
SECTION 19 – TRENCH EXCAVATION, BEDDING AND BACKFILL

19-1 TRENCH EXCAVATION

Trench excavation shall include the removal of all materials or obstructions and the control of water as necessary to construct the Work as shown or specified in the Contract. Unless otherwise shown or specified in the Contract, excavation shall be by open cut or as directed by the City.

Attention is directed to Section 10-5, “Control of Water in the Work”, and Section 14, “Restoration of Surfaces”, of these Specifications, for additional requirements. Surface water shall not be allowed to enter any pipe trench and shall not be permitted to enter the existing downstream pipe system.

19-1.01 Exploratory Excavation

An encroachment permit shall be obtained from the City prior to any exploratory excavation within roadway rights-of-way or other public easements. Prior to the end of each Working Day, exploratory excavations made outside the paved surface during that Working Day shall be backfilled with sand or native excavated materials as directed by City and mechanically compacted to prevent subsequent settlement. Excavations made within the paved surface shall be permanently restored per Standard Drawing ST-6.

19-1.02 Trench Width

Minimum and maximum trench widths at the top of the pipe shall be shown or specified elsewhere under the specific facility sections in the Contract or as specified in these Specifications.

19-1.02A Storm Drain Pipe

Unless otherwise shown or specified in the Contract, for storm drain pipe the minimum and maximum trench width shall be as shown on Standard Drawing ST-1 through ST-5. If trench widths at the top of the pipe are exceeded by any amount, the Contractor shall provide stronger pipe or improved bedding and backfill conditions, as approved by the City to meet the changed load requirements. If the trench width is exceeded for any reason within the Contractor's control, the stronger pipe or improved bedding and backfill shall be provided at the Contractor's expense.

19-1.02B Sewer Pipe

Unless stated otherwise, all trench excavation, requirements for sanitary sewer systems shall be constructed in accordance with the standard specifications of the specific utility company. Within the City Limits of Elk Grove, the primary sewer utility companies include, but are not limited to, Sacramento Area Sewer District (SASD), and Sacramento Regional County Sewer District (SRCSD).

19-1.02C Water Pipe

Unless stated otherwise, all trench excavation, requirements for water distribution systems shall be constructed in accordance with the standard specifications of the specific utility company. Within the City Limits of Elk Grove, the primary water supply companies include, but are not limited to, Elk Grove Water Service District, Sacramento County Water City, Zone 40, and Omochumne-Hartnell Water District.

19-1.03 Pavement Cutting

When the trench is in an existing paved area, the pavement shall be saw cut on neat lines parallel and equidistant from the trench centerline. The width of the saw cut shall not be any greater than is required to properly install the pipe and not damage the edges of the pavement left in place, or as directed by the City. Pavement between the lines shall be broken and removed as directed by the City immediately ahead of the trenching operations. The existing pavement shall be removed and repaired in conformance with Standard Drawing ST-1A.

Pavement shall not be cut until the respective utility companies have marked the location of their underground facilities and the City has given final approval of the trench alignment.

19-1.04 Maximum Length of Open Trench

Unless otherwise specified in these Specifications or the Special Provisions, at the end of each Working Day, there shall be a maximum of three hundred feet (300') of trench allowed to remain open in unimproved areas, excluding manhole excavations, for each operation unless otherwise authorized by the City. The remainder of the trench shall be backfilled and compacted, and when in active streets, opened to traffic as soon as possible. The maximum length of trench open for cast-in-place concrete pipe shall be as specified in Section 36-3, "Trench Excavation", of these Specifications.

19-1.05 Control of Groundwater

If groundwater is encountered in the trench, the Contractor shall design a method to remove the groundwater from the trench in order to allow for the proper installation of the planned designed pipe. The means and methods of groundwater removal from the trench shall be such that existing underground improvements are not affected by removal of water through the pipe zone materials causing potential settlement of previously placed backfill materials. All adjacent improvements shall be protected during trench dewatering operations.

19-1.06 Shoring and Bracing

The Contractor shall furnish and install sufficient shoring and bracing to insure the safety of personnel and public, the protection of the Work, and the protection of adjacent improvements. The Contractor must comply with all of the requirements of Section 6-20, "Excavation and Trench Safety", of these Specifications.

