SECTION 02250 – TRENCHING, PIPE EMBEDMENT AND BACKFILL

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies requirements for trench excavation, pipe embedment, backfill and compaction for the installation of water, sanitary sewer and storm water piping.

1.02 SPECIFICATION MODIFICATIONS

A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements or as otherwise modified in the Contract Documents.

1.03 RELATED SECTIONS

A. Section 01000 – General Project Requirements.
B. Section 01015 – Specific Project Requirements.
C. Section 02180 – Clearing and Grubbing.
D. Section 02190 – Demolition.
E. Section 02200 – Earthwork.
F. Section 02230 – Geotextiles.
G. Section 02575 – Surface Restoration.
H. Section 02930 – Seeding.
I. Section 02931 – Sodding.

1.04 CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
B. American Society for Testing and Materials (ASTM):

ASTM C33	Standard Specification for Concrete Aggregates.
ASTM C150	Standard Specification for Portland Cement.
ASTM C494	Standard Specification for Chemical Admixtures for Concrete.
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
ASTM C940	Method of Determination of Purity by Measurement of Freezing Points.
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft3).
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.05 DEFINITIONS

A. Paved Areas – Areas for which the final surfacing will be traffic-bearing surface treatments such as street pavement, shoulders, driveways, parking lots, curbs, gutters, gravel roads or other surface treatments for traffic (pavers, etc…). Sidewalks and trails are excluded from the definition.
B. Unpaved Areas – Areas for which the final surfacing will not be a Paved Area.
C. Downtown Loop – The area of the city bounded on the north by Interstate 70, on the east by U.S. 71, on the south by Interstate 670 and on the west by Interstate 35.

1.06 INFORMATION PROVIDED BY THE CITY

A. As provided in the Contract Documents.

1.07 SUBMITTALS

A. Submit as specified in Section 01300 – Submittals.
B. Shop Drawings:
   1. Sheeting and Shoring Design – Contractor shall submit, in accordance with 29 CFR Past 1926 - OHSA Subpart P - Excavations and Trenches, a shoring design sealed by a registered professional engineer in the State of Missouri for all excavations greater than twenty (20) feet in depth prior to excavation. Submittal will be for informational purposes only.
C. Testing Reports:
   1. Laboratory testing results for proposed Borrow Materials.
   2. Laboratory testing results and quarry control reports for Granular Material.
   3. Laboratory testing results for and quarry control reports Granular Bedding.
   4. Laboratory testing results for compression testing of CLSM.
   5. Moisture-density (Proctor) test results.
   6. In-Place Density test results.
D. Other Submittals:
   1. Commercial Laboratory – submit name, contact information and certification of the commercial testing laboratory required by paragraph QUALITY ASSURANCE.
   2. Mix Design for CLSM.
   3. Concrete Plant – submit the name and location of the concrete plant which will provide the CLSM.

1.08 QUALITY ASSURANCE

A. The Contractor is responsible for the quality assurance and quality control of the Work.
B. Sampling and Testing:
   1. Tests to determine conformance with all requirements of this Specification and for the quality and properties of all Contractor provided materials, including borrow materials proposed for use. The aforementioned testing shall be performed by an independent, state-certified, commercial laboratory retained and compensated by the Contractor and approved by the City.

2. All work associated with QUALITY ASSURANCE shall be included in the Bid Price and will be incidental to the Work.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Stockpile materials in other areas or offsite when adjacent structures, easement limitations or other restrictions prohibit storage adjacent to the Work.
B. Offsite areas shall be arranged for by the Contractor in accordance with Section 01000 – General Project Requirements.
C. Granular fill and granular bedding material shall be stored so that it is protected from freezing and significant changes in moisture content.

