SAN ANTONIO RIVER AUTHORITY
UTILITIES DEPARTMENT

SECTION 33-05-05
SEWER EXACAVATION, TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 DESCRIPTION:

A. RELATED WORK SPECIFIED ELSEWHERE

Section 01-33-00 – Submittals
Section 33-01-31 - Sewer Main TV Inspection
Section 33-05-06 - Sanitary Sewer Testing
Section 33-05-07 - Jacking, Boring or Tunneling Pipe
Section 33-05-61 - Standard Sanitary Sewer Manholes
Section 33-05-63 - Sanitary Sewer Structures
Section 33-31-00 - Sanitary Sewers
SAWS ITEM NO. 299 Flowable Fill
SAWS ITEM NO. 300 Concrete (Natural Aggregate)
SAWS ITEM NO. 550 Trench Excavation Safety Protection

B. SCOPE

This section shall govern the excavation, trenching and backfilling for sanitary sewers and pipe culverts, unless otherwise noted in the project plans and specifications. The work shall include all necessary pumping or bailing, sheeting, drainage, the construction and removal of any required cofferdams, and any incidental construction.

Unless otherwise shown on the plans, bid proposal or contract documents, all excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed, to include, but not limited to, rock, stone, sand, organic material, or whatever material is encountered.

C. OTHER JURISDICTIONS

All work within the railroad, local, county or state right of way must meet the indicated requirements in this section or the requirements indicated in the plans or permit, whichever is more stringent. Prior to the start of construction, the CONTRACTOR will be responsible for contacting the appropriate jurisdiction and coordinating his activities in accordance with the appropriate operating procedures. Approval for all completed work in other rights of way must be obtained from the appropriate official prior to acceptance.

D. SUBMITTALS

Submittals shall be as specified in *Section 01-33-00 – Submittals.*

Prior to the start of construction, the CONTRACTOR shall submit to the OWNER test results utilizing the provided tests. However, actual types of tests performed will be performed as specified on the project plans or contract documents:

- Plasticity Index: *ASTM D4318* (Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils),

- Gradation: *ASTM D6913* (Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis),
- Laboratory Compaction: *ASTM D698* (Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort),
- *ASTM D558* (Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures),
- *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).

All laboratory tests must be performed by a third-party laboratory with a current ASTM certification. CONTRACTOR shall also submit to OWNER all test results.

Prior to construction, CONTRACTOR shall provide the qualifications of an independent third-party testing laboratory to be approved by OWNER.

PART 2 PRODUCTS

2.1 SUBGRADE FILLER

Subgrade filler shall meet the following gradation requirements unless modified by the OWNER:

Passing 1½ inch sieve	100%
Passing 1 inch sieve	95 to 100%
Passing $^{3}/_{8}$-inch sieve	40 to 60%
Passing No. 4 sieve	20 to 40%
Passing No. 200 sieve	5 to 10%

Flowable fill may also be used as Subgrade Filler. If utilized, the flowable fill shall conform to the specifications provided in *SAWS ITEM No. 299 Flowable Fill*.

2.2 BEDDING MATERIAL

Bedding material shall be composed of well-graded crushed, washed, angular stone conforming to the following requirements unless modified by the OWNER. This bedding is typically referred to as AASHTO #57. 3/8" diameter "pea gravel" will not be an acceptable alternative.

Passing 1½ inch sieve	100%
Passing 1 inch sieve	95% to 100%
Passing ½ inch sieve	25% to 60%
Passing No. 4 sieve	0 to 10%
Passing No. 8 sieve	0 to 5%

Bedding material shall be inspected prior to installation.

2.3 SELECT INITIAL BACKFILL

Select initial backfill shall conform to the gravel requirements of "*Subgrade Filler*" as specified in

Section 2.1.

Upon OWNER approval, flowable fill may also be used as Select Initial Backfill. If utilized, the flowable fill shall conform to the specifications provided in *SAWS ITEM No. 299 Flowable Fill.* Additional requirements may be required for anchoring against buoyancy, which requires design by a licensed professional engineer, to be paid by the CONTRACTOR, and requires review and approval by OWNER.

Cohesionless materials may be used for backfilling. Use cohesionless materials that conform to the requirements of Table 1.

Table 1 - Cohesionless Material Gradation Limits

Sieve Size	Percent Retained
3″	0
#10	Note 1
#200	90–100

Note 1: No. 10 sieve requirements are 0 to 30% retained when used as aggregate for cement-stabilized backfill.

Compact cohesionless materials using vibratory equipment.

