SECTION 02223

Trenching, Backfilling, and compacting

# GENERAL

## DESCRIPTION

### This section includes materials, installation, and testing of trench excavation, backfilling, and compacting.

## REFERENCE STANDARDS

### The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

#### ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

#### ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

#### ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

#### ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3))

#### 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 D75 - Standard Practice for Sampling Aggregates

#### ASTM C90 - Standard Specification for Load bearing Concrete Masonry Units

#### ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

## RELATED WORK SPECIFIED ELSEWHERE

### EVMWD Standard Drawings.

### Section 02140 – Groundwater Dewatering

## EARTHWORK AND REPAIRS IN CITY, COUNTY, AND STATE RIGHTS OF WAY

### Conform to the requirements and provisions of the permits issued by those agencies in addition to the requirements of these Specifications. If a permit is not required, earthwork and repairs shall conform to the standards of the agency in whose right of way the work is done in addition to the requirements of these Specifications. Repairs may include street pavement, curb, gutters, swales, sidewalks or other improvements.

## SAFETY PRECAUTIONS

### Observe safety precautions in all phases of the work. Included shall be trench shoring, bracing, lighting, and barricades as dictated by reason and by the Safety Orders of the Division of Industrial Safety, State of California (CAL OSHA). Acquire an exemption letter or trenching permit from the California Division of Industrial Safety (CAL OSHA) and comply with Labor Code Section 6705, Excavation Plans For Worker Protection. Submit a copy of the exemption letter or trenching permit with excavation plans to the DISTRICT prior to excavation work.

## OBSTRUCTIONS

### The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the Plans. The Contractor shall preserve and protect any such improvements whether shown on the Plans or not and expose such improvements in advance of the pipeline construction to allow for changes in the alignment as necessary. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained, and permanently replaced by the Contractor at his expense. Existing underground utilities shall be protected in place.

## SUBMITTALS

### Submit shop drawings in accordance with Specification Section 1, Shop Drawings and Submittals.

### Submit a report from a testing laboratory verifying that imported material is asbestos free and conforms to the specified gradations or characteristics.

## TESTING FOR COMPACTION

### The DISTRICT or the agency having jurisdiction over the area of the work will require the Contractor to test for compaction as described below:

#### Determine the density of soil in place by the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017.

#### Determine laboratory moisture density relations of soils by ASTM D 1557.

#### Determine the relative density of cohesion less soils by ASTM D 4253 and D 4254.

#### Sample backfill materials by ASTM D 75.

#### "Relative compaction" is the ratio, expressed as a percentage of the in place dry density to the laboratory maximum dry density.

#### Make excavation for compaction tests at the locations and to the depths designated by the DISTRICT's Representative. Backfill and re-compact the excavations at completion of testing. When tests indicate that the compaction is less than the specified relative compaction, rework and retest those areas until the specified relative compaction has been obtained.

## PIPE BEDDING

### The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be a minimum of 6 inches.

## PIPE ZONE

### The pipe zone shall include the full width of trench from the bottom of the pipe to a horizontal level 12 inches above the top of the pipe. Where multiple pipes are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be a minimum of 12 inches.

## TRENCH ZONE

### The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the pavement zone or to the existing surface in unpaved areas.

## UPPER ZONE

### The upper zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

## WATER FOR CONSTRUCTION

### Water supplied by the DISTRICT, for whatever needs and uses, shall be paid for in accordance with the rates and rules of the DISTRICT. The only exception is by written agreement with the DISTRICT.

### If DISTRICT water is not available, the Contractor shall be responsible for supplying the construction water.

# MATERIALS

## NATIVE EARTH BACKFILL TRENCH ZONE

### Native earth backfill used above the pipe zone shall be excavated fine grained materials or loose soil free of asbestos, organic matter, roots, debris, rocks larger than 3 inches in diameter, clods, clay balls, broken pavement, and other deleterious materials. Sand Equivalent for said material shall be 20 or better. Backfill material shall be so graded that at least 40% of the material passes a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material. Backfill materials that are obtained from trench excavated materials to the extent such material is available, shall be either screened directly into the trench or screened during the trenching operation. If screened during trenching, the material shall be maintained free of unscreened material during the handling and backfilling process. Hand selecting of rocks from earth as it is placed into the trench will not be permitted in lieu of the specified screening. Under no circumstances will native earth backfill be allowed or used in the pipe base or pipe zone areas.

