SECTION 02140
UTILITY BACKFILL MATERIALS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Material Classifications.
- B. Utility Backfill Materials:
  1. Concrete sand.
  2. Gem sand.
  3. Pea gravel.
  4. Crushed stone.
  5. Crushed concrete.
  6. Bank run sand.
  7. Select backfill.
  8. Random backfill.
- C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. No separate payment will be made for backfill material. Include payment in unit price for applicable utility installation.
  2. Payment for backfill material, when included as separate pay item or when directed by the Project Manager, shall be on a cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to the Drawings or as directed by the Project Manager.
  3. Payment for backfill of authorized over-excavation is in accordance with Section 02130 – Extra Unit Price Work for Excavation and Backfill.
  4. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section shall be included in Total Stipulated Price.

1.3 DEFINITIONS
- A. Unsuitable Material:
  1. Materials classified as ML, CL-ML, MH, PT, OH and OL according to ASTM D2487.
  2. Materials that cannot be compacted to required density due to gradation, plasticity or moisture content.
  3. Materials containing large clods, aggregates or stones greater than four inches (4 In) in any dimension; debris, vegetation or waste; or any other deleterious materials.

4. Materials contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material:
   1. Materials meeting specification requirements.
   2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material shall be placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs as directed by the Project Manager.

D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement-stabilized sand or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation twelve inches (12 In) above top of pipe and including pipe bedding, haunching and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

I. Source: Source selected by the Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits or sand and aggregate production or manufacturing plants, subject to approval by the Project Manager.

J. Refer to Section 02125 – Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

A. ASTM – American Society for Testing and Materials.
   1. ASTM C33 – Standard Specification for Concrete Aggregate.
   2. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
   3. ASTM C123 – Standard Test Method for Lightweight Particles in Aggregate.
   4. ASTM C131 – Standard Test Method for Resistance to

Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.

5. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
6. ASTM C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
7. ASTM D1140 – Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
8. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
10. ASTM D4643 – Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

B. CFTS – City of Friendswood Technical Specifications.

C. TxDOT – Texas Department of Transportation.

1. TxDOT Tex-110-E – Determining Particle Size Analysis of Soils.
2. TxDOT Tex-460-A – Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.

B. Submit description of source, material classification and product description, production method and application of backfill materials.

C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.3, Material Testing.

D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on a private property.

E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as a specific bid item.

1.6 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 2.3.B.

B. Verification tests of backfill materials shall be performed by the City in accordance with Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures and in accordance with Paragraph 3.3.

1.7 EMBEDEMENT

A. Gravity Sanitary Sewers and Storm sewers shall use Cement-Stabilized Sand for bedding, haunching and initial backfill.

B. Water lines and Force Main Sewers shall use Bank run sand for bedding, haunching and initial backfill.

PART II: 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 D2487. Material use and application is defined in utility installation specifications and the Drawings either by class, as described in Paragraph 2.1.B or by product descriptions, 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 four percent (4%); amount passing No. 200 sieve – less than or equal to five percent (5%).
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 four (4).
   b. Gradations:
      1) Gradation (GP, SP): amount passing No. 200 sieve – less than five percent (5%).
      2) Gradation (GM, SM): amount passing No. 200 sieve – between twelve percent (12%) and fifty percent (50%).
      3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve – between five percent (5%) and twelve percent (12%).
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 seven (7).
   b. Gradation: Amount passing No. 200 sieve – between twelve percent (12%) and fifty percent (50%).
4. Class IVA: Lean clays (CL).
   a. Plasticity Indexes:
      1) Plasticity index: Greater than seven (7) and above A line.
      2) Borderline plasticity with dual classifications (CL-ML): PI between four (4) and seven (7).
   b. Liquid limit: Less than fifty (50).
   c. Gradation: Amount passing No. 200 sieve – greater than fifty percent (50%).
   d. Inorganic.
5. Class IVB: Fat clays (CH).

a. Plasticity index: Above A line.
b. Liquid limit: Fifty (50) or greater.
c. Gradation: Amount passing No. 200 sieve – greater than fifty percent (50%).
d. Inorganic.

6. Use soils with dual class designation according to ASTM D2487 and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML) silty clay (CL-ML with PI of four (4) to seven (7), elastic silt (MH), organic clay and organic silt (OL, OH) and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by the Project Manager. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Section 02120 – Excavation and Backfill for Structures and Section 02125 – Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than six inches (6 In), free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
1. Clay lumps: Less than one-half percent (1/2%) for Class I and less than two percent (2%) for Class II, when tested in accordance with ASTM C142.
2. Lightweight pieces: Less than five percent (5%) when tested in accordance with ASTM C123.
3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification and as approved by the Project Manager, provided that physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW or SM by Unified Soil Classification System (ASTM D2487) meeting following requirements:
1. Less than fifteen percent (15%) passing No. 200 sieve when tested in accordance with ASTM D1140. Amount of clay lumps or balls may not exceed two percent (2%).
2. Material passing No. 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318: Plasticity index: not exceeding seven (7).

