

**SECTION 33 05 05**  
**TRENCHING AND BACKFILLING**

**PART 1 GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Trenching requirements for underground piping and appurtenances, including requirements for excavation, backfill, and compaction.

B. Related Sections:

1. Section 33 10 00 – Water Utilities
2. Section 33 12 12 – Water Services
3. Section 33 31 00 – Sanitary Sewer Piping
4. Section 33 31 14 00 – Sanitary Sewer Services
5. Section 33 34 00 00 – Sanitary Sewer Force Mains
6. Section 33 39 00 00 – Sanitary Sewer Structures
7. Section 33 40 00 - Storm Drainage Utilities
8. Section 33 10 00 – Water Utilities
9. Section 33 12 12 – Water Services

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Trench Excavation: Excavation and backfilling of trench and associated pipe bedding shall be included in the price of pipe provided.
2. Improved Pipe Foundation: Measurement shall be by the ton of material placed. Measurement shall not include material used within 6" of the pipe.
3. Piling: Piling up to 20 feet long including caps shall be paid for at the contract unit price for each single pile bent in place. No additional payment will be made for cradles. Any piling required over twenty feet in length shall be paid for as excess length of piling. Payment will not be made for cut off lengths. Double pile bents shall be paid for according to the length of each individual pile. There shall be no additional compensation for lumber or hardware used to tie the piles together.
4. Foundation Material: Material used for refilling to pipe foundation grade to assure firm foundation for pipe shall be paid for at the contract unit price per ton placed. Payment shall include cost of excavation and placement.
5. Sheeting Ordered Left In-Place: Sheeting ordered left in-place shall be paid for at the contract unit price per 1000 board feet.
6. Rock Excavation: Rock excavation shall be paid for at the contract unit price bid per cubic yard excavated. The volume used for payment shall be computed assuming a rectangle, the width of which is equal to the outside diameter of the pipe installed plus one foot (1'), and the depth of which is the distance from the top of the rock formation to a point twelve inches (12") below the barrel of the pipe.
7. All other Work and costs of this Section shall be incidental to the Project and included in the Total Base Bid.

- B. The furnishing and installing of specific items and/or the performance of work under certain circumstances shall not be individually paid. The costs shall be included in the unit price bid for

the individual pipeline items associated with the stated specific item or work effort. Such items of work include but are not limited to:

1. Interference with other above and underground structures and utilities.
2. The removal and restoration, or protection of existing structures and utilities that are shown on the plans and for which there is no bid item for removing and restoring or working around the utility.
3. Unless separately itemized in the Schedule of Unit Prices, any dewatering necessary for construction.
4. Foundation materials placed in lieu of performing necessary dewatering.
5. Bulkheading of existing pipes to be abandoned in place.
6. Granular foundation, granular bedding and granular encasement materials.
7. Granular foundation materials used in lieu of bedding materials in the specified bedding zone, where specified.
8. Granular foundation materials used in unstable trench conditions.
9. The removal and disposal of native materials that are unsuitable for bedding and/or backfill.
10. Providing and maintaining utility service.
11. The replacement of all material displaced due to shrinkage or loss during the excavation and backfilling operations.
12. The removal of excess materials above the original topography the resulting from the additional volume created from pipe bedding, utility pipe, and/or underground structures.
13. Delays due to other utility conflicts that result during the course of construction.
14. Protecting existing improvements and previously accepted elements of this construction from damage.
15. Protecting the inverts of other utility pipes from the accumulation of debris and soil, the removal of blockages that threaten to damage property, and/or the cleaning of both the newly constructed lines and the existing lines of all debris and soil that accumulated during the construction.
16. The use of special construction techniques such as trench boxes, sheeting, shoring, etc. , include in the price bid for the associated items being installed.

- C. Compaction testing and compaction, if required, include in the price bid for the associated items being installed.

### 1.03 REFERENCES

- A. Chapter sixty-six: Trench bracing of the Minnesota Regulations Relating to Industrial Safety
- B. Minnesota Department of Transportation "Standard Specifications for Construction" 2020 Edition (MnDOT Spec.):
1. 2106 - Excavation and Embankment.
  2. 2451 - Structure Excavations and Backfills.
  3. 3149 - Granular Material.