Sheeting shall not extend below the bottom of the pipe barrel. Unless otherwise specified in the Special Provisions or required by the City, all sheeting, timbering, lagging, and bracing shall be removed during backfilling, and in such a manner to prevent any movement of the ground or damage to the pipe or to other structures. When the City requires that sheet piling, lagging, and bracing be left in place, such materials shall be cut off where designated and the upper part withdrawn. If steel piling is used, it may be removed simultaneously with placing and compacting of backfill.

When using movable trench supports, care shall be exercised to prevent disturbing the pipe location, jointing, or embedment. Removal of any trench protection below the top of the pipe and within two and one-half (2-1/2) pipe diameters of each side of the pipe will be

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prohibited after the pipe embedment has been placed and compacted. Movable trench supports shall only be used in either wide trench construction where supports extend below the top of the pipe on a shelf above the pipe with the pipe installed in a narrow, vertical wall sub-ditch. Any voids left in the trench wall or embedment materials by support removal shall be carefully filled with bedding material and compacted. Removal of bracing between sheeting shall only be done where backfilling proceeds and bracing is removed in a manner that does not relax trench support.

19-1.07 Special Foundation Treatment

Whenever the bottom of the trench is soft or rocky, or, in the opinion of the City, otherwise unsuitable as a foundation for pipe bedding, the unsuitable material shall be removed to a minimum depth of six inches (6”) and replaced with crushed rock, gravel, or sand as directed by the City. When the trench bottom is cobbled or of any other material which might, in the opinion of the City, allow loss of sand backfill, the backfill material shall be crushed rock or gravel graduated so that one hundred percent (100%) will pass the three-quarter inch (3/4”) sieve and not more than fifteen percent (15%) will pass the number 8 sieve. Crushed rock or gravel shall conform to Section 50-14, “Crushed Rock”, of these Specifications. Sand backfill, when permitted by the City, shall conform to the requirements in Section 50-13.01, “River Sand”, of these Specifications. Such backfill material shall be compacted to a minimum relative compaction of ninety percent (90%).

As an alternate to the bedding materials specified above, the City may direct the Contractor to furnish and place geotextile fabric below the bedding materials. The geotextile material shall be a high modulus woven fabric, and shall be inert to commonly encountered chemicals, rot-proof and resistant to ultraviolet light exposures, insects, and rodents. The geotextile fabric shall have a minimum grab tensile strength of two hundred pounds (200 lbs.) in any direction as measured in accordance with ASTM D 1682, a Mullen burst strength of at least four hundred pounds (400 lbs.) per square inch per ASTM D 3786, and an Equivalent Opening Size no larger than U.S. Standard Sieve Number 50 as determined by U.S. Corps of Engineers Specification CW-02215. Geotextile fabric shall be Mirafi 600X, or equal. Each roll of fabric used shall be labeled in accordance with ASTM D 4873. Geotextile fabric shall be handled and placed in accordance with the manufacturer’s recommendations. Furnishing and placing of geotextile fabric will be paid for as extra work as provided in Section 9, “Changes and Claims”, of these Specifications.

If material more than twelve inches (12”) below the typical trench bottom is ordered removed by the City, the excavation below that point and the imported material required to backfill the trench to that elevation will be paid for as extra work as provided in Section 9, “Changes and Claims”, of these Specifications unless otherwise specified in the Special Provisions. Before excavation of the pipe trench in fill areas or roadway embankments, the fill area or embankment shall be completed to a height above the pipe invert grade line of not less than twice the internal pipe diameter or to final fill or embankment subgrade, whichever is lower, but in no case less than twelve inches (12”) above the top of the pipe. Such embankment shall be compacted to a minimum relative compaction of ninety three percent (93%) for a distance on each side of the pipe equal to at least two (2) pipe diameters. The remainder of the embankment shall be compacted to the minimum relative compaction specified elsewhere in these Specifications for the type of construction being done, or as specified in the Special Provisions or on the Plans. Special foundation treatment for cast-in-place concrete pipe shall be as specified in Section 36-4, “Cast-In-Place Concrete

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Pipe (CIPCP) - Special Foundation Treatment”, of these Specifications.

When soft, loose, or yielding materials are encountered in the roadway subgrade or trench bottom, the unsuitable material shall be removed to a suitable depth such that aggregate replacement materials will provide adequate support for the overlying pipe and trench backfill or and roadway section. The City Public Works representative should be consulted to evaluate the proper depth of removals during construction. Crushed rock with a maximum dimension of one and one-half inches (1-1/2”) shall be used as replacement material. If sand bedding is used for underground installations, this crushed rock layer shall be wrapped in fabric meeting the requirements discussed in the section entitled “Geotextile Fabric”.