PART 2 - PRODUCTS

2.01 MATERIALS ENCOUNTERED

A. Suitable Materials – As defined by, Section 02200 – Earthwork, paragraph MATERIALS ENCOUNTERED.
B. Unsuitable Materials – As defined by, Section 02200 – Earthwork, paragraph MATERIALS ENCOUNTERED.
C. Topsoil – As defined by, Section 02200 – Earthwork, paragraph MATERIALS ENCOUNTERED.
D. Rock – Unless otherwise specified in Section 01015 – Specific Project Requirements, all Materials encountered, regardless of type, character composition and condition shall be considered "unclassified" for the purpose of payment. Contractor shall determine the quantity of various materials to be excavated prior to submitting their Bid. Rock encountered shall be excavated at no extra cost to City.

2.02 WASTE MATERIALS

A. As defined by, Section 02200 – Earthwork, paragraph WASTE MATERIALS.

2.03 BORROW MATERIALS

A. As defined by, Section 02200 – Earthwork, paragraph BORROW MATERIALS.

2.04 GRANULAR BEDDING

A. Granular bedding for pipe bedding or embedment shall be clean crushed rock with not less than 95 percent passing a ½-inch sieve and not more than 5 percent passing a #No. 4 sieve. The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5 when tested in accordance with ASTM D4318.
B. Granular bedding material shall contain no cinders, clay lumps or other material which may cause pipe corrosion.

2.05 JOB EXCAVATED MATERIAL

A. Material excavated from the trench.
B. Meets the requirements of suitable material, except that it may include shale particles gravel or stone with any dimension up to 2 inches.

2.06 GRANULAR FILL MATERIAL

A. Granular Fill Material shall be as defined by, Section 02200 – Earthwork, paragraph GRANULAR FILL MATERIAL.

2.07 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Materials:
   1. Portland cement Type I or Type II conforming to ASTM C150.
   2. Fly ash conforming to ASTM C618 for Class C.
   3. Fine aggregate conforming to ASTM C33.
   4. Water, clean and potable conforming to ASTM C1602.
   5. Shrinkage compensation shall be proportioned in accordance with the manufacturer's recommendations and as tested by ASTM C940.
   6. Admixtures for air entrainment or for other purposes shall conform to ASTM C494 or other appropriate standards referenced by the manufacturer. Admixtures shall only be used when specified in the Contract Documents.

B. Mixture Design:
   1. Mix design for CSLM shall meet the requirements of Kansas City Public Works Department Specification Section 2600, except that the maximum compressive strength shall be from 50 to 125 psi and shall be removable without using a breaker and without damaging the utility.
   2. The unit weight of the CLSM shall be a maximum of 120 pounds per cubic foot.

C. Quality Control:
   1. CLSM material shall be provided from a City-approved concrete plant. Contractor shall submit name and location of plant to be used.
   2. One set of cylinders for compressive strength testing shall be obtained once per day or for every 100 cubic yards of flowable backfill placed.
   3. Cost for Quality Control shall be included in the Bid Price. No separate measurement or payment shall be made.

2.08 TOPSOIL

A. Topsoil shall be as defined by Section 02200 – Earthwork.

PART 3 - EXECUTION

3.01 DEMOLITION

A. Demolition shall be conducted in accordance with Section 02190 – Demolition.
B. Waste materials resulting from the cutting of pavement shall be considered demolition debris and disposed in accordance with Section 02190 – Demolition.

3.02 PAVEMENT REMOVAL AND RESTORATION

A. See additional requirements in Section 01000 – General Requirements, paragraph CUTTING AND PATCHING.
B. Public Right of Way:
   1. Kansas City, Missouri Public Works Department Standard Detail SR-1, Street Cut Restoration is hereby incorporated by reference.
   2. See Section 01015 – Specific Project Requirements for additional detail.
C. Other Pavement Cut and Restoration:
   1. Removal and replacement on private property shall be done in accordance with paragraph STREET CUT RESTORATION.
   2. Pavement removal shall be no larger than necessary to provide adequate working space for the proper installation of pipe and appurtenances.
   3. Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for their installation.

4. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs or other hard surfaces, the hard surfaces shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

D. Driveways:
   1. Demolition and restoration of driveways will be as indicated in Section 01015 – Specific Project Requirements or as shown on the Drawings.