### 1.04 SUBMITTALS

- A. Provide the following submittals consistent with Section 01 33 00:
1. Product Data for each Borrow Material:
    - a. Name and location of source.
    - b. Results of gradation tests.

### 1.05 WARRANTY

- A. The Contractor shall be held responsible for any and all defects in workmanship and materials which may be developed in any part of the entire installation furnished by the Contractor and upon written notice from the Engineer shall immediately replace and make good, without expense to the owner, any such faulty part or parts and damage done by reason of same, during the period as prescribed in Section 31 of the General Conditions.
- B. Should the Contractor fail to make good the defective parts within a period of thirty (30) days of such notification, after written notice has been given to the Contractor, the Owner may replace these parts, charging the expense of same to the Contractor.

## **PART 2 PRODUCTS**

### **2.01 PIPE BEDDING MATERIAL**

- A. Polyvinyl Chloride (PVC) Pipe and High Density Polyethylene (HDPE) Pipe
  - 1. Comply with MnDOT Spec. 3149.2B1 for granular borrow
    - a. No on Site granular material encountered during construction may be used (without the permission of the Engineer).
    - b. 1 inch maximum aggregate size.
- B. Ductile Iron Pipe (DIP) and Reinforced Concrete Pipe (RCP)
  - 1. Class C-1 Bedding
    - a. Undisturbed soil.

### **2.02 IMPROVED PIPE FOUNDATION MATERIAL**

- A. Comply with MnDOT Spec. 3149.2G.1 (Table 3138-3, Class 5).

### **2.03 BACKFILL MATERIAL**

- A. Suitable materials selected from the excavated materials to the extent available and practical.
- B. Suitable materials are mineral soils free of rubbish, trees, stumps, branches, debris, frozen soil, oversize stone, concrete and bituminous chunks, and other similar unsuitable material.
- C. All excess excavated material shall become the property of the Contractor and shall be removed from the site and disposed of at a location secured by the Contractor.

### **2.04 GRANULAR SELECTED MATERIAL**

- A. Mn/DOT Specification 3149 aggregate shall be used for granular selected material as shown and specified under the pipe bedding classification or an equivalent natural granular soil.

### **2.05 FINE GRANULAR FILL MATERIAL**

- A. This material shall consist of sound durable particles without cohesion of clean sand and/or well rounded gravel.
- B. The largest size of gravel which may be used shall be dependent upon the size of the pipe used.
- C. A maximum of 3/8 inch gravel may be used when the pipe diameter exceeds 24 inches.

### **2.06 CLASS 4 AND CLASS 5 SAND AND GRAVEL**

- A. Class 4 and Class 5 sand and gravel shall be in conformance with Mn/DOT Specification 3138.

#### 2.07 CRUSHED ROCK

- A. Material shall consist of durable crushed quarry rock of which 100% passes a 2" sieve and of which 95% is retained on a #4 sieve size.
- B. Material shall not contain soil overburden, sod, roots, plants, and other organic matter, or any other materials considered objectionable by the Engineer.

#### 2.08 PIT RUN GRAVEL

- A. The material shall consist of sound, durable particles of gravel and sand with which may be included limited amounts of fine soil particles as binding material, and of which 100% passes a 2" sieve and of which 90% is retained on the #200 sieve size.
- B. It shall not contain sod, roots, plants, and other organic matter, or any other objectionable materials.

#### 2.09 ROCK STABILIZATION

- A. Rock stabilization shall consist of 3/4 inch minus rock installed in the trench bottom at the direction of the Engineer.

#### 2.10 COURSE FILTER AGGREGATE

- A. Coarse filter aggregate material, to be used beneath sanitary sewer and storm sewer structures or to be used as the gravel pit material below hydrants, shall be per Mn/DOT Spec. 3149.2H as determined by the Engineer.
- B. Course filter aggregate material shall also be used for surfacing due to wet conditions or other such uses.
- C. The use of course filter aggregate will be considered incidental to the utility being installed.