## IMPORTED MATERIAL FOR BACKFILL TRENCH ZONE

### Imported material shall conform to that specified for native earth backfill or imported sand.

## IMPORTED SAND PIPE BEDDING AND PIPE ZONE

### Imported sand used in the pipe base and pipe zone shall consist of natural or manufactured granular material, or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances. Under no circumstances will decomposed granite or native earth backfill be allowed or used in the pipe base or pipe zone areas. Imported sand shall have the following gradation or similar:

| **Sieve Size** | **Percent Passing By Weight** |
| --- | --- |
| 3/8‑inch | 100 |
| No.4 | 95 – 100 |
| No.30 | 30 – 50 |
| No.100 | 2 – 20 |
| No.200 | 0 – 5 |

### Imported sand shall have a sand equivalent (S.E.) of 30 or greater.

## ROCK REFILL FOR FOUNDATION STABILIZATION

### Rock refill shall be crushed or natural rock having the following gradation:

| **Sieve Size** | **Percent Passing By Weight** |
| --- | --- |
| 3 inches | 100 |
| 1‑1/2 inches | 70 – 100 |
| 3/4‑inch | 60 – 100 |
| No.4 | 25 – 55 |
| No.30 | 10 – 30 |
| No.200 | 0 – 15 |

## GRANULAR MATERIAL FOR BACKFILL

### Where crushed aggregate base is called for in these specifications or in the Standard Drawings, the granular material for backfill shall be free of asbestos, organic materials, clay balls, and shall have the following gradation:

|  |  |
| --- | --- |
| **Sieve Size** | **Percent Passing By Weight** |
| 1-inch | 100 |
| 3/4‑inch | 90 – 100 |
| 1/2‑inch | 40 – 70 |
| 3/8‑inch | 20 – 50 |
| No.4 | 0 – 10 |
| No.8 | 0 – 5 |

### Whenever the phrase "crushed aggregate base backfill material" is used in these Standard Specifications, it shall mean granular material for backfill as described above in 2.05.A and shall be referenced as No. 67.

### Excavated material may be used for backfill provided it conforms to the Standard Specifications for structural backfill material.

## CONCRETE FOR BELOW GROUND INSTALLATIONS

### Concrete for anchors, collars, encasements, supports, and thrust blocks shall be Class A for reinforced items and Class C for un-reinforced items per Specification Section 03300, except use rapid set concrete mix where indicated. Concrete slurry backfill, when required, shall be in accordance with Table 201-1.1.2 (A), 100-E-100 of the Standard Specifications for Public Works Construction (Green Book), latest edition.

### Provide anchor blocks at valves in pipe having rubber gasket bell and spigot or unrestrained mechanical joints.

### Provide support blocks at all valves, depending on Geotechnical Investigation results. Typical support of valves shall be accomplished by compacted Class 2 aggregate base, unless geotechnical conditions dictate otherwise.

### Provide thrust blocks at fittings in pipe having rubber gasket bell and spigot or unrestrained mechanical joints.

### Items B, C, and D shall be in accordance with the Standard Drawings.

## TRENCH CUT OFF WALLS

### Provide ASTM C 90, Grade N I, hollow load bearing concrete masonry units, medium weight, moisture controlled, average compressive strength over gross area of 1,000 psi. Nominal face dimensions: 8 inches by 8 inches by 16 inches.

### Provide ladder conforming to ASTM A 82.

### Mortar and grout shall be a mixture of cement, sand, and water. Mortar shall consist of not more than one part cement to two and one half parts sand by damp loose volume. The quantity of mixing water shall be not more than necessary for handling and placing.

## WATER FOR COMPACTION

### Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe or coatings. Salt water will not be allowed.

# EXECUTION

## GENERAL

### The Contractor shall perform all site grading, soil sterilant application, structure excavation and backfill, trench excavation and backfill for pipelines and conduits, and other earthwork required to complete the work under this contract. Included are all necessary clearing, grubbing, grading, and excavation of all classes and of whatever substance encountered, stockpiling, backfilling, compaction, controlling water, bracing excavations, stabilizing subgrade, protecting existing structures and facilities, complying with conditions of permits and safety regulations, cleaning up debris, papers and loose rocks, restoring fences and other disturbed property, maintaining trees which are not permitted to be removed, and disposing of excess material, and such supplementary operations as are necessary to properly complete the entire work indicated or specified.