2.4 SECONDARY BACKFILL

Secondary backfill shall generally consist of materials removed from the trench and shall be free of roots, organics, or other degradable/deleterious material. Rock or stones having a dimension larger than 6 inches at the largest dimension shall be sifted out and removed before the material is used in the secondary backfill zone. Secondary backfill material shall be primarily composed of compacted soil materials. The soil material shall be placed and compacted in controlled lifts appropriate for the type of backfill, the type of compaction equipment being utilized, and compaction limits specified.

PART 3 EXECUTION

All existing utilities shall be protected from damage during the excavation and backfilling of trenches, and if damaged shall be replaced by the CONTRACTOR at CONTRACTOR'S expense.

Where construction is within the limits of the floodplain of a river, creek or stream, the CONTRACTOR is required to keep the floodplain clear of potential obstructions to flood flows. Potential obstructions include excavated material, waste material, stockpiled fill material, temporary roads, heavy construction equipment, etc. Under threatening weather conditions and where flooding is possible, obstructions shall be immediately removed by the CONTRACTOR.

3.1 EXCAVATION

The CONTRACTOR shall perform all excavation of every description and whatever substances encountered, to the lines and grades shown on the plans or determined by the OWNER. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading, slides or cave-ins. All excavated material

not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as selected by the CONTRACTOR and approved by the OWNER. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or excavations, and any water accumulating therein shall be removed by pumping or by other approved methods.

Sheeting and shoring shall be installed as necessary for the protection of the work, adjoining property, and for the safety of the personnel. Unless otherwise indicated, excavation shall be by open cut, whether by hand, backhoe, ram-hoe, rock saw, or any method necessary. CONTRACTOR shall provide shoring plan to OWNER.

A. ARCHAEOLOGICAL

If the CONTRACTOR encounters any archaeological deposits during construction operations, the CONTRACTOR must stop excavation immediately and notify the OWNER. The CONTRACTOR cannot begin excavation again without written permission from the OWNER. If more than 5 working days are required for investigation, and if the CONTRACTOR cannot work in other areas of the project, the CONTRACTOR will be permitted to negotiate for additional construction time. The CONTRACTOR must submit a time extension request in writing within 10 working days of stopping work.

B. SAFETY

CONTRACTOR shall provide and maintain barricades, flags, lighting and other safety devices as required by local, state and federal codes and ordinances and conduct work to create a minimum inconvenience to the public. Temporary suspension of work does not relieve responsibility for the above requirements.

All excavations, trenching and shoring shall conform to *SAWS ITEM NO. 550 Trench Excavation Safety Protection.* CONTRACTOR shall at all times conform to all applicable regulations of the Occupational Safety and Health Administration's (OSHA) Excavation standards, *29 Code of Federal Regulations (CFR) Part 1926, Subpart P* and all applicable state and local rules and regulations.

3.2 TRENCHING

A. TRENCH SIDES

Walls should be vertical and the practice of undercutting at the bottom or flaring at the top will not be permitted unless specifically requested in writing by CONTRACTOR and allowed by OWNER. In special cases where trench flaring is permitted and directed by the OWNER, the trench walls shall remain vertical to a depth of at least 12 inches above the top of pipe. The bottom of the trench shall be square or slightly curved to the shape of the trenching machine cutters.

Where the CONTRACTOR has selected "sloping" and/or "benching" as the means of trench excavation protection, trench walls may be allowed that are other than vertical. Where the resulting trench width is wider than that normally required by this section of the specifications, a licensed professional engineer in the state of Texas, who is hired by the CONTRACTOR, must submit engineering calculations showing that additional loadings do not result in the need for a stronger class of pipe. If the calculations show that a stronger class of pipe is required, all additional cost shall be borne by the

CONTRACTOR.

Any voids created during the retention system removal, shall be backfilled by the CONTRACTOR by placing the backfill material in compacted lifts.

B. TRENCH BOTTOM

For rigid pipe and where suitable bedding exists, the bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of pipe on the undisturbed soil at every point along its entire length.

For flexible pipe and/or rigid pipe on unsuitable bedding, the bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of pipe on the minimum subgrade filler layer as established in the bedding requirements of this section, at every point along its entire length.

Bell holes and depressions for joints shall be dug after the trench bottom has been graded to allow for proper sealing of pipe joints and to allow the pipe to rest upon the prepared bottom for its full length.

Where over excavation occurs, the under-cut trench shall be restored to grade, to the satisfaction of the OWNER, by replacement of excavated material compacted to the same density as the surrounding natural ground or to the compaction level specified on the drawings or in the specifications at no additional cost to the OWNER.