#### 2.11 AGGREGATE BEDDING

- A. The aggregate bedding material to be used for granular bedding and granular encasement purposes shall be per Mn/DOT Spec. 3149.2G.

### **PART 3 EXECUTION**

#### 3.01 EXISTING UTILITIES

- A. Existing water and sewer mains, and other underground utilities, are shown on the plans only by general location.
  - 1. The Owner does not guarantee the locations as shown on the plans, and the Contractor shall be solely responsible for verifying the exact location of each of these utilities, without additional compensation.
  - 2. Prior to the start of any construction, the Contractor shall notify all utility companies having utilities in the project area.

- B. The Contractor shall have sole responsibility for providing temporary support and for protecting and maintaining all existing utilities in the project area during the entire period of construction, including but not limited to the period of excavation, backfill and compaction.
  - 1. The Contractor shall exercise particular care, whenever gas mains or other utility lines are crossed, to provide compacted backfill or other stable support for such lines to prevent any detrimental displacement, rupture or other failure.

### 3.02 SUBSURFACE EXPLORATION

- A. It shall be the Contractor's responsibility to determine and verify the location of existing pipes, valves or other underground structures as necessary to progress with the work with no additional compensation allowed.
- B. The Engineer shall make all known records available.
- C. All known utilities are designated on the plans in a general way only as stated above.

### 3.03 OVERHEAD UTILITIES AND OBSTRUCTIONS

- A. Overhead utilities, poles, etc., shall be protected against damages by the Contractor and if damaged by the Contractor, shall be replaced by the Contractor.
- B. Should it become necessary during the progress of the work to remove or relocate existing poles, overhead utilities and obstructions, the Contractor shall cause the same to be done at no expense to the Owner unless otherwise provided for in the "Special Provisions".
- C. This requirement is not intended to allow utility companies to charge for expenses incurred for work performed where their utilities lie within the street right-of-way or dedicated easements.
- D. It will be the duty of the Contractor to visit the site and make exact determination of the existence of any such facilities prior to the submission of the Contractor's bid.

### 3.04 TRENCH

- A. TRENCH WIDTH AND DESCRIPTION
  - 1. The trench width at the top of the excavation may vary depending upon the depth of the trench and the nature of material encountered.
    - a. The maximum allowable width of trench shall be in strict accordance with MnDOT Specification 2503.3B.
    - b. The width of the trench shall also be kept at a minimum to prevent excess destruction of the existing street or highway pavement.
    - c. For trench width at the top of pipe greater than specified in above, the Contractor may propose alternate strength of pipe to depth of cover relationships other than those listed on the Form of Proposal, or shown on the plans.
      - 1) Such proposals must be submitted to the Engineer for approval in writing and with pertinent pipe strength and soil weight data at least fourteen (14) days prior to the desired construction date.
      - 2) No extra compensation shall be allowed for any increase in material or construction costs created by alternate plans.
  - 2. The excavation of trenches shall be fully completed a sufficient distance in advance of the pipe laying and the exposed ends of all pipe shall be fully protected with a board or approved stopper to prevent earth or other substances from entering the pipe.

3. Dig bell holes of ample dimension at each joint such that the pipe barrel rests continuously on the bedding.
4. The trench shall be so dug that the pipe can be laid to the alignment and depth required and shall be excavated only so far in advance of pipe laying as the Engineer shall specify.
5. The trench shall be so braced and drained that the workers may work therein safely and efficiently.
6. All trenches shall be sheeted and braced as per Chapter sixty-six: Trench bracing of the Minnesota Regulations Relating to Industrial Safety to a safe angle of repose.
  - a. Such angle of repose shall be no less than that repose required by the Accident Prevention Division of the Minnesota State Industrial Commission or the requirements of the Occupational Safety and Health Act (OSHA) whichever is more restrictive.
7. Pipe shall not be laid in water, or when the trench conditions are unsuitable for such work except by written permission of the Engineer.
8. It is essential that the discharge of any required trench dewatering pumps be conducted to natural public drainage channels, drains or storm sewers.
  - a. Only clean groundwater can be discharged into waters of the State.
9. All trench bedding material shall be incidental unless otherwise indicated in the plans and specifications or if so directed by the Engineer.