19-1.08 Excavation Method

Methods used in excavation shall not cause damage to surrounding property or damage remaining pavement and other existing improvements that are to remain. Outriggers for excavation equipment, and other heavy equipment, shall be fitted with street pads to prevent pavement damage.

19-1.09 Payment

Full compensation for trench excavation, including all equipment, labor, materials, control of water, shoring and bracing, and other safety measures required, is included in the prices paid per linear foot of the respective sizes, grades, and types of pipes listed in the Contract, and no additional compensation will be paid.

19-2 PIPE BEDDING AND BACKFILLING OF TRENCHES

19-2.01 Pipe Bedding

Compaction of Bedding and Pipe Zone Backfill

Pipe bedding and pipe zone backfill materials shall meet the requirements of the City. Bedding and backfill shall be placed in loose lifts not exceeding eight (8) inches and mechanically compacted to a minimum of 90 percent of the ASTM D1557 maximum dry density, and be consistent with the typical trench detail. Where clean crushed rock is used and conventional compaction testing is not practical, the material shall be mechanically compacted until no further yielding of the material is observed under the compactor. Sand should be placed at or above the optimum moisture content, not to exceed 5 percentage points over the optimum moisture content. . Tests should be completed at a frequency of one (1) per 200 linear feet or one (1) per manhole run whichever occurs first.

Pipe Zone Materials

Pipe zone material shall meet the requirements of the City. For storm drains the pipe zone material shall consist of Type “C” Material. For reinforced concrete storm drain pipes greater than 48 inches in inside diameter, the pipe zone material shall extend vertically to at least the spring line of the pipe. Alternate pipe zone materials may be submitted by Contractor for City review and approval.

19-2.01.A Sewer

Unless stated otherwise, all bedding and backfill requirements for sanitary sewer

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systems shall be constructed in accordance with the standard specifications of the specific utility company. Within the City Limits of Elk Grove, the primary sewer utility companies include, but are not limited to, County Sewer District 1 (CSD-1) and Sacramento Area Sewer District SASD.

Geotextile Fabric

A layer of non-woven geotextile fabric shall be placed between the pipe zone backfill and the intermediate zone backfill to reduce fines migration into the pipe zone. Filter fabric placement shall conform to standard drawing SD-6. Filter fabric shall meet the specifications presented in the table below:

Table 1: Recommended Filter Fabric Specifications

Property	Requirement	Test Method
Apparent Opening Size (AOS)	#70 U.S Standard Sieve Size	ASTM D4751
Grab Tensile/Elongation	120 lbs./50%	ASTM D4632
Puncture Strength	70 lb. minimum, Average Roll Value	ASTM D4833

Filter fabric is not required over sand bedding. An example of a fabric meeting these specifications is Mirafi 160N or equivalent.

19-2.01.B Storm Drain

Where crushed rock is allowed as pipe zone backfill for pipes with diameters greater than 12 inches, it shall be placed and shovel sliced as described herein. The crushed rock shall be placed up to the spring line of the pipe and shovel sliced (a procedure used to force material under the haunches of the pipe by the lateral movement of the shovel) to provide proper support of the haunches of the pipe.

The Pipe shall be bedded uniformly throughout its length. The bearing shall be achieved by shaping the bedding or by lightly "bouncing" the pipe to set it into the bedding. Pipe bedding material shall be placed at a minimum thickness meeting the greater of the following criteria:

1. The minimum bedding thickness shall be four inches (4") for pipe with internal diameter forty eight inches (48") or less, and six inches (6") for pipe with internal diameter greater than forty eight inches (48"); or
2. The minimum bedding thickness shall be equal to the difference between the outside diameter of the pipe barrel and bell plus one and one-half inches (1-1/2"); or
3. When soil conditions in the trench bottom are unstable, rocky, or otherwise unsuitable as a foundation for pipe bedding, the minimum bedding thickness shall conform to Section 19-1.07, "Trench Excavation - Special Foundation Treatment", in this Section.

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19-2.01.C Water Distribution Systems

Unless stated otherwise, all bedding and backfill requirements for water distribution systems shall be constructed in accordance with the standard specifications of the specific utility company. Within the City Limits of Elk Grove, the primary water supply companies include, but are not limited to, Elk Grove Water District Sacramento County Water Agency.