Whenever wet or otherwise unstable soil that is incapable of properly supporting the structure or pipe, as determined by the OWNER, is encountered in the bottom of the trench, such soil shall be removed to the depth shown on the plans or determined by the OWNER and the trench backfilled to the proper grade with a subgrade filler layer as established in the bedding requirements of this section.

C. MINIMUM WIDTH OF TRENCH

Unless otherwise specified in the design drawings or specifications, the minimum width of pipe trench, measured anywhere between the bottom of the pipe and the top of the trench shall be 12 inches (6 inches per side) greater than the exterior diameter of the pipe, exclusive of bells. Minimum width shall accommodate backfill placement, compaction equipment, and testing. Exceptions apply at special structures, connections and at temporary structures such as trench supports.

D. MAXIMUM WIDTH OF TRENCH

Except as stipulated herein or on the plans, the maximum allowable width of trench for pipelines, measured anywhere in the pipe envelope (between the bottom of the pipe and 6 inches above the pipe) shall be the outside diameter exclusive of bells or collars) plus 24 inches (12 inches per side).

Within the pipe envelope, a trench wider than the outside diameter plus 24 inches may be used but must fully meet one of these requirements:

1. At the CONTRACTOR'S expense, he shall furnish and install pipe of the required strength to carry additional trench load. Such modifications and calculations shall be submitted in writing to OWNER by a licensed professional engineer in the state of Texas, hired by the CONTRACTOR, for approval. This requirement will not require special bedding or backfill unless required by the CONTRACTOR'S engineer.

2. Except as provided for on the drawings, specifications or by advance written approval of the OWNER, CONTRACTOR, at his expense, shall encase the pipe within the pipe envelope, from trench wall to trench wall, or encase in other pipe bedding material, with advance written approval from OWNER.

In Item 1 or 2, above, excavation wider than the stated minimum that also causes additional work of any kind, including additional pavement or removal and replacement of any surface amenity or utility, such additional work shall be at the CONTRACTOR's expense.

The maximum trench width above the pipe envelope will be governed by the trenching method and work requirements and limitations shown on the plans or included in these specifications.

E. UNACCEPTABLE BEARING MATERIALS

Where water, silt, muck, trash, debris, organics, rock, boulders or coarse gravel (particle size larger than 1¾ inch), or other degradable/deleterious material is encountered at the bearing level, the CONTRACTOR shall, as directed by the OWNER, excavate and remove such materials to a depth of not less than 6 inches below the bottom of the pipe and replace with a subgrade filler layer as established in the bedding requirements of this section.

F. DEWATERING AND CARE OF WATER

The CONTRACTOR shall take necessary steps to prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area. Also, the CONTRACTOR shall not allow water to accumulate in excavations or at changes detrimental to stability of subgrades and foundations. Accordingly, the CONTRACTOR shall:

1. Provide, install and maintain a dewatering (or surface diversion) system with components necessary to deter water from and convey water from excavations.

2. Convey water removed from excavation and rainwater to collecting or runoff areas, ditches and other diversions outside excavation limits. CONTRACTOR shall not use trench excavations as temporary drainage ditches or drainage conveyance devices.

3. Dewatering devices shall be provided by the CONTRACTOR with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the OWNER shall order immediate shutdown, and remedial measures will be the responsibility of the CONTRACTOR.

4. Upon completion of the dewatering work, the CONTRACTOR shall remove all equipment and leave the construction area in a neat and clean condition that is acceptable to the OWNER.

5. CONTRACTOR shall maintain ground water table at least 12 inches below the finished excavation subgrade.

6. Performance of the dewatering system shall be measured by observation wells and piezometers installed by the CONTRACTOR in conjunction with his dewatering system, and these shall be documented once a day, at a minimum. The CONTRACTOR shall maintain a log of these readings and submit them to the OWNER.

3.3 BACKFILLING

A. GENERAL

Trenches shall not be backfilled until the structures or appurtenances have been installed according to the project plans and specifications.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section shall be excavated, in addition to 50 feet on each side. The section shall be excavated to the depth of pipe, then refilled and compacted to the grade and compaction required. The use of sand backfill shall not be allowed.

B. SANITARY SEWER BACKFILLING

Backfill for sanitary sewers is divided into 3 separate zones: (a) bedding material in trench bottom in direct contact with the bottom of the pipe, (b) select initial backfill extending from the surface of the bedding to a point 12 inches above the top of pipe, and (c) secondary backfill extending from the initial backfill surface to the top of the trench.