3.03 CLEARING AND GRUBBING

A. Perform clearing and grubbing as indicated or as necessary to perform excavation or trenching.
B. Clearing and grubbing shall conform to Section 02180 – Clearing and Grubbing.

3.04 STRIPPING

A. Stripping shall conform to the requirements of Section 02200 – Earthwork, paragraph STRIPPING.

3.05 GENERAL REQUIREMENTS FOR OPEN EXCAVATIONS

A. See Section 02200 – Earthwork for additional requirements on open excavations.

3.06 BLASTING

A. Blasting is prohibited unless approved by the City. If approved, Blasting shall conform to the requirements of Section 02200 – Earthwork, paragraph BLASTING.

3.07 DEWATERING

A. Dewatering of trench excavations shall conform to the requirements of Section 02200 – Earthwork, paragraph DEWATERING.

3.08 SHEETING AND SHORING

A. Sheeting and shoring for trench excavations shall conform to the requirements of Section 02200 – Earthwork and as specified herein.
B. Excavations shall provide adequate working space and clearances for the Work to be performed.
C. In no case shall excavation faces be undercut for extended footings. Trench sheeting shall be removed only if the pipe strength is sufficient to carry trench loads based on the trench width to the back of sheeting. Trench sheeting shall not be pulled until backfilling is completed.
D. With the written approval from the City, sheeting may be left permanently in the trench. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

3.09 TRENCH EXCAVATION

A. Classification of Excavated Materials – No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition or condition.

B. No more trench shall be opened than is necessary to expedite the work. Except where tunneling is indicated on the Drawings, specified or permitted by the City, all trench excavation shall be open cut.

C. Alignment, Grade and Minimum Cover:
   1. The alignment, grade and elevation of each pipeline shall be as indicated on the Drawings.
   2. Trenches for waterlines shall be excavated to a depth sufficient to provide a minimum of 42 inches of pipe cover. Sixteen inch and larger diameter water lines shall be installed with a minimum of 60 inches of pipe cover.
   3. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance for air release vaults, existing pipes, conduits, drains, drainage structures or other obstructions.

D. Limiting Trench Widths:
   1. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing and embedment. Minimum trench widths shall be as follows:

Table 1. Ductile Iron Pipe (DIP) and Polyvinyl Chloride (PVC) Pipe and High-Density Polyethylene Pipe (HDPE)

Pipe Size (inches)	Min. Trench Width in Earth (inches)	Max. Trench Width in Earth (inches)	Min. Trench Width in Rock (inches)
4	18	24	18
6	24	30	24
8	26	32	26
12	28	34	28
16	34	40	34
20	38	44	38
24	42	48	42
≥ 27	O.D. plus 24	O.D. plus 30	O.D. plus 24

O.D. = Outside Diameter

Table 2. Prestressed Concrete Cylinder Pipe (PCCP) and Reinforced Concrete Pipe (RCP)

Pipe Size (inches)	Min. Trench Width in Earth (inches)	Max. Trench Width in Earth (inches)	Min. Trench Width in Rock (inches)
16	36	44	36
20	40	50	40
24	44	56	48
≥ 27	2 * O.D.	(2 * O.D.) + 12	(2 * O.D.) – 12

O.D. = Outside Diameter

E. Mechanical Excavation:
   1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, adjoining property, utilities or other structures above or below ground. In all such locations, hand excavating methods shall be used.
   2. Mechanical equipment used for trench excavation shall be of a type, design and construction and operated so that the rough trench excavation bottom elevation can be controlled and that trench alignment is such that pipe, when accurately laid to the specified alignment will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance is not permitted.

F. Excavation Below Pipe Subgrade – The trench bottom shall be over excavated below the proposed pipe, as indicated in Figure 1 and Figure 2 of this Section, to provide for the installation of granular embedment.

G. Foundations in Trenches:
   1. Whenever unsuitable or unstable soil conditions are encountered, trench subgrades shall be over-excavated until the trench subgrade is suitable as determined by the City/Design Professional.
   2. Adjustments may be made in the Contract Price in accordance with the provisions of the General Conditions.

