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**ADDENDUM NO. 1
CSP # 20-0021**

Date: June 15, 2020
To: All Interested Parties
From: Grady Garrow, CPPB, CTCM, CTCD
Buyer
Re: **CSP No. 20-0021 Siphon 29 Improvements**



The following additions, deletions, changes or clarifications to CSP No. 20-0021 are hereby made a part of the originally issued documents for the above referenced project as fully and as completely as though the same were included therein.

Specifications

Add the attached Specification Section “31 21 33 – Trenching, Backfilling, and Compacting for Utilities” to the Contract Documents.

All provisions which are not so amended or supplemented remain in full force and effect.

Please acknowledge receipt of this addendum with signature and date and return with completed Proposal/Quotation. Failure to do so may cause your Proposal to be considered non-responsive.

Receipt of this Addendum No. 1 is hereby acknowledged

Authorized Signature

Date

Company Name

SECTION 31 21 33

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Excavation, trenching, backfilling and compacting for all underground utilities.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 2. Division 01 – General Requirements.
 3. Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.
 4. Section 31 23 00 – Earthwork.
 5. Section 32 11 13.01 – Lime/Fly-Ash Stabilized Subgrade.
 6. Section 32 11 13.13 – Lime Treated Subgrades.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for this item. Include costs in associated items for the project.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
1. ASTM International (ASTM):
 - a. C33 – Standard Specification for Concrete Aggregates.
 - b. C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - c. C94 – Standard Specification for Ready-Mixed Concrete.
 - d. C123 – Standard Test Method for Lightweight Particles in Aggregate.
 - e. C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - f. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - g. C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
 - h. D558 – Standard Test Methods for Moisture-Density (Unit Weight)

Relations of Soil-Cement Mixtures.

- i. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - j. D1140 – Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve.
 - k. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - l. D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - m. D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - n. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - o. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - p. D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
2. Texas Department of Transportation (TxDOT):
 - a. Tex-101-E – Preparing Soil and Flexible Base Materials for Testing.
 - b. Tex-110-E – Particle Size Analysis of Soils.
 - c. Tex-460-A – Determining Crushed Face Particle Count.
 3. Occupational Safety and Health Administration (OSHA):
 - a. Federal Regulations – 29 CFR Part 1926,
 4. AWWA Standards – Excavation:
 - a. AWWA M9 – Concrete Pressure Pipe
- B. Qualifications:
1. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner.
 2. Contractor shall provide licensed professional engineer licensed in Texas for design of trench shoring systems or other trench safety plans.

1.4 DEFINITIONS

- A. Classification of Excavation: Excavation shall be "unclassified" and involves the removing of the necessary materials to provide the trench to the required width and depth. The Contractor, prior to submitting a proposal, must satisfy himself as to the actual subsurface conditions. No extra or separate payments shall be made for rock, or any other condition.

1.5 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Submit planned typical method of excavation, backfill placement and compaction including:
 - a. Trench widths.
 - b. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction
 - c. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
4. Submit backfill material sources and product quality information in accordance with requirements of this section, including Atterberg Limit tests for select backfill material.
5. Submit sieve analysis reports on all granular materials.
6. Certified Test Reports for embedment material, coarse gravel, and flexbase. Certified Test Reports shall be from an independent laboratory. Test reports shall include sieve analysis, Atterberg limits, and results of an Abrasion test.

B. Miscellaneous Submittals:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give northing and easting coordinates, horizontal dimensions, elevations, inverts and gradients.
3. Submit 11-inch by 17-inch copy of Drawing with plotted utility or obstruction location titled Critical Location Report to Owner's Representative as described in 1.6.D.1. Drawing shall be signed and sealed by R.P.L.S.
4. Submit trench excavation safety program.
5. Submit trench shield (trench box) certification if employed:

- a. Specific to Project conditions.
- b. Re-certified if members become distressed.
- c. Certification by licensed professional structural engineer, licensed in the State of Texas
- d. Owner's Representative and Owner are not responsible to, and will not, review and approve.