Unless otherwise specified in the standard details, the thickness of the bedding material will be determined by the outside diameter of the pipe as given in the following table, or as specified by the ENGINEER:

Pipe Outside Diameter (in.)	**Bedding Material Thickness (in.)**
Less than 30	3
30 to 60	4
Greater than 60	6

Flooding with water will not be accepted as a compaction method for subgrade filler, bedding material, or initial or secondary backfill.

1. SUBGRADE FILLER

a. Subgrade filler shall be placed to achieve at least 98% of the maximum density as

determined by *ASTM D698*.

2. BEDDING MATERIAL

   a. Existing stable materials and laying conditions encountered at the pipe bearing level which are acceptable for direct bedding purposes for rigid pipe are coarse sands and gravels with maximum particle size of 1¾ inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry, fine sands and clayey gravels, fine sand, sand/clay mixtures and gravel-clay mixtures.

   b. For flexible sewer pipe to be placed on all types of materials, or for rigid sewer pipe to be placed where unacceptable materials exist at the bearing level, the CONTRACTOR shall, as directed by the OWNER, excavate and remove existing materials to a depth of 6 inches or $^{1}/_{8}$ of the outside diameter of the pipe, whichever is greater, beneath the pipe bottom elevation. Bedding material shall be placed over the full width of the excavation between the undisturbed trench walls. The bedding material shall extend up the sides of the pipe sufficient to embed the lower quadrant of the pipe.

   c. Where the trench bottom has been over excavated beyond the limits defined in this specification due to blasting or removal of unstable material, the pipe shall be concrete encased. Encasement shall extend from the trench wall to trench wall and be a minimum of 6 inches above the top of pipe. No separate pay item.

   d. Where the trench bottom is not excavated in accordance with the specification due to rock or other hard underlying materials, then the pipe shall be concrete encased on all sides and to a minimum of 6 inches above the tope of pipe.

   e. Bedding material shall be consolidated from the bottom of the trench to the top of the pipe centerline.

   f. Bedding material shall be compacted to achieve at least 98% of the maximum density as determined by *ASTM D698*.

3. SELECT INITIAL BACKFILL

   a. Select initial backfill shall be used where the following exists in the initial backfill zone: water, silt, muck, trash, debris, rock, boulders or coarse gravel (particle size larger than 1¾ inch), or for all flexible pipes. Select initial backfill material shall conform to the requirements provided in section 2.3.
   b. For sewer lines less than 24 inches in diameter, select initial backfill material shall be placed in equal lifts not exceeding 8 inches in loose lift thickness. The first lift shall be spread uniformly and simultaneously on each side and under the shoulders of the pipe to its spring line. The first lift of select initial backfill shall be inspected and approved prior to placement of the second lift. The second lift shall extend from the spring line of the pipe to a compacted depth of 12 inches above the top of pipe. The second lift shall be spread in a similar manner as the first lift.
   c. For sewer lines 24 inches in diameter and larger, select initial backfill material shall

be evenly spread alongside, under the haunches of the pipe and over the pipe in maximum 8-inch loose lifts to a compacted depth of at least 12 inches above the top of pipe.

d. Each layer of backfill must provide the density as indicated on the drawings or in the specification. Soils shall be watered as required to provide no more than four percent over optimum moisture content and compacted to the extent shown on the plans. The in-situ density of surrounding natural ground adjacent to trench walls will not be considered in establishment of control densities.

e. Select initial backfill shall be compacted to achieve at least 98% of the maximum density as determined by *ASTM D698*.

4. SECONDARY BACKFILL

a. Secondary backfill is defined as backfill from 12 inches above the top of pipe to the top of the trench, unless otherwise defined in the construction drawings.

b. The secondary backfill material shall be placed in maximum 8-inch loose lifts or as directed by OWNER.

c. All compaction within the secondary backfill zone shall be a minimum of 98% compaction at + or -2% optimum moisture content as per the latest provisions of the *TxDOT Testing Method Tex 113-E*, unless otherwise shown in the project plans.

d. The depth of layers, prior to compaction shall depend on the type of watering and compacting equipment used to achieve the required density and the test results thereby obtained and shall be a maximum of 8 inches.

5. SEEPAGE RETAINERS

To prevent piping and/or seepage along the bedding, concrete seepage retainers, unless otherwise indicated in the construction drawings, are required to be located at 20 feet upstream and downstream of each manhole installation. Seepage retainers are also required at a spacing interval of every 120 feet. When length is not sufficient for placing at every 120 feet, place one retainer at midpoint of pipeline, allowing a total of three retainers per run of pipe between each manhole installation. In cases where less than 120 feet of separation will exist between manholes, two retainers are required at 20 feet upstream and downstream of each manhole installation. Seepage retainers are similar to sand migration prevention collars and shall consist of *SAWS ITEM NO. 300 Concrete (Natural Aggregate) Class B* concrete encasement.