H. Bell Holes:
   1. Bell holes shall provide adequate clearance for tools and methods used in installing pipe.
   2. No part of any bell or coupling shall be in contact with the trench bottom, trench walls or granular embedment when the pipe is jointed. Place embedment around the joint connection after joining the pipe.

3.10 TRENCH SUBGRADE

A. Subgrades for trench bottoms shall be firm, dense and thoroughly compacted and consolidated.

B. Protect and maintain the trench subgrade when natural suitable materials are encountered.

C. Remove rock fragments and materials disturbed during excavation and stripped from trench walls.

D. Subgrades shall be free from mud and muck and shall be sufficiently stable to remain firm and intact.

3.11 FOUNDATION

A. Description – A foundation is necessary when the native soils are unsuitable. For such a condition, the trench shall be over-excavated and a layer of supportive material shall be placed and compacted to provide a firm foundation for the subsequent pipe embedment material.

B. The Foundation layer is shown on Figure 1 and Figure 2.

C. Subgrades for trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with trench stabilization material.

D. Material – If the trench foundation is an unsuitable foundation for the pipe, the Contractor shall submit a plan, to the City/Design Professional for review and approval, to include the proposed material to be used for the foundation.

E. Layer Thickness – Unsuitable material shall be over-excavated until the trench subgrade is suitable as determined by the City/Design Professional.

F. Bedding:

1. Description – A layer of supportive compacted material to provide even support of the pipe at the grade indicated on the Drawings.
2. The Bedding layer is shown on Figure 1 and Figure 2.
3. Material – Granular Bedding.
4. Layer Thickness:
   (a) A minimum of 3 inches below the pipe or pipe bell when the pipe is placed on a foundation or suitable material.
   (b) A minimum of 6 inches below the pipe or pipe bell when the pipe is placed on rock.

3.12 HAUNCHING

A. Description – Extends from the bottom of the pipe to the spring line of the pipe. Haunching provides the most resistance to pipe deflection.

B. The Haunching layer is shown on Figure 1 and Figure 2.

C. Material – Granular Bedding.

D. Layer Thickness – One half the outside diameter of the pipe or pipe bell.

3.13 INITIAL BACKFILL

A. Description – Extends from the spring line of the pipe to a point above the top of the pipe.

B. Bedding Material:
   (a) Class A Bedding – Granular Bedding.

3.14 FINAL BACKFILL

A. Description – The zone from the top of the Initial Backfill to the bottom of final surfacing.

B. The Haunching layer is shown on Figure 1 and Figure 2.

C. Material:

1. Paved Areas within the Downtown Loop – For areas where the final surfacing is a paved area, the final backfill shall be Controlled Low Strength Material (CLSM).
2. Paved Areas – For areas where the final surfacing is a paved area, the final backfill shall be Granular Fill Material. CLSM may be substituted for Granular Fill Material as approved by the City or as indicated in the Contract Documents.
3. Unpaved Areas:
   (a) For areas where the final surfacing is an unpaved area, the final backfill material shall be a suitable material.
   (b) Where the pipe cover is 8 feet or more, job excavated material may be used as backfill if the following requirements are met:
      (i) The final surfacing is unpaved.
      (ii) The minimum clearance from the top of the initial backfill is 36 inches or 42 inches from the top of the pipe.
      (iii) The job excavated material shall not be placed within 18 inches of the finished grade.