1.6 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
 1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner's Representative to prevent serious interruption of travel.
- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner's Representative and controlling agency.
- D. Protection of Existing Structures and Utilities. "Structure" shall be defined as including concrete headwalls, wingwalls, siphon pipes, riprap protection, and associated appurtenances.
 1. The Contractor shall advise the Owner's Representative of any existing utilities that are not shown on the Drawings, or are shown incorrectly, that affect the structure layout. Contractor shall also propose a resolution to the utility conflict for the Owner's Representative's review. The Owner's Representative will determine whether the utility will be relocated or the proposed structure location will be revised. If the structure location is revised, an adjustment to the Contract price will be agreed to as described in the General Conditions. If the proposed structure and surrounding grade is adjusted by 2 vertical feet or less, no Contract Price adjustment will be made. If the proposed structure and surrounding grade is adjusted by more than 2 vertical feet, a Contract Price adjustment will be agreed to as described in the General Conditions.
 2. Utilities that affect the structure layout will be interpreted by the Owner's Representative as follows:
 - a. Utilities that conflict with the grade of the proposed structure will be interpreted as affecting the structure layout.
 - b. Utilities that conflict with the operations and maintenance of the proposed structure will be interpreted as affecting the structure layout.

- E. Where excavation endangers adjacent structures and utilities, the Contractor shall, carefully support and protect such structures and/or utilities so that there shall be no damage.
- F. If in the opinion of the Owner's Representative, concrete backfill is necessary for the support of utility lines crossing trenches, the Owner's Representative may direct 2000 psi concrete backfill to be used. Payment shall be made to the Contractor at the lump sum price (proposal item A.12) for the installation of such quantity of the concrete backfill as directed by the Owner's Representative.

1.7 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings by class, as described in Paragraph 2.1B, and by material requirements, as given in Paragraph 2.2.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: non-plastic.
 - b. Gradation: D_{60}/D_{10} - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: non-plastic to 4.
 - b. Gradations:
 - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
 - 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
 - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
 - 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.

- b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
- 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: greater than 7, above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 5. Class IVB: Fat clays (CH).
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 MATERIAL REQUIREMENTS

- A. Soils classified as silt (ML), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials.
 - 1. These soils may be used for site grading and restoration in unimproved areas as approved by the Owner's representative.
 - 2. Soils in Class IVB, fat clay (CH) may only be used as backfill materials outside of roadways and outside select backfill limits for structural walls as shown on the Drawings and where otherwise allowed by this Specification Section.
- B. Provide backfill material that is free of stones greater than 2 IN, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:
 - 1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C142.
 - 2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C123.
 - 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C40.
 - 4. Clay Clods: Less than 2 inches in least dimension.

- 5. In no case will the above materials be permitted in the pipe zone.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in the product specification and on the Drawings, and approved by the Owner’s representative, provided that the physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, or SW by the Unified Soil Classification System (ASTM D2487) meeting the following requirements:
 - 1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM D 1140.
 - a. The amount of clay lumps or balls not exceeding 2 percent.
 - 2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318:
 - a. Liquid limit: not exceeding 25 percent.
 - b. Plasticity index: not exceeding 7.
- E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C33 and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
3/8 IN	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to the requirements of ASTM C33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
3/8 IN	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of angular gravels and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
1/2 IN	100
3/8 IN	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for the same construction activity from a single source.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C131.
4. Crushed aggregate shall have a minimum of 90 percent of the particles retained on the No. 4 sieve with 2 or more crushed faces as determined by Test Method TxDOT Tex-460-A, Part I.
5. Crushed stone:
 - a. Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from a naturally occurring single source.
 - b. Uncrushed gravel are not acceptable materials for embedment where crushed stone is shown on the applicable utility embedment drawing details.
 - c. Where coarse gravel is required for water drainage, restoration of trench foundation, or other uses, it shall be crushed stone in compliance with ASTM C33 for Coarse Concrete Aggregate. Gradation shall be ASTM C33 No. 57, No. 67, or as follows:

Sieve Size Sq. Openings	Amount Passing Percent by Weight
1"	95-100
3/4"	55-85
1/2"	25-50
No. 4	0-5

6. Crushed Concrete:
 - a. The Owner's Representative will make a determination as to whether crushed concrete can be allowed and what the acceptable gradation is.

- b. Gradation and quality control test requirements are the same as crushed stone.
- c. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.