## TRENCHING SUBJECT TO PERMIT CONDITIONS

### Trenching within public rights-of-way controlled by a state, county or city, or trenching within railroad rights-of-way shall be in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such permit requirements and provisions which are more restrictive than those specified herein, shall take precedence, and supersede the provisions of these Specifications.

## PROTECTION OF WORKMEN

### Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The latest revision of the rules, orders and regulations of the Division of Industrial Safety of the State of California shall be complied with.

## PUBLIC SAFETY

### Barriers shall be placed at each end of all excavations and such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, water valves, meters, and private drives, or other property or facilities that may have routine use.

## SUPPORT OF ADJACENT PROPERTY

### Excavations shall be so braced, sheeted, and supported that the ground alongside the excavation will not slide or settle, and all existing improvements of any kind, either on public or private property, will be fully protected from damage. Damage to adjacent property or to the work occurring through settlements, water or earth pressures, slides, caves or other causes due to failure of lack of sheeting or bracing or improper bracing, or through negligence or fault of the Contractor in any other manner, shall be repaired by the Contractor at his own expense.

## EXISTING IMPROVEMENTS

### The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the plans. The Contractor shall preserve and protect any such improvements whether shown on the plans or not. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained, and permanently replaced by the Contractor at his expense, except as otherwise provided in the General Provisions.

## DRAINAGE CONTROL

### Control of Surface Drainage

#### The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can flow uninterrupted in existing gutters, other surface drains or temporary drains.

### Preservation of Existing Drainage

#### Except as shown on the Plans, existing drainage patterns shall be preserved. Where construction methods cause a temporary obstruction of drainage patterns temporary facilities adequate for expected flows and a means of emergency removal of the obstruction shall be provided.

## COMPACTION REQUIREMENTS

### Unless otherwise shown on the Plans or otherwise described in the Specifications and required by the agency having jurisdiction over the area of the work, relative compaction in pipe trenches shall be a minimum as follows:

#### Pipe bedding 90% relative compaction.

#### Pipe zone 90% relative compaction.

#### Trench zone 90% relative compaction.

#### Upper zone 95% relative compaction.

## SHEETING, SHORING, AND BRACING OF TRENCHES

### Trenches shall have sheeting, shoring, and bracing conforming with 29CFR 1926, Subpart P Excavations, CAL/OSHA requirements, and the DISTRICT's requirements.

## SIDEWALK, PAVEMENT, AND CURB REMOVAL

### Cut and remove bituminous and concrete pavements regardless of the thickness, and curbs and sidewalks prior to excavation of the trenches with a pavement saw, hydrohammer, or pneumatic pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

## BLASTING

### No blasting is anticipated to be required for this project. No blasting will be allowed without prior approval.

## DEWATERING

### Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipelaying, during the laying of the pipe, until cement mortar of exterior joints has set hard, when concrete is being deposited and during the hydration process, and until the backfill at the pipe zone and trench zone has been completed. These provisions shall apply during the noon hour as well as overnight. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Dewatering flows shall be discharged to storm drain facilities in accordance with Riverside County Flood Control and Water Conservation DISTRICT requirements or as otherwise directed by the Owner. Contractor shall be responsible for obtaining a permit and performing monitoring and reporting to Regional Water Quality Control Board (RWQCB). Do not drain trench water through the pipeline under construction.

## MATERIAL REPLACEMENT

### Remove and replace any trenching and backfilling material which does not meet the Specifications, at the Contractor's expense.

## TRENCH WIDTHS

### Pipe trench widths in the pipe zone will be limited as follows:

|  |  |  |
| --- | --- | --- |
| **Pipe Diameter** | **Minimum Trench Width** | **Maximum Trench Width** |
| 4" through 12" | O.D. + 12" | O.D. + 16" |
| 14" through 48" | O.D. + 16" | O.D. + 24" |

### Trench width at the top of the trench will not be limited except where width of excavation would undercut the structural support of adjacent structures and footings. Where shoring or encasement is required, trench widths shall be increased accordingly.

## TRENCH EXCAVATION

### Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

### Excavate the trench to the lines and grades shown on the Plans with allowance for pipe thickness, sheeting and shoring if used, and for pipe base. If the trench is excavated below the required subgrade, refill any part of the trench excavated below the subgrade at no additional cost to the DISTRICT with imported sand. Place the refilling material over the full width of trench in compacted layers not exceeding 6-inches deep to the established grade with allowance for the pipe base.

### Trench depth shall accommodate the pipe and the pipe base at the elevations shown in the profile on the Plans. No pipe shall be installed without a designed profile unless approved by the DISTRICT.