19-2.02 Initial Backfill

Initial backfill shall be in accordance with the requirements in these Specifications.

19-2.02.A Storm Drain

Unless otherwise specified in the Special Provisions, the following initial backfill requirements shall apply. For cast-in-place concrete pipe, initial backfill shall conform to Section 36-14, "Cast-in-Place Concrete Pipe (CIPCP) – Backfill", of these Specifications and Standard Drawing SD-6. For all other pipes initial backfill for storm drain construction shall conform to this Section 19 and Standard Drawing SD-6.

Granular materials shall conform to Section 50-14, "Crushed Rock", of these Specifications. For field conditions requiring control density backfill the material shall conform to Section 50-15, "Control Density Backfill", of these Specifications. For field conditions requiring portland cement concrete backfill the material shall conform to Section 50-5.01, "Portland Cement Concrete - Composition", Class "C", of these Specifications.

After placement of bedding, the Contractor shall place initial backfill material to the spring line of the pipe, thoroughly compacting it by shovel slicing or light tamping to provide proper support under the pipe haunches. The remaining initial backfill material shall be placed per Standard Drawing SD-6. Care shall be used not to disturb or displace the pipe. When using control density or concrete backfill, the Contractor shall anchor the pipe to prevent floating or displacement of the pipe. The anchors shall be spaced to insure a continuous even grade in the flow line of the pipe.

19-2.02.C Water Distribution Systems

Initial backfill for water distribution systems shall conform to the requirements of Standard Drawing 8-17. Unless otherwise specified in the Special Provisions, initial backfill for water distribution systems, including water mains, fire hydrant branch leads, and water services, shall be sand conforming to the requirements in Section 50-13.02, "Graded Sand", of these Specifications. Ductile iron distribution mains shall have sand backfill to eight inches (8") above the top of the distribution main. Initial backfill for PVC water distribution pipe may be of native material or sand. Initial backfill for ductile iron or cast iron fittings used with PVC pipe shall be sand to eight inches (8") above the top of the fittings.

Initial backfill shall be placed immediately after pipe joints have been completed and inspected by the Agency. The material shall be carefully placed so as not to disturb or damage the pipe, and shall be brought up evenly on both sides. Initial backfill material shall be placed in layers not exceeding eight inches (8") in depth before compaction at or near optimum moisture content. Compaction shall be by mechanical pneumatic or vibratory compaction equipment approved by the Agency. Ponding and jetting methods will not be permitted, although water may be sprayed from a two-inch (2") truck hose onto initial and final sand backfill. The compacted material must achieve a relative compaction of at least

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ninety percent (90%) as determined by ASTM Designation: D 698. If steel piling is used, it may be removed simultaneously with placement and compaction of intermediate backfill. Trench jacks or other shoring shall not be removed before completion of initial backfill.

19-2.03 Trench Backfill

Trench backfill shall consist of material placed between the initial backfill and subgrade in paved areas or to the top of the trench in unpaved areas, unless otherwise shown or specified in the Contract.

The trench backfill material may be native material excavated at the work site if the trench depth is greater than four feet (4') measured from the top pipe to the finished road surface. Such material must be free of organic or other unsuitable materials as determined by the City that may cause voids or depressions to develop during or after placement of the backfill. Rocks, stones and solid earth chunks exceeding three inches (3") in greatest dimension shall be removed from the trench backfill material.

The backfill material for trench depths less than four feet (4') measured from the top pipe to the finished road surface shall be imported granular material, uniformly graded Class 2 aggregate base conforming to the requirements in Section 50-7, "Aggregate Bases", of these Specifications. The imported granular material shall be placed in lifts not to exceed six inches (6") after compaction. Compaction requirements for imported granular material shall be the same as required for compaction of job excavated native material.

Unless otherwise shown or specified in the Contract, compaction of all backfill material shall be by mechanical pneumatic or vibratory compaction equipment. Hydraulic ponding and hydraulic jetting methods are not permitted.

1. Compaction

The first lift of the intermediate backfill shall be no more than eighteen inches (18") in loose thickness and shall be compacted to achieve a minimum of 90 percent of the ASTM D1557 maximum dry density at a moisture content between 0 and 3 percent above the optimum moisture content. This lift shall be tested for relative compaction prior to continuation of backfill procedures. All subsequent backfill shall be placed in lifts no greater than 12 inches in loose thickness (or less depending on ability of compaction equipment) and compacted to achieve a minimum of 93 percent of the ASTM D1557 maximum dry density at a moisture content between 0 and 3 percent above the optimum moisture content. The backfill material within a two foot (2') wide zone surrounding vertical structures shall be mechanically compacted by smaller hand operated or walk behind compactors in addition to the larger trench compaction equipment. Hydraulic jetting will not be permitted in the City of Elk Grove.