7. Gradations, as determined in accordance with TxDOT Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipes Sizes		
	>15 IN	15 IN - 8 IN	<8 IN
1 IN	95 - 100	100	-
3/4 IN	60 - 90	90 - 100	100
1/2 IN	25 - 60	-	90 - 100
3/8 IN	-	20 - 55	40 - 70
No. 4	0 - 5	0 - 10	0 - 15
No. 8	-	0 - 5	0 - 5

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime to meet plasticity criteria.
- J. Native Backfill: Any suitable soil or mixture of soils initially excavated during trench excavation, meeting the requirements of section 2.2 B of this Specification, and within Classes I, II, III and IV; or fat clay (CH) where allowed by 2.2A in this Specification Section.
 - 1. Native backfill is not permitted for wall backfill, import select fill from off site borrow source meeting soil parameters listed in section 2.2.1 of this specification.
- K. Cement Stabilized Sand: Provide cement stabilized sand material per Specification Section 31 32 13.06 – Cement Stabilized Sand.
- L. Concrete Backfill: Conform to Class B concrete as specified in Division 03 – Concrete.
- M. Subgrade Stabilization Materials: Provide subgrade stabilization material per Specification Section 32 11 13.01 – Lime/Fly-Ash Stabilized Subgrade, or

N. Granular Embedment Material: Granular embedment material may be pea gravel or bank run sand as defined in sections 2.2 G and 2.2 D, respectively. Additionally, granular embedment material shall be free from large stones, clay, and organic material. Granular embedment material shall be a soil classification of GW, GP, SW, or SP as determined by ASTM D2487. The granular embedment material shall be such that when wet, the fine material shall not form mud or muck. The granular embedment material shall be composed of angular, tough durable particles, free from thin, flat and elongated pieces, of suitable quality to insure permanence in the trench and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or ASTM C535. The P.I. of the fines shall not exceed 3. Light weight aggregate is not acceptable for granular embedment. Material used for granular embedment shall have a resistivity of not less than 5000 ohms/cm as measured by ASTM G57.

O. Well-graded Crushed Stone Bedding Material:

1. ASTM C33, gradation 67 (3/4 IN to No. 4 sieve) defined below:

Sieve	Percent
1"	100
3/4"	90 to 100
3/8"	20 to 55
No. 4	0 to 10

P. Lime Stabilized Clay Backfill.

1. Clayey material hydrated lime or quicklime to achieve a pH of 12.4 and a plasticity index (PI) of less than 20 in accordance with ASTM D 4318.
2. The optimum lime content to be determined by lime optimization curve using specific soil sample and proposed lime additive.

Q. Flowable fill: Provide Flowable Fill in accordance with Specification Section 31 23 23.33 – Flowable Fill as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by Owner's Representative to site provided by Contractor.
- B. Establish traffic control when working within the public right of way per applicable specifications. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.

- C. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as designed by the Contractor's engineer licensed in the State of Texas.
- D. Immediately notify agency or company owning any existing utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.
- E. Maintain permanent benchmarks, monumentation and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed.
- F. Limit pavement removal to less than five pipe laying days in advance of pipe laying.

3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, sand, gravel, hard pan, loose shale, and loose stone to required lines and grades, or as directed by Owner's Representative.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner's Representative and obtain instructions before proceeding.
- C. Excavation for Appurtenances:
 - 1. 12 IN (minimum) clear distance between outer surface and embankment.
 - 2. See Specification Section 31 23 00 – Earthwork for applicable requirements.
- D. Groundwater Dewatering:
 - 1. Shall be in accordance with Specification Section 01 57 23.02 – Control of Ground Water and Surface Water.
 - 2. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade, to allow subgrade stabilization, pipe, bedding, embedment, and backfill material to be placed in a dry, stable trench.
 - 3. Groundwater shall be drawn down and maintained at least 5 FT below the bottom of any trench or manhole excavation prior to excavation.
 - 4. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - a. Employ dewatering specialist for selecting and operating dewatering system.
 - 5. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
 - 6. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.

7. Install groundwater monitoring wells as necessary.
8. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

E. Critical Location Investigation

1. Prior to excavation, the contractor shall properly locate and identify all existing utilities in proximity to the structure. The contractor shall confirm utilities using vacuum excavation or other suitable excavation method and provide a submittal to the Owner with their findings and proof of completion.
2. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. Unless otherwise approved by Owner's Representative, at Critical Locations shown on Drawings, perform vacuum excavation to field verify horizontal and vertical locations of such lines within zone of 2 feet vertically and 4 feet horizontally of proposed work.
 - a. Verify location of existing utilities prior to manufacturing pipe. Use extreme caution and care when uncovering utilities designated by Critical Locate.
 - b. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction within 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.
3. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.
4. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 11 inch by 17 inch copy of Drawings.