**B. PILING OF EXCAVATED MATERIAL**

1. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways.
  - a. Gutters shall be kept clear or other satisfactory provisions made for street drainage.
  - b. Material shall not be placed where runoff or sluffing of piles will encroach onto private property.
  - c. Silt fence shall be placed in all places where runoff will exit the right-of-way or outside the construction easement.

**C. CORRECTING FAULTY GRADE**

1. Any part of the trench excavated below grade shall be corrected with approved material and thoroughly compacted without additional compensation to the Contractor.

**D. PIPE FOUNDATION IN POOR SOIL**

1. When the bottom of subgrade is soft and in the opinion of the Engineer cannot adequately support the pipe, a further depth and/or width shall be excavated and refilled to pipe foundation grade with approved material and thoroughly compacted; or other approved means such as piling, shall be adopted to assure a firm foundation for the pipe with extra compensation allowed the Contractor as provided elsewhere in these specifications.
  - a. This does not apply to soil which is unsuitable due to high water level.
    - 1) The Contractor shall dewater the area to provide adequate laying conditions.
2. The Contractor shall furnish, drive, and place piling if ordered by the Engineer. Piles shall be driven in exact position at locations determined by the Engineer
  - a. The Contractor, at the Contractor's own expense, must replace piles not correctly positioned at the completion of driving.

**E. TRAFFIC AND UTILITY CONTROLS**

1. Excavations for pipe laying operations shall be conducted in a manner to cause the least interruptions to traffic.
2. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways.
3. The Contractor shall post, where directed by the Engineer, suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic.

4. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.
- F. PRIVATE PROPERTY PROTECTION
1. Trees, fences, poles and all other private property shall be protected unless their removal is authorized; and any property damage shall be satisfactorily restored by the Contractor, or adequate compensation therefore shall be the responsibility of the Contractor.
- G. RAILROAD AND HIGHWAY CROSSINGS
1. When any railroad is crossed, all precautionary construction measures required by the railroad shall be followed. See Special Provisions or Detail Drawings.
  2. The Contractor shall be responsible for the securing of necessary crossing permits.
  3. Before any construction is started, the successful bidder shall meet with the Minnesota Department of Transportation, County Highway Department, Railroad Maintenance Engineer, and the Engineers to determine the construction procedure to be followed, methods of rerouting traffic, placing of barricades, flares, signs, flaggers, etc., and methods of preventing damage to the highway or railroad.
  4. If required by the railroad or highway department, the Contractor shall deposit with them a certified check in the amount specified by them to cover the required repair work.
- H. PIPE FOUNDATION IN ROCK
1. The space between the bottom of the trench and the bottom of the pipe shall be backfilled with granular base material thoroughly tamped and compacted, a minimum of 12 inches.
  2. The material from the trench excavation, other than rocks or boulders shall be considered as suitable material.
    - a. No additional compensation for placing or tamping this material shall be allowed.
- I. SOLID ROCK EXCAVATION DEFINED
1. Solid rock excavation shall include such rocks as are not decomposed, weathered or shattered and which will require blasting, barring, wedging or use of air tools for removal.
  2. Under this classification shall be included the removal of any concrete or masonry structure (except concrete pavement, curb, gutter and sidewalk) exceeding one (1) cubic yard in volume that may be encountered in the work.
- J. BLASTING PROCEDURE
1. The hours of blasting will be fixed by the Engineer.
  2. The Contractor's methods of procedure relative to blasting shall conform to local and State laws and Municipal Ordinances.
- K. BRACED AND SHEETED TRENCHES
1. The Contractor shall adequately brace and sheet excavation wherever necessary to prevent caving or damage to nearby property.
    - a. The cost of this temporary sheeting and bracing, unless provided for otherwise, shall be considered as part of the excavation costs without additional compensation to the Contractor.
    - b. Trench sheeting shall remain in place until pipe has been laid, tested for defects and repaired if necessary, and the earth around it compacted to a depth of one (1) foot over the top of the pipe.
    - c. Sheeting, bracing, etc., placed in the "pipe zone" (that part of the trench below a distance of one (1) foot above the top of the pipe) shall not be removed without the written permission or written order of the Engineer; that sheeting thereby left in place shall be paid for at the unit price bid.