6. TRENCH SURFACE RESTORATION

a. The surface of the backfilled trench shall be restored to match the previous existing conditions. This shall include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that have maintained lawns), or other unprepared and prepared surfaces.

b. Natural ground shall be in accordance with native seeding or sodding (refer to specification section)

c. All pavement and alley restoration shall be in accordance with applicable jurisdictional authority requirements. Included in this requirement is replacement of any curbs, sidewalks, flatwork, or other grade supported features damaged or removed during the construction.

7. DISPOSAL OF EXCAVATED MATERIALS

Excess excavated material, not utilized after all fill requirements have been met, shall become the property of the CONTRACTOR and he shall dispose of it by hauling and wasting outside the limits of the right of way of the project and of public thoroughfares and water courses, in conformity with pertinent city, county, state and federal codes and ordinances and in a manner meeting the approval of the OWNER.

3.4 QUALITY CONTROL/ASSURANCE

A. The CONTRACTOR shall procure, store and place materials from either onsite or offsite sources which comply with the specified requirements.

B. Quality Assurance Testing: The OWNER shall have such tests and inspections as they may desire performed by a nationally accredited independent testing laboratory for guidance and control of the work. Payment for such tests shall be the responsibility of the CONTRACTOR, to be billed to the CONTRACTOR, including the material laboratory compaction tests and field density tests. The CONTRACTOR shall provide access to the test area, associated trench excavation safety protection and backfilling of the test areas. The frequency and location of testing shall be determined solely by the OWNER but will be a minimum of 1 compaction test per 1,000 linear ft on each lift. The OWNER may test any lift of fill at any time, location or elevation.

C. Quality Control Testing: The CONTRACTOR shall be responsible for compaction in accordance with the appropriate specification. Compaction tests will be done at one location point randomly selected or as indicated by the OWNER, per 8-inch loose lift per 400 feet, at a minimum. The OWNER shall determine the depth at which the density test shall be taken. The costs for all quality control testing shall be the responsibility of the CONTRACTOR.

In-place density tests shall be conducted by a nationally accredited independent testing laboratory. The frequency and location of testing shall be in accordance with the following table:

Secondary Backfill Depth (Ft)	Number of Tests per 400 Linear Feet
0-6	3
6-12	5
>12	7 or as directed by the Engineer

Any failed test shall require the CONTRACTOR to remove and replace or rework as required the layer of backfill to points hallway to the next test location at no additional cost. Retests of these areas shall be at the CONTRACTOR's expense.

The CONTRACTOR shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas at the CONTRACTOR's expense.

D. CONTRACTOR shall be responsible for all costs associated with supplying material for the proctor and density tests. These tests shall be performed by a nationally accredited, independent testing laboratory. The CONTRACTOR shall provide access to the results of the material proctor tests to the OWNER prior to performing any backfill operations.

E. If material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent work to obtain the indicated density. At any time, the OWNER may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots which develop shall be corrected immediately by the CONTRACTOR.

F. The test requirements listed in this section are indicated as minimum requirements. There may be more stringent requirements established by other jurisdictional agencies (such as City or County Jurisdiction, TxDOT, etc.)

G. Any failed test shall require the CONTRACTOR to remove and replace that layer of backfill to 50 feet from either side of the failed test location. The CONTRACTOR will also be required at no cost to the OWNER, to provide two additional tests at the replaced location where the initial test failed, and at one location point randomly selected by OWNER.

H. The CONTRACTOR shall provide access to the test area, associated trench excavation safety protection and backfilling of the test areas at CONTRACTOR'S expense.

I. The CONTRACTOR will determine in-place density and moisture content by any one or combination of the following methods: *ASTM D2922* (density of soil and soil aggregate in-place by nuclear methods – shallow depth), *D1556* (lab density of water content of soil and rock), *D3017* (water content of soil and rock – shallow depth in-place by nuclear methods).

PART 4 MEASUREMENT AND PAYMENT

Excavation, trenching, backfilling, dewatering and trench surface restoration will be considered subsidiary to the amount bid for *Section 33-31-00 - Sanitary Sewers*. Measurement and payment shall include full compensation for furnishing all materials, trenching, pumping, bedding, haunching, initial backfilling, secondary backfill, concrete or seepage retainers, concrete encasement for unsuitable bedding materials, laying and jointing tamping, temporary pavement, seeding, sodding, water, labor, tools, equipment and other incidentals necessary to complete the work.

END OF SECTION