For new and existing street areas where over-compaction of expansive soils is a concern, if native material, used in the upper three feet (3') of trenches, has an Expansion Index (EI) greater than 70 (based on 1997 UBC Test Method 29-2), then the contractor/developer shall submit for approval, alternative methods to either reduce the expansion potential of the native material or replace with suitable non-expansive material. An alternative to conventional trench backfill materials would be CDF.

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2. Moisture Content

The moisture content of the backfill during compaction shall be between 0 and 3 percent above the optimum moisture content as established by ASTM D1557 unless otherwise specified by the geotechnical report for the specific project. The backfill material shall be uniformly moisture conditioned as needed prior to placement and compaction.

Construction Quality Assurance

1. Field Density Tests

Nuclear moisture content and density testing shall conform to ASTM D2922 and ASTM D3017. Test frequency, at minimum, shall include at least one test per 200 linear feet of trench length and every two feet (2') vertically starting two feet (2') above the pipe. Density tests shall be performed at a frequency of at least one test for every two feet (2') of backfill vertically for vertical structures (i.e. manholes, valve risers, etc.). Backfill above lateral services shall be tested at least every two feet (2') vertically. Calibration shall be performed for each nuclear gauge on a weekly basis to confirm the accuracy of nuclear density gauge moisture readings. The frequency and location of testing may be revised as determined by the Engineer.

2. Modified Proctor Compaction Curve

Modified Proctor compaction curves (ASTM D1557) shall be performed as needed depending on changes in material types or a minimum once for every 2,000 cubic yards of material placed.

3. Profile Plots of Test Locations

All compaction tests performed on trench backfill placed in utility trench mainlines, services, and around manholes shall be plotted and individually numbered on a set of record drawings.

Unless otherwise specified in the Special Provisions, the Contractor has the option to use imported granular material for trench backfill in place of native material excavated at the work site. The imported granular material shall be uniformly graded Class 2 aggregate base conforming to the requirements in Section 50-7, "Aggregate Bases", of these Specifications. The imported granular material shall be placed in lifts not to exceed six inches (6") after compaction. Compaction requirements for imported granular material shall be the same as required for compaction of job excavated native material. Unless otherwise specified in the Special Provisions, the optional use of imported granular material for trench backfill will be at the Contractor's expense.

19-2.03A Cut Off Collars

If crushed rock, Type "E" Material, is selected for pipe zone backfill on drain pipe, a path is created that can allow water flow within the pipe zone material. Trench plugs or cut off collars of CDF material shall be installed within the pipe zone. Cut off collars, where required, shall be at least 8 inches thick (as measured in the direction of the pipeline) and extend at least one foot (1') laterally beyond the pipe zone backfill into the surrounding soils in all directions. The required pipe sleeves shall be placed a minimum of 2 feet away

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from all service connections on the main line. The plugs or collars shall be generally placed near the mid-point of the pipeline between manholes. However, final placement shall be determined at the mandatory pre-construction meeting with City representatives.

Cut off collars shall also be installed around all services that extend beyond the curb or back of sidewalk at the outside edge of a roadway, including joint utility crossings. The collars may either be installed on the horizontal portion of the main service lateral prior to the elbow or on the vertical portion of the service prior to any plumbing fittings installed by the Contractor. The collar shall be placed behind the back of curb and sidewalk where present. The horizontal collar has the added benefit of being easier to construct and reduces the potential of the pipe shearing by extending horizontally through a rigid structure.

19-2.03B Backfill within Existing Streets

Backfill operations performed within existing City streets shall be backfilled with Type “A” material (AB). Materials shall be compacted per the appropriate “ST Drawing”, and moisture conditioned to be between 0 and 3 percent above the optimum moisture content. An alternative use of Type “F” material shall be approved in writing by the project’s City Inspector. Type “F” material will not be allowed over SCWA water pipes or CSD-1 sewer pipes.

19-2.04 Payment

Full compensation for furnishing, placing, and compacting pipe bedding and trench backfill materials is included in the prices paid per linear foot of the respective sizes, grades, and types of pipes listed in the Contract, and no additional compensation will be paid.