2. Sheeting ordered left in place by the Engineer in writing shall be paid for at the unit price bid.
  - a. The Contractor may leave in place, at the Contractor's expense, to be embedded in the backfill of the trench any sheeting or bracing in addition to that ordered left in place by the Engineer for the purpose of preventing injury or damage to persons, corporations, or property, whether public or private, for which the Contractor under the terms of this contract is liable.

### 3.05 PIPE BEDDING

- A. If bedding material is to be paid for on a weight basis, weight slips shall be delivered to the Engineer daily.
- B. Bedding material as specified or other suitable material as determined by the Engineer, free from rocks and boulders, shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a height above the top of the pipe as specified, shovel placed and plate tamped to fill completely all spaces under and adjacent to the pipe.
- C. Class B (first class bedding) or Class C (ordinary bedding) as shown in the Standard Plates, shall be used as directed on the plans or specified in the Special Provisions. PVC pipe shall be bedded in accordance with the specifications described below.
- D. Polyvinyl Chloride Pipe (PVC)
  1. All PVC pipe shall be installed and bedded in accordance with ASTM Specification D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Embedment materials shall be Class I or Class II. These materials shall all pass a 1 3/4 inch sieve and not more than 10% shall pass a #200 sieve. Embedment materials shall be compacted in six inch (6") lifts to a point twelve inches (12") above the pipe and to a density of at least ninety-five percent (95%) of Standard Proctor density as described by ASTM Methods D698. All embedment materials shall be tested for compliance with the above specification and test results shall be supplied to the Engineer.
  2. The Owner reserves the right to check for excess deflection in any portion of the PVC sanitary sewer line after placement of the backfill material in the trench. The deflection will be checked by means of a mandrel device prior to final acceptance of the sanitary sewer line or within thirty (30) days of its installation. Deflections greater than 5% of the inside diameter of the pipe shall be considered failure of the bedding procedure.
- E. Class B or first class bedding shall be achieved with compacted backfill in the "pipe zone". The pipe shall be bedded in compacted granular selected material placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth the outside pipe diameter. The side fills plus a minimum depth of twelve inches (12") over the top of the pipe shall be filled with carefully compacted granular selected material.
- F. Class C or ordinary bedding shall be achieved by bedding the pipe with ordinary care in an earth foundation formed in the trench bottom by a shaped excavation which will fit the pipe barrel with reasonable closeness for a width of at least 50% of the outside pipe diameter. The side fills and area over the pipe to a minimum depth of six inches (6") above the top of the pipe shall be filled with compacted normal fill material.

### 3.06 BACKFILLING

- A. GENERAL
  1. All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or shown on the plans.

2. The backfilling shall begin as soon as practicable after the pipe has been placed.
3. Prior to any backfilling, the excavation shall be cleaned of all trash, debris, organic material, and other undesirable material.
4. All trenches must be completely backfilled at the end of each day.
5. No open trenches shall be allowed after daylight hours without written approval from the City Engineer.

B. BACKFILL PROCEDURE AT PIPE ZONE

1. Backfilling and compacting shall be done as thoroughly as possible so as to prevent settlement.
  - a. Depositing of the backfill shall be done so the shock of falling material will not injure the pipe or structures.
  - b. Grading over and around all parts of the work shall be done as directed by the Engineer.
2. In the event that natural, suitable, granular material is not encountered during the normal excavation of the trench, or when the material encountered is determined unsuitable by the Engineer for backfilling around the pipe as required above, the Contractor shall provide and place such approved material obtainable from other excavation on the project at no additional compensation.
3. If suitable material is not available as stated above, the Contractor shall purchase suitable material as specified for backfilling around the pipe.
4. The Contractor shall be paid for only that select material required for filling or backfilling as they may be directed to purchase and place by the Engineer.