D. Layer Thickness – Varies with pipe depth.

3.15 EMBEDMENT

A. Class A Embedment shall be used for all pipes.

3.16 BACKFILL PLACEMENT

A. Granular Bedding and Granular Fill Material shall be placed in lifts not exceeding 12 inches in loose thickness.
B. Suitable Material shall be placed in lifts not exceeding 12 inches in loose thickness.
C. Bedding – Bedding Granular bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It is permissible to slightly disturb the finished subgrade surface by the withdrawal of the pipe sling or other lifting tackle.
D. Haunches:
    1. After each pipe has been graded, aligned and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted by shovel slicing or chalking under the pipe haunches on each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.
    2. Care shall be taken to protect protective pipe coatings or wraps. If coating or wrapping is damaged, then the Contractor shall repair or replace the coating to the satisfaction of the City at no additional cost to the City.
    3. Haunching and initial backfill material shall be deposited uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
E. Weather Limitations – Backfilling of trenches during freezing weather shall not be done except by permission of the City. No backfill materials shall be installed on frozen surfaces, nor shall froze materials, snow or ice be placed in the trench.
F. Pipe Encasements – A layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.
G. Use of Geotextile Material:
    1. Where indicated on the Drawings, migration of soil into the embedment material shall be prevented with geotextile fabric.
    2. Geotextile material shall conform to Section 02230 – Geotextiles, paragraph GEOTEXTILES on Subsurface Drainage, unless otherwise indicated on the Drawings or in Section 01015 – Specific Project Requirements.
    3. Geotextile shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped 12 inches.

3.17 COMPACTION

A. Granular Bedding – Vibratory compactors and shovel slicing under the haunches of the pipe.
B. Granular Fill Material – The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content. Each layer shall be thoroughly compacted, utilizing a vibratory compactor, to achieve the minimum allowable density of 95% of the maximum dry density (at moisture content range from 3% below optimum to 2% above optimum as determined by ASTM D698). If the granular fill material fails to meet the minimum 95% density specified, the material shall be removed and compacted to achieve 95% or greater.
C. CLSM – Not applicable.

D. Suitable Material:
   1. Cohesive Materials – As required to obtain 95% maximum dry density in accordance with ASTM D698 with a moisture content range from 3% below optimum to 2% above optimum.
   2. Cohesion-less Materials – As required to obtain not less than 85% relative density as determined by ASTM D4253 and ASTM D4254.

E. Job Excavated Material – Where job excavated material is used for trench backfill, the Contractor shall use compaction methods to ensure that settlement does not occur within the limits of trench excavation. The Contractor shall repair settlement as directed by the City at any time during the Work or at any time during the warranty period. Repairs shall be made at no additional cost to the City.

3.18 FINAL SURFACING

A. Final surfacing shall be indicated on the Drawings.
B. For unpaved areas, see Section 02200 – Earthwork, paragraph FINAL GRADING AND PLACEMENT OF TOPSOIL.

3.19 DITCH CHECK

A. Continuity of embedment material shall be interrupted by low permeability groundwater barriers to impede passage of groundwater through the embedment.
B. Materials:
   1. Unpaved Areas – Suitable material classified as GC, SC, CL or ML-CL as defined in Section 02200 – Earthwork, paragraph MATERIAL ENCOUNTERED. Barriers shall be compacted to 95% maximum dry density in accordance with ASTM D698 with a moisture content range from 3% below optimum to 2% above optimum.
   2. Paved Areas – CLSM.
C. Barriers shall be constructed the full depth of the trench and shall include the foundation, bedding, haunching, initial backfill and final backfill zones of the trench.
D. Barriers shall be the full width of the trench excavation and 3 to 5 feet in length measured along the pipe.
E. Barriers shall be placed in the trench at intervals as shown on the Drawings or as directed by City/Design Professional. Unless otherwise specified by the City/Design Professional or specified in Section 01015 – Specific Project Requirements, the spacing of the groundwater barriers shall not exceed 250 feet.
F. The installed location of all groundwater barriers shall be noted on the Field Mark-Up Drawing and Construction Record Drawing.
G. Construction of the groundwater barriers shall be incidental to trenching and backfilling. No separate measurement or payment will be made.

3.20 SPECIAL REQUIREMENTS

A. For trench excavation within paved areas that required full depth and width pavement replacement, refer to additional instruction in Section 01015 – Specific Project Requirements.
B. Suitable materials shall be approved by the City/Design Professional prior to backfill.
C. Granular Fill Material may be used for final backfill in unpaved areas to within 18 inches of the final graded surface at the option of the Contractor.