F. Protection

1. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.
2. Protect and support above-grade and below-grade utilities which are to remain.
3. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.

4. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to Owner.

G. Trench Excavation:

1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
 - a. Support existing utility lines where proposed work crosses at a lower elevation.
 - 1) Stabilize excavation to prevent undermining of existing utility.

H. Pipe Trench:

1. The "pipe zone" shall be defined as the zone from 12 inches below the bottom of the pipe to 12 inches above the top of the pipe, unless otherwise noted on Drawings.
2. The trench walls in the pipe zone shall be vertical. Trench widths shall be as shown on the Drawings.
3. Trench walls above the pipe zone may be laid back or benched where room permits as necessary to meet the requirements of OSHA.
4. For semi-rigid pipe or flexible pipe (including AWWA C200 steel pipe, AWWA C303 bar-wrapped concrete cylinder pipe, PVC, Ductile Iron, and other pipe materials as listed in appropriate specifications), where the character of the trench walls is loose, unstable, saturated soft clays, quicksand or otherwise unable to provide adequate side support to maintain the required pipe deflection, the Contractor shall modify the backfill to keep the pipe within the limits of the specified pipe deflection.
 - a. Contractor shall widen the trench excavation to accommodate modified backfill procedure.
 - b. Contractor shall protect exterior pipe coating, and shall repair any damage caused by backfilling.
 - c. Concrete encasement, soil cement, flowable fill or some other method approved by the Owner's Representative may be used in lieu of this procedure.

I. Pipe Foundation:

1. Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints make up properly. Excavate the trench to the line and grade indicated and as directed by the Owner's Representative. Grades shall be uniform between high points and low points to eliminate intermediate "highs and lows."

2. The trench shall be "rough cut" a minimum of 12 inches below the bottom of the pipe, unless otherwise noted on drawings. The "rough cut" dimension shall be increased as necessary to provide a minimum clearance of 2 inches from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.
3. The entire foundation area in the bottom of all excavations shall be firm, stable material. Loose material shall be removed, leaving a clean, flat trench bottom, and material shall not be disturbed below required sub grade except as hereinafter described. If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be obtained at the elevation specified, then when directed by the Owner's Representative the Contractor shall deepen the excavation to a depth where a satisfactory foundation can be obtained. The subgrade shall then be brought back to the required grade with the well-graded crushed stone bedding materials and construction methods specified in section 3.3 and 3.4 of this specification.
4. Remove soft, loose or spongy foundation soil caused by Contractor failure to dewater, rainfall, or Contractor operations. Replace with well-graded crushed stone bedding material, as noted above, with no additional compensation.
5. If over excavation does not yield satisfactory foundation conditions, then construct the foundation in accordance with section 3.3 J. of this specification.

J. Correcting Faulty Grade:

1. If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade as specified below:
 - a. In uniform, stable dry soils, correct the faulty grade with embedment material thoroughly compacted, as defined in sections 3.3 and 3.4 of this specification.
 - b. In soft spongy disintegrated soils or where necessary to allow proper drainage, correct the faulty grade using well-graded crushed stone bedding in accordance with section 3.3 J. of this specification.
 - c. Maximum allowable loose lift thickness for embedment or well-graded crushed stone bedding material shall be 8 inches.

K. Pipe Clearance in Rock: Remove ledge rock, rock fragments, or unyielding shale or marl to provide a clearance of at least 12 inches below the parts of the pipe, valves or fittings. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes. Refill the excavation to grade with embedment material.

L. Blasting Procedure: Blasting shall not be allowed.

M. Bell Holes Required:

1. Bell holes of ample dimension shall be dug in trenches at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel.
 2. Pipe with field-applied exterior coatings shall have the joints excavated to sufficient depth to allow proper cleaning, application, testing and inspection of the field-applied coating system.
- N. Care of Surface Material for Reuse: Surface materials such as topsoil in its natural state, suitable for reuse in restoring the excavated surface, shall be kept separate from the general excavation material. The top 12 inches of the trench backfill shall be considered topsoil. Save the topsoil to be used as backfill of the top 12 inches of the trench after pipe laying.
- O. Manner of Piling Excavated Material: Place excavated material so that Work is not endangered or interferes with public traffic, or the stability of excavations and open trenches. Do not place excavated material over buried pipelines or existing utilities unless adequate provisions are made to protect those pipelines and/or utilities. Roads and driveways must be kept open in every case. Keep drainage channels clear of obstructions or make other satisfactory provisions for drainage.

