill existing utilities.
- .3 The proposed drill path shall be determined and documented, including its horizontal and vertical alignments and the location of buried utilities and subsurface structures along the path.
- .4 Prior to commencement of the pilot bore, the proposed borepath shall be "swept" for interference by the Locator. Based on the results of the "sweep" (for electromagnetic interference that may affect the locating system) the Contractor will indicate to the Departmental Representative any concerns regarding the ability to accurately locate and track the drill head. Alternative tracking methods or realignment of the borepath may be required if tracking along the proposed borepath is deemed impractical.
- .5 Exit and entry areas should be delineated using traffic cones, barricades, construction taping, flagging, or by some combination of these. If necessary warning signs should be placed to indicate open excavation.
- .6 Exit area should be suitable size to accommodate activities related to reamer and product pipe connection.
- .7 Location must be identified for product pipe layout, as well as suitable space for pipe fusion or coupling depending on product pipe material. This area may require delineation depending on level of pedestrian and vehicular traffic at the discretion of the Departmental Representative.

3.2 INSTALLATION PROCEDURES

- .1 Only a fully trained and experienced operator shall be permitted to operate the drilling equipment. While operating the drill rig, the manufacturer's operating instructions and safety practices shall always be followed.
- .2 Provide any additional anchoring required for the drill rig such that the installation can proceed in a safe and effective manner.
- .3 Entry angle of the drill string should range between 8 and 20 degrees, exit angles between 5 and 10 degrees. Any deviation from these angles must be approved by the Departmental Representative.
- .4 Drilling of the pilot bore should be performed in a manner that minimizes the over-stressing and straining of the drill stem as well as the product pipe on the backream. Location of entry and exit pits are to be of sufficient size and located such to avoid a sudden radius change of the product pipe and the resultant excessive deformation.
- .5 Drilling mud pressure in the borehole should not exceed that which is supported by the overburden pressure to prevent surface heave or hydraulic fracturing of the soil (frac-out).
- .6 Pilot bore shall have an horizontal alignment of +/- 0.5% or within the minimum bending radius of the product pipe. Depth must not be less than the minimum specified depth, and not exceeding 130% of the specified minimum depth unless either specifically indicated on the drawings or approved by the Departmental Representative.
- .7 If a drilled hole must be abandoned for whatever reason, the hole shall be filled with grout or bentonite to prevent future subsidence.
- .8 All phases of the installation require the utilization of a properly formulated drilling fluid. Drilling fluid properties, drilling fluid volumes, and rate of penetration must be matched to ground conditions to maintain proper circulation, borehole stability, and increase the chances of a successful installation.

3.3 REAMING AND PRODUCT INSTALLATION

- .1 The pilot bore shall be reamed to accommodate and permit the free sliding of the product inside the borehole according to these minimum specifications:
 - .1 Product size > 200 mm (8 inches) then final backream hole diameter should be product diameter plus 100 mm (4 inches).
 - .2 Product size 200 - 600 mm (8 - 24 inches) then final backream hole diameter should be 1.5 times product diameter.
 - .3 Product size > 600 mm (24 inches) then final backream hole diameter should be product diameter plus 300 mm (12 inches).
- .2 After fabrication and pre-installation testing of the product is completed, the pulling head may be attached to the product. A swivel must be installed between the pulling head and reamer to prevent rotation of the product during the installation.
- .3 The product pipe must be properly positioned and supported to enter the borehole. Pipe rollers, skates or other protective devices shall be used for the installation of products 150 mm (6 inches) outside diameter or larger.

- .4 Pullback and product installation should be completed without interruption, to reduce the risk of the product from becoming stuck in the borehole.
- .5 During pullback or back-reaming the pipe or conduit must be sealed on both ends with a cap or lug to prevent water, drilling fluids and other foreign materials from entering the pipe.
- .6 Several reaming passes may be required to achieve the desired minimum borehole diameter for the installation of the product.
- .7 During reaming and product installation, drilling fluid must be used, and proper circulation must be maintained.
- .8 The Contractor shall avoid excessive reaming and pullback rates. The Contractor shall match pullback and reaming rates with downhole tooling and borehole cleaning ability of their equipment. Excessive backream rates and outrunning hole cleaning ability may result in surface heave and frac-outs. Under no circumstances shall the pulling force on the product pipe exceed the maximum recommended by the pipe manufacturer for the specific product and installation conditions.
- .9 The Contractor shall use a breakaway connector set to pipe manufacturer's maximum recommended tensile strength. Departmental Representative to confirm breakaway connector setting prior to pipe installation.

3.4 DRILLING FLUIDS - COLLECTION AND DISPOSAL PRACTICES

- .1 Precautions shall be taken to keep drilling fluids out of streets, manholes, sanitary and storm sewers, and other drainage systems including streams and rivers.
- .2 Fluid returns not contained by the entry or exit pits to be promptly cleaned up.
- .3 Excess drilling mud slurry shall be contained in a lined pit or temporary holding container at the exit of entry points until recycled or removed from site. Entrance and exit pits shall be of sufficient size to contain the expected return of drilling mud and spoils.
- .4 Recycling of drilling fluids is an acceptable alternative to disposal.
- .5 If working in an area of contaminated ground, the circulated drilling fluid shall be tested for contamination and disposed of in a manner that meets government requirements.
- .6 The contractor shall make a diligent effort to minimize the amount of drilling fluids and cuttings spilled during the drilling operation and shall clean up all drilling mud overflows and spills.
- .7 Contractor shall have in place a suitable emergency response plan to respond to inadvertent returns and frac-outs. This plan shall include a procedure, contact numbers for appropriate regulatory agencies, materials and or equipment to contain the drilling fluid, and materials and or equipment to collect and dispose the drilling fluid. Plan to be discussed with Departmental Representative prior to commencement of the bore, and be scaled according to the size and risk associated with the installation.

- .8 After product is installed, entry and exit pits shall be cleaned of drilling fluids and cuttings, and backfilled with native material or select backfill in accordance with the Contract Documents.

3.5 RECORD OF CONSTRUCTION

- .1 Contractor shall indicate any horizontal or vertical deviations between the designed bore path and the actual bore installation. Contractor to provide a set of as built drawings including both alignment and profile constructed from actual field readings.
- .2 A log book, to be tracked at every rod, must be kept for all installations. Log book shall include pipe number, depth, pitch, and any steering commands. For more complicated or high risk installations log book shall also include rig performance parameters (thrust, pullback, rotational torque), drilling fluid circulation, drilling fluid composition, ground conditions and objects encountered during the bore, start and end of production shifts, as all as shift productivity. Logs must be legible and accurate, and copies submitted to the Departmental Representative with the as-built drawings.

3.6 TOLERANCES

- .1 Deviation from proposed alignment shall be limited to the following:
 - .1 Vertical: +/- 150 mm
 - .2 Horizontal: +/- 300 mm

END OF SECTION