3.21 DRAINAGE MAINTENANCE

A. To the greatest extent practical, open trench excavations shall be protected from surface water. The Contractor shall conduct the Work in a manner that diverts surface water away from the open excavation.

B. Trenches across roadways, driveways, walks or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway to prevent impounding water after the pipe has been laid.

C. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor.

D. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches.

E. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed; and the original cross section, grade and contour of the ditches or watercourses shall be restored.

F. Surface drainage shall not be obstructed longer than necessary.

G. If the trench subgrade becomes unsuitable or unstable after the trench is excavated and as a result of the Contractor's inability to meet the requirements for DRAINAGE MAINTENANCE, then the Contractor shall over-excavate the unsuitable material and construct a foundation to the satisfaction of the City/Design Professional and at no additional cost to the City.

3.22 FIELD QUALITY CONTROL

A. Compaction Tests:

1. All tests shall conform to ASTM D6938. All tests required shall be made by an approved independent testing laboratory.
2. Two initial gradation tests shall be made for each type of embedment, fill and backfill material.
3. Storm and Sanitary Sewer Installations:
   (a) Unless otherwise specified in Section 1015 – Specific Project Requirements, the minimum frequency of in-place compaction testing including density and moisture content will be as follows:
      (i) Compaction testing is required for all trench zones where suitable material or granular fill material is placed.
      (ii) Compaction testing is not required for granular bedding material or zones of random fill.
      (iii) One compaction test shall be done every 100 feet of trench length under pavement and for every three vertical feet of backfill lifts placed. A minimum of two sets of tests are required for each trench backfilled regardless of length.
      (iv) One compaction test will be done for every 300 feet of trench length in unpaved areas and for every three vertical feet of backfill lifts placed. A minimum of two sets of tests are required for each trench backfilled regardless of length.
      (v) As required when the City/Design Professional suspects the quality of moisture control or effectiveness of compaction.
4. Water Mains and Service Lines:
   (a) Unless otherwise specified in Section 01015 – Specific Project Requirements, the Contractor shall conduct a minimum of ten (10) in-place

compaction tests at various locations throughout the project area as designated by the City/Design Professional.

5. Backfill that fails to meet required densities shall be removed and compacted as necessary to achieve specified results at no additional cost to the City.

B. Controlled Low-Strength Material (CLSM) Tests:
   1. Determine unconfined compressive strength using cylinders of CLSM sampled, handled, cured and tested in accordance with ASTM D4832. All tests required shall be made by an acceptable independent testing laboratory at the expense of the Contractor.
   2. The minimum frequency of compressive strength testing will be one set of cylinders obtained once per day or for every 100 cubic yards of flowable backfill placed.

C. Field Quality Control shall be considered incidental to the Work associated with trenching, backfill and compaction. The Contractor shall include all costs in the Bid Price and no separate measurement or payment shall be made.

3.23 DISPOSAL OF EXCESS EXCAVATED MATERIALS

A. Except as otherwise permitted in Section 01015 – Specific Project Requirements, all excess excavated materials shall be hauled off and disposed of off-Site by the Contractor.