### Construct trenches in rock by removing rock to a minimum of 6-inches below bottom of pipe and backfilling with imported sand.

## LOCATION OF EXCAVATED MATERIAL

### During trench excavation, place the excavated material only within the working area or within the areas shown on the Plans. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

## FOUNDATION STABILIZATION

### After the required excavation has been completed, the DISTRICT will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials such as soft, spongy or deleterious materials exist at the exposed grade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a minimum width equal to the maximum trench width and to a depth determined by the DISTRICT. Backfill the trench to the established subgrade of the pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6-inches deep to the required grade. Place imported sand on the compacted foundation stabilization and apply water to wash the sand into the voids of the rock refill material. Continue this procedure until the voids of the rock refill have been filled with imported sand. Do not apply water in such quantities that it will damage the integrity of the compacted foundation.

## CONCRETE FOR BELOW GROUND INSTALLATIONS

### Place concrete between the undisturbed ground and the pipe or fittings to be restrained or supported. Quantity or bearing area of the concrete against undisturbed ground shall be as shown on the Standard Drawings, Plans, or as directed by the DISTRICT. Provide temporary support on the pipe, fittings, or valves until the concrete has obtained a 3-day cure. Place concrete such that the pipe joints, fittings, or valves are accessible for repairs. Spade or rod the concrete during placement to eliminate honeycombing. Backfilling of the trench adjacent to the concrete will not be allowed until the concrete has cured for at least 3 days. Allow concrete to cure for at least 7 days prior to subjecting the concrete to pipeline pressure. Where rapid set concrete mix has been used, the 3-day and 7-day cure time is not required. Backfill the rapid set concrete mix as soon as the concrete is hard (approximately one to two hours) and place pipeline into service.

## TRENCH BACKFILLING

### Place the specified thickness of pipe bedding material over the full width of trench and compact to the specified relative compaction. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of the trench for the pipe, fittings, and valves.

### Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill and compact the area excavated for the joints with the pipe base material.

### After the pipeline has been bedded and the cement mortar used in the exterior joints has set hard, place pipe zone material simultaneously on both sides of the pipe, fittings, and valves, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or un-compacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

### Compact material in the pipe zone by hand tamping only. Care shall be exercised in backfilling to avoid damage to pipe coatings and polyethylene encasement.

### Push the native earth backfill or imported material for backfill carefully onto the imported sand previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Compact backfill material in the trench zone to the specified relative compaction by mechanical compaction or hand tamping.

### Place and compact pipe zone material in layers not exceeding 12 inches of compacted thickness. Place and compact native earth or imported material for backfill in the middle zone in layers not exceeding 6 inches of compacted thickness.

## MECHANICAL COMPACTION OR HAND TAMPING

### Place imported sand and backfill materials in uniform layers of the indicated thickness. Compact each layer to the required minimum relative compaction at the optimum moisture content. Do not use heavy duty compaction equipment with an overall weight in excess of 125 pounds per square foot until backfill has been completed to a depth of 2 feet over the top of pipe. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

## DISPOSAL OF EXCESS EXCAVATED MATERIAL

### Dispose of excess excavated material offsite. Contractor shall make his own arrangements for the disposal of the excess material and bear all costs incidental to such disposal.

## FINAL CLEAN UP AND STRAW WATTLES

### After backfilling, grade the right-of way to the contours of the original ground and match the adjacent undisturbed ground. Make surfaces free of all cleared vegetation, rubbish and other construction wastes. Dispose of all excavated or surface rocks and lumps which cannot be readily covered by spreading. On slopes 35-percent and steeper or where rainfall would create an erosion problem as determined by the DISTRICT's Representative, provide straw wattles across the backfilled trench at the locations shown on the Standard Drawings, Plans, or as directed by the DISTRICT's Representative. Place wattles across the backfilled trench and level with the contours of the slope.

### Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, mailboxes, landscaping, irrigations systems and other existing improvements that are cut, removed, damaged, or otherwise disturbed by the construction.

## SLOPE PROTECTION

### Install slope protection as required by the agency of jurisdiction. Prepare and seed all open ground within the easement or working area disturbed by the construction, not otherwise protected from erosion, or as determined by the DISTRICT's Representative. After final clean up, cultivate areas to be seeded to break up any compaction resulting from grading operations.

### Seed mixture shall be specified by the DISTRICT or by the Developer's landscape architect or revegetation specialist, who shall sign and seal such recommendations.

# END OF SECTION