E. Concrete Sand: Natural sand, manufactured sand or combination of natural and manufactured sand conforming to requirements of ASTM C33 and graded within limits specified in Table 4.1 – SIEVE ANALYSIS REQUIREMENTS FOR CONCRETE SAND in this section, when tested

in accordance with ASTM C136.

F. Gem Sand: Sand conforming to requirements of ASTM C33 for course aggregates specified for No. 8 size and graded within the limits specified in Table 4.2 – SIEVE ANALYSIS REQUIREMENTS FOR GEM SAND in this section, when tested in accordance with ASTM C136.

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the limits specified in Table 4.3 – SIEVE ANALYSIS REQUIREMENTS FOR PEA GRAVEL in this section, when tested in accordance with ASTM C136.

H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:
   1. Materials of one (1) product delivered for same construction activity from single source, unless otherwise approved by the Project Manager.
   2. Non-plastic fines.
   3. Los Angeles abrasion test wear not exceeding forty-five percent (45%) when tested in accordance with ASTM C131.
   4. Crushed aggregate shall have minimum of ninety percent (90%) of particles retained on a No. 4 sieve with two (2) or more crushed faces as determined by Tex-460-A, Part I.
   5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
   6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. 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 Table 4.4 – SIEVE ANALYSIS REQUIREMENTS FOR CRUSHED AGGREGATE in this section, in accordance with Tex-110-E.

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between seven (7) and twenty (20) or clayey soils treated with lime in accordance with Section 02845 – Pavement Repair and Resurfacing, to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Section 02120 – Excavation and Backfill for Structures and Section 02125 – Excavation and Backfill for Utilities.

K. Cement-Stabilized Sand: Conform to requirements of Section 02145 – Cement-Stabilized Sand.

L. Concrete Backfill: Conform to Class A concrete as specified in Section 03300 – Structural Concrete.
M. Flexible Base Course Material: Conform to requirements of applicable portions of Section 02700 – Cement-Stabilized Base Course, Section 02705 – Crushed Concrete Base Course and Section 02715 – Hot-Mix Asphaltic Base Course.

2.3 MATERIAL TESTING
A. Source Qualification: Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
1. Gradation: Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
2. Plasticity of material passing No. 40 sieve.
3. Los Angeles abrasion wear of material retained on a No. 4 sieve.
4. Clay lumps.
5. Lightweight pieces.
6. Organic impurities.
B. Production Testing: Provide reports to the Project Manager from an independent testing laboratory that backfill materials to be placed in the Work meet applicable specification requirements.
C. Assist the Project Manager in obtaining material samples for verification testing at source or at production plant.

PART III: EXECUTION

3.1 SOURCES
A. Use of existing material in trench excavations is acceptable, provided applicable Technical Specification requirements are satisfied.
B. Identify off-site sources for backfill materials at least fourteen days (14 D) ahead of intended use so that the Project Manager may obtain samples for verification testing.
C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications shall be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials or by contamination. Once material is approved by the Project Manager, expense for sampling and testing required to change to different material shall be arranged and paid for by the Contractor.

D. Bank run sand, select backfill and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
E. The City does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
B. Establish temporary stockpile locations for practical material handling, control and verification testing by the Project Manager in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

A. Quality Control.
    1. The Project Manager may sample and test backfill at:
        a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
        b. On-site stockpiles.
        c. Materials placed in the Work.
    2. The Project Manager may re-sample material at any stage of work or location if changes in characteristics are apparent.
B. Production Verification Testing: A Certified testing laboratory as described in Section 01470 – Testing Laboratory Services, will provide verification testing on backfill materials, as directed by the Project Manager. Samples may be taken at source or at production plant, as applicable.

PART IV: TABLES

4.1 SIEVE ANALYSIS REQUIREMENTS FOR CONCRETE SAND

Sieve	Percent Passing
3/8”	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%

4.2 SIEVE ANALYSIS REQUIREMENTS FOR GEM SAND

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

4.3 SIEVE ANALYSIS REQUIREMENTS FOR PEA GRAVEL

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

4.4 SIEVE ANALYSIS REQUIREMENTS FOR CRUSHED AGGREGATES

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

END OF SECTION