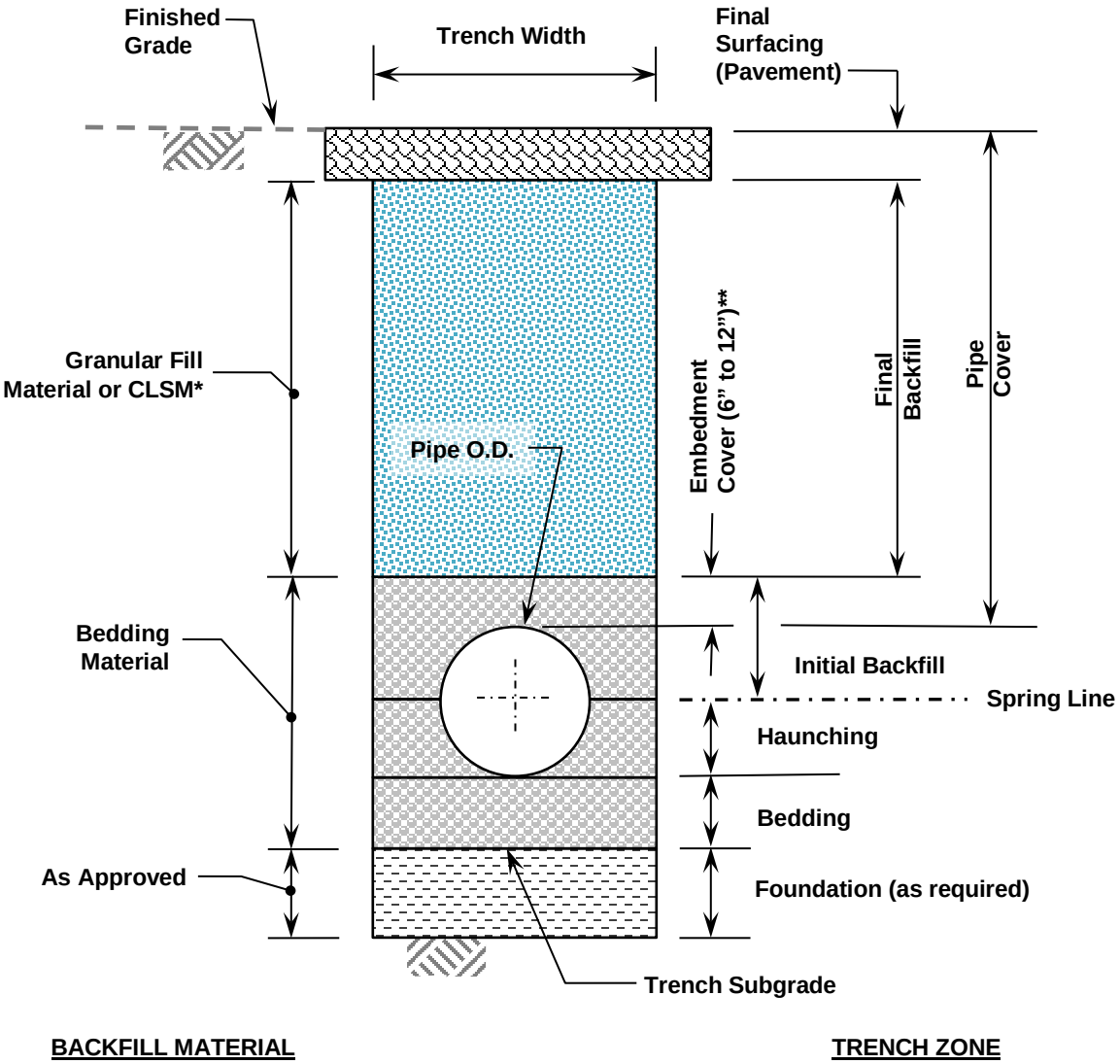
B. The disposal of waste and excess excavated materials, including hauling, handling, grading and surfacing shall be incidental to the work associated with trenching, backfill and compaction. No separate measurement or payment shall be made.

3.24 SEEDING AND SODDING

A. All areas disturbed by the Contractor's operations shall be seeded or sodded according the requirements of Section 02930 – Seeding or Section 02931 – Sodding.

3.25 SETTLEMENT

A. The Contractor is solely responsible for all settlement of backfills, fills and embankments which may occur within the correction period as stipulated in the General Conditions and Supplementary Conditions. The Contractor shall make or cause to be made, all repairs, replacements and restoration associated with settlement within 30 days after receipt of notice from the City.



* CLSM is required as Final Backfill within the Downtown Loop. All other areas shall be Granular Fill Material unless otherwise noted.