3.3 BACKFILLING OF TRENCHES OUTSIDE ROADWAYS

- A. General: This Section is intended to cover the requirements for trench backfill where trench is in open fields, unimproved alleys, fields, and other similar open areas, except public and private roadways.
- B. Time of Backfilling: Backfill operations shall immediately follow pipe jointing, joint coating application, and curing.
- C. Braced and Sheeted Trenches: Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is obtained between the backfill material and the undisturbed trench walls.
- D. Protection of Pipe during Backfilling Operations: Take the necessary precautions to protect the pipe during backfilling operations. Take care to prevent damage to the pipe or to the pipe coating, and repair any damaged pipe before being "covered up". Backfill the trench to prevent the deformation or otherwise deflection of the cylindrical shape of the pipe by more than the allowable pipe deflection as specified elsewhere. Use methods such as stulling or ellipsing as necessary.
- E. Site and Preparation: In addition to clearing and grubbing of brush and trees along the right of way for this Project, alteration to the topography shall be done if indicated on the Drawings, at the locations and to the extent shown.
- F. Compaction: All compaction shall be in accordance with specification 3.6 of this specification. See specification section 3.7 for density and testing requirements.
- G. Backfill Procedure for Culvert Pipe and Structures:

1. Embedment material for culvert pipe and structures shall be cement stabilized sand material as specified in Specification Section 32 32 13.16 – Cement Stabilized Sand. Place the first lift of granular embedment material (bedding layer) to a depth slightly above the bottom of pipe grade and compact. Lay pipe on this material to the indicated grade. Provide bell holes to permit the pipe to rest on the full length of the barrel and to permit joint make-up.
2. Place subsequent lifts of granular embedment uniformly on both sides of the pipe to a depth of 12 inches above the pipe and structures. Compact using low ground pressure vibration or mechanical tamping in 6 to 8 inch loose lifts. Contractor shall take precautions to ensure no voids occur under the haunches of the pipe and to prevent disturbance of the pipe alignment. The Contractor shall be responsible for any damage that may occur to the pipe.
3. Backfill above culvert pipe and structure:
 - a. Under unimproved areas: After placement and compaction of the granular embedment, place native backfill in the trench for the full width of the trench to the top of the trench. Consolidate this material by mechanical compaction in 6 to 8 inch loose lifts. The Contractor shall be responsible for any damage that may occur to the pipe.
 - b. Under proposed paving: After placement and compaction of the granular embedment, deposit native backfill in the trench for the full width of the trench to within 3 feet of pavement subgrade then place lime stabilized clay or cement stabilized sand or Owner approved select backfill to immediately below pavement subgrade. Consolidate this material by mechanical compaction in 6 to 8 inch loose lifts. The Contractor shall be responsible for any damage that may occur to the pipe.

H. Surface Material Replacement:

1. The top 12 inches of the trench backfill shall be composed of the original surface material or topsoil excavated from the trench. Place the topsoil over the consolidated trench backfill material and neatly round over the trench to a sufficient height to allow settlement to grade after consolidation. Grade the surface to allow drainage in the same manner as existed prior to construction.
2. Top soil shall not contain rocks or clods larger than those adjacent to the trench in the undisturbed condition.

I. Do not place backfill in wet conditions:

J. Flowable Fill:

1. Backfill with flowable fill in areas as shown in construction drawings.
2. Place in 4 FT maximum lifts to the elevations indicated.
 - a. Allow 12 HR set-up time before placing next lift or as approved by the Owner's representative.

- b. Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
3. Do not place flowable fill on frozen ground.
4. Place flowable fill on subgrade free of disturbed or softened material and water.
5. Conform to appropriate requirements of Specification Section 31 23 23.33 – Flowable Fill.
6. Start flowable fill batching, mixing, and placing if weather conditions are favorable, and the air temperature is 34 DegF and rising.
7. Temperature of flowable fill at the time of placement: At least 40 DegF.
8. Stop mixing and placing when the air temperature is 38 DegF or less and falling.
9. Each filling stage shall be as continuous an operation as is practicable.
10. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
11. Do not place flowable fill until water has been controlled or groundwater level has been lowered in conformance with the requirements of the Groundwater Dewatering paragraph in this Specification Section.