C. BACKFILL PROCEDURE ABOVE THE PIPE ZONE

1. Unless otherwise specified, suitable backfill material shall be furnished and the following backfill procedures as applicable shall be used above the "pipe zone" to either the existing surface elevation or design grade, as specified, with the cost of such considered incidental to the installation of the pipe unless specified for a particular section of the project by the Special Provisions and/or plans, or allowed in writing by the Engineer, and a unit price has been established.
2. Type I
  - a. Under improved or proposed roads and streets and under existing utilities, "Fill Material" (Item 13.05) shall be placed by mechanical or other means as approved by the Engineer so that excessive settlement will not result.
  - b. The material shall be compacted at or near the optimum moisture content.
  - c. The trench shall be backfilled in no greater than one foot (1') lifts to the top of existing ground. Backfill material shall be compacted to 95% of the standard moisture density relationship of soils (ASTM D698-70) except the top three feet (3') of the trench which shall be compacted to 100% density.
  - d. All material shall be plate tamped on either side of the pipe to completely fill all voids regardless of the type of pipe being installed.
  - e. Any settlement greater than one inch (1") as measured with a ten foot straight-edge within the warranty period of this contract shall be considered failure of the mechanical compaction and all street surfaces, driveways, boulevard and ditch areas shall be repaired by the Contractor at no cost to the City.
3. Type II
  - a. Under areas where settlement is allowable, in the judgment of the Engineer, "Fill Material" (Item 13.05) may be placed in layers thicker than twelve inches, and a high degree of compaction shall not be necessary.
  - b. When backfilling with loose soil types, the material may be backfilled above the existing ground surface or design grade so that the backfill in settling will more nearly conform to the design grade.
4. Type III

- a. Under State or county highways and roads, the Contractor shall obtain the necessary permits, at the Contractor's expense, before commencing any type of work within a State or county right-of-way.
  - b. All such work shall conform to State and county standards and specifications.
- D. DISPOSAL OF EXCESS MATERIAL AND DEBRIS
1. Unless otherwise specified, excavated material, either not suitable or not required for fill material, shall be disposed of by the Contractor outside of the right-of-way at the Contractor's expense in any manner the Contractor may elect subject to the provisions of the following paragraph.
  2. Before dumping such materials or debris on a private or public land, the Contractor must obtain from the Owner of such land written permission for such dumping and a waiver of all claims against the Owner for any damage to such land which may result therefrom together with all permits required by law for such dumping
    - a. A copy of such permission, waiver of claims and permit shall be filed with the Engineer before said disposal is made.
- E. FILL MATERIAL
1. Normal, allowable "fill material" used in backfilling shall be sand, gravel, or clay, free from pieces of rock, concrete or clay lumps more than one-third (1/3) cubic foot in volume, roots, stumps, organic soil, vegetation, tin cans, rubbish, frozen materials, and similar articles and substances whose presence in the backfill would cause excessive settlement.
  2. In that portion of the backfill which is within six inches (6") of a road subgrade or 12" of the top of the pipe, there shall be no stones which will be retained on a three inch (3") sieve.
- F. TEMPORARY STRUCTURE COVERS
1. Immediately after backfilling is completed all sanitary sewer and storm sewer manholes and catch basins shall be covered with MnDOT Type 5 geotextile fabric and have either the structure casting or a metal plate placed over the fabric. The fabric and plate (casting) should be placed so that when covered, they don't slide off of the structure during gravel lay down or grading operations. The fabric and plate (casting) shall remain in-place until iron is raised prior to the first lift of bituminous pavement being placed.
  2. Storm sewer catch basins and catch basin manholes shall also have 1 1/2" rock placed on and around them to allow for drainage. Rock shall be placed as directed by the Engineer.
  3. All such work shall be considered incidental to the project.

### 3.07 QUALITY CONTROL

#### A. DENSITY TESTS

1. Density tests will be performed by an approved soils testing firm at various locations and depths throughout the project as directed by the Engineer.
  - a. The Contractor shall cooperate fully and provide assistance, including equipment and labor, as necessary to complete these tests with no additional compensation being made to the Contractor.
2. All testing costs pertaining to passing tests shall be paid for by the City. All testing costs pertaining to failing tests will be charged to and paid for by the Contractor.

### **END OF SECTION**

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