** Embedment cover shall be 12 inches within the Downtown Loop

Figure 1. Trench Detail, Class A Bedding, Paved Areas

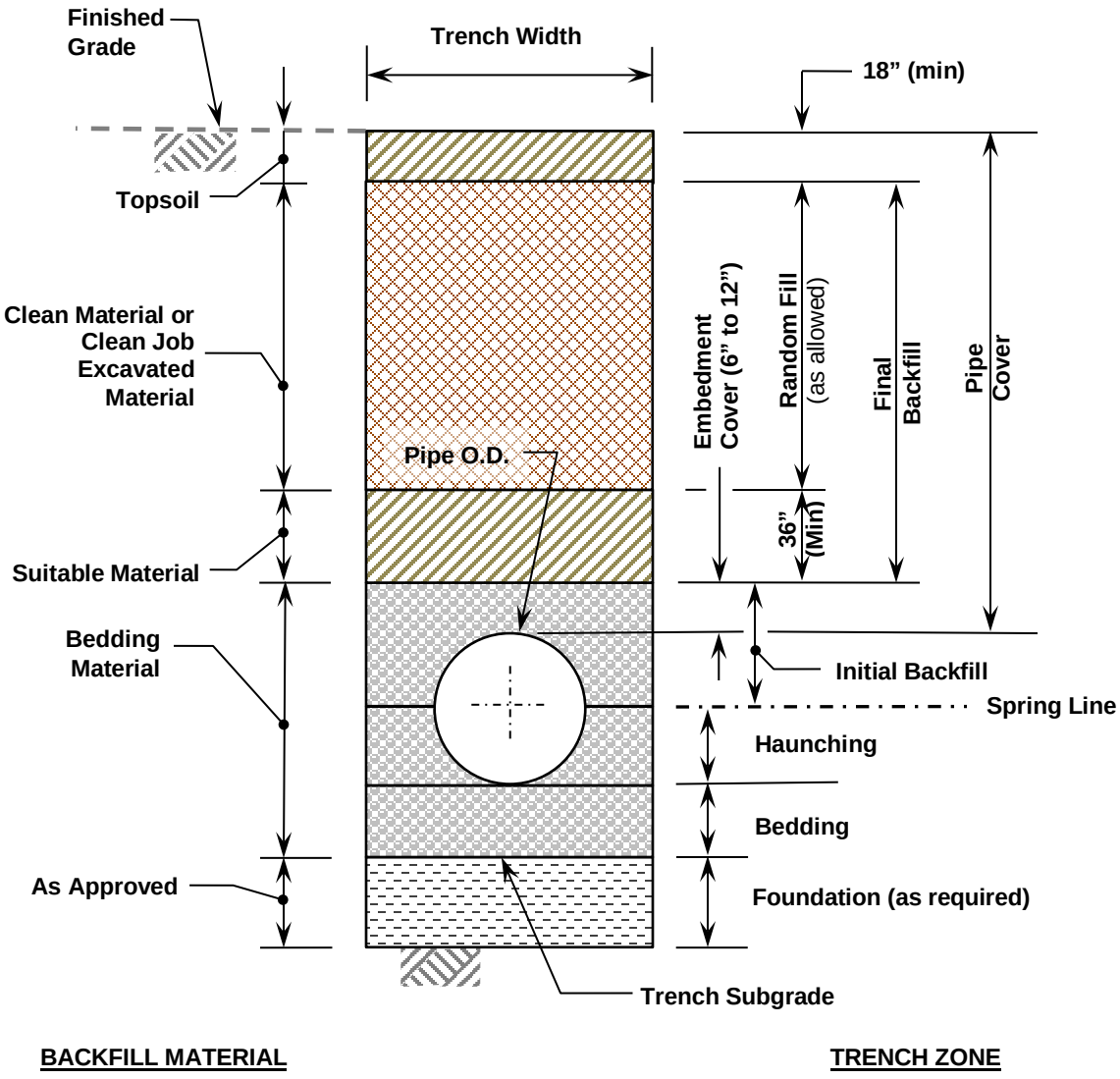


Figure 2. Trench Detail, Class A Bedding, Unpaved Areas

END OF SECTION