3.4 BACKFILL PROCEDURE FOR UTILITIES UNDER EXISTING PUBLIC AND PRIVATE ROADS OR UNDER OTHER UTILITIES

- A. Compact backfill material within the pipe zone as described in 3.3.
- B. For trench excavation above the pipe zone, fill the excavation to the pavement subgrade with cement stabilized sand compacted to 95 percent standard density at plus 2 to minus 1 percent optimum moisture in maximum 6 to 8 inch lifts.

3.5 TRENCH SHORING AND BACKFILL

- A. Shoring of Trench Walls.
 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.

4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.
- B. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, and degree of compaction reduced. Recompile after shield is moved is soil is disturbed.
 3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
 5. Conform to applicable Government regulations.
- C. Voids under paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.
- D. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- E. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of pipeline company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by pipeline company's representative.

3.6 COMPACTION

A. General:

1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:

1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.

LOCATION	MATERIAL	COMPACTION DENSITY
All applicable areas	Bank sand	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D698 and ASTM D2922
	Pea gravel	95 percent of maximum relative density by ASTM D4253 and ASTM D4254
	Well-graded crushed stone	95 percent of maximum relative density by ASTM D4253 and ASTM D4254
	Native and select backfill	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D698 and ASTM D2922
	Cement stabilized sand	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D558 and ASTM D2992

3.7 FIELD QUALITY CONTROL

A. Testing:

1. Atterberg limit tests shall be furnished by contractor for select backfill material for review and approval prior to placement of select backfill in areas shown in drawings
2. In-place density tests of compacted materials will be performed by Owner's Representative according to the standards provided in section 3.6, and at the following frequencies and conditions.
3. Owner will provide a recognized testing laboratory capable of performing a full range of testing procedures complying with the standards or testing procedures specified. The testing lab shall provide certified technicians that are trained and knowledgeable in, in-trench nuclear density testing, sand cone, concrete sampling and testing, ASTM D698 and D1557 proctors at a minimum.
4. Testing Frequency: Accommodate the Owner's Representative in performing the following:
 - a. Testing: Pothole every 1000 feet and grab Samples at pipe level for materials testing and proctors.

- b. Owner's Representative shall take a minimum of three in-trench/ pipe zone nuclear density tests every 150 feet of installed pipe.
 - c. Owner's Representative shall take a minimum of three nuclear density tests above the pipe zone for every 150 feet.
 - d. Owner's Representative shall take a minimum of three in-trench/pipe zone nuclear density test and a minimum of three above pipe zone nuclear density test at all open cut road crossings.
 - e. Contractor to update his field "as-built" drawings with density test locations in the profile.
5. When requested by Owner's Representative, Contractor shall excavate test pits after the backfill has been placed and compacted in the pipe zone for the purpose of taking field density tests and inspecting the haunch areas under the pipe for voids.
 6. When requested by Owner's Representative, Contractor shall excavate the test pits to a depth and area of sufficient size to allow the inspector to visually inspect the haunch area of the pipe for voids or loose material next to the pipe and to make a field density test. Provide a safety trench shield to protect the inspector while in the pit.
 7. After inspection, backfill and compact the test pit area in accordance with the applicable specification herein.
 8. Dig one test pit for inspection of each day's work, if deemed necessary, as determined by the Owner's Representative. Repair and replace areas that are found not to be in compliance with the Specification requirements, until satisfactory results are consistently and uniformly attained.
 9. Special care should be taken by the Contractor to ensure the backfill material flows under the pipe haunches. The Contractor's method and procedures used to accomplish this will be observed to confirm that adequate results are being achieved. This may require the removal of pipe joints to observe the results and make density tests. Pipe laying shall not begin until satisfactory results are achieved by the Contractor's proposed method. Perform additional tests as directed until compaction meets or exceeds requirements.
 - a. Cost associated with "Failing" tests shall be paid by Contractor.
 10. Assure Owner's representative has immediate access for testing of all soils related work.
 11. Ensure excavations are safe for testing personnel.

3.8 OWNER TRAINING (NOT USED)

END OF SECTION