

**SECTION 02200
EARTHWORK**

PART 1 - GENERAL

1-1. SCOPE.

This section covers earthwork and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation; handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of sub-grades; pumping and dewatering as necessary; protection of adjacent property; backfilling; construction of fills and embankments; grading; and other appurtenant work.

1-2. GENERAL.

With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a licensed or registered professional engineer in the state where the earthwork is located, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS.

Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the General Conditions, Section F-29 Equipment and Material Items section.

At least 30 days before starting construction on the sheeting and shoring and in accordance with OSHA requirements enumerated above, the Contractor shall ensure that the sheeting and shoring design engineer shall complete and submit to Engineer the Protective System Design Certificate - 1 (available at the end of this section) and the Contractor shall use the sheeting and shoring design. If required by the OSHA requirements enumerated above or to protect existing facilities, then the Contractor is responsible for ensuring that a separate certificate shall be submitted for each unique design. If required for protection of existing facilities or as required by the enumerated OSHA regulations, the certificate shall be signed and sealed by the registered professional engineer that designed the protection system.

Earthwork (Custom)
Section 02200-2

1-3.01 Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted in accordance with the Submittals Procedures section. Data submitted shall include:

- A 12 inch square sample of fabric.
- Manufacturer's descriptive product data.
- Installation instructions.

1-3.02 Test Results for Preliminary Review of Materials. Complete test results by an independent commercial laboratory retained by the Contractor for preliminary review of materials proposed for use in fills and embankments, structure backfill, select fill, general fill, granular fill, gravel beneath slabs, and any other fill material specified herein.

1-3.03 CDF Mix Design. Mix design by an independent commercial laboratory to be retained by the Contractor. Refer to Section 02252.

1-4. BASIS FOR PAYMENT.

Basis of Payment for all onsite grading and earthwork including excavation protection shall be lump sum.

1-4.01 Sheeting for Excavation of Structures. No additional payment above the Contract Price will be made for steel sheet piling or any other type of excavation support left in place in excavations for structures.

1-5. INSURANCE.

Insurance shall be provided as specified in the Special Conditions.

1-6. Compliance with Regulations.

The Contractor shall familiarize himself, and comply with all applicable state, county and municipal rules and regulations pertaining to sanitation, fire protection and safety.

1-7. STRUCTURE PROTECTION.

1-7.01. Contract Drawings. The drawings show the position of various pipes and conduits and other structures as they are supposed to exist in construction areas, but no error or omission on said drawings shall be construed to relieve the Contractor from the responsibility of protecting any such pipe, conduit, or other structure.

When deemed necessary by the Engineer, revisions of the contract drawings and additional detailed drawings will be issued to the Contractor during the progress of the work.

1-6.02. Notification of Underground Service Alert of Southern California. When performing underground work, the Contractor shall call Underground Service Alert (USA), the one- call underground facility locating service two (2) working days prior to making an excavation. Contractor shall be responsible for such notification of subcontractor's work, or shall require subcontractor or assume this responsibility.

1-8. GUARANTEE.

The Contractor hereby guarantees that the entire work constructed by him under the contract will fully meet all the requirements thereof as to quality of workmanship, and of materials furnished by him. The Contractor hereby agrees to make at his own expense any repairs or replacements made necessary by defective materials or workmanship supplied by him which have become evident within one (1) year, or other guarantee period elsewhere specified, after date of notice of completion and acceptance of the work is filed, and to restore to full compliance with the requirements of these specifications including the test requirements, any part of the facilities or appurtenant works which during said guarantee period is found to be deficient with respect to any provision of this specification. Replacement of backfill where it has settled below the lines established by the Engineer shall be considered part of such repair work. The Contractor shall make all repairs and replacements promptly upon receipt of written orders for same from the Engineer. If the Contractor fails to make the repair and replacements promptly, the District may do the work, and the Contractor and his surety shall be liable to the District for the cost thereof.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01 Filter Fabric. Filter fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01 Filter Fabric Type A. Filter Fabric Type A is intended to provide separation between the soil subgrade and overlying granular fill or other clean granular material as well as other applications where a light duty filter fabric is required. Refer to drawings for required placement locations.

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Min Roll Value*</u>
Fabric Weight	ASTM D3776	oz/yd ² [g/m ²]	6.0 [203]
Grab Strength	ASTM D4632	lbs [N]	160 [711]
Grab Elongation	ASTM D4632	percent	50
CBR Puncture Strength	ASTM D6241	lbs [N]	410 [1,824]

Earthwork (Custom)
Section 02200-4

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Min Roll Value*</u>
Trapezoidal Tear	ASTM D4533	lbs [N]	60 [267]
UV Resistance at 500 hours	ASTM D4355	% Strength Retained	70

*Minimum average roll value in weakest principal direction.

The apparent opening size (diameter) for the filter fabric Type A shall be no larger than the U.S. Standard Sieve Size 70 [212 µm] per ASTM D4751.

2-1.01.02 Filter Drain Fabric. Filter drain fabric is a non-woven geotextile intended for to as barrier for separating granular embedment from surrounding soil.

- a) Composed of polypropylene fibers, inert to biological degradation, resists naturally encountered chemicals, alkalis, and acids.
 1. AOS: 0.212 mm, in accordance with ASTM D4751.
- b) Minimum Flow Rate: 120 gal/min/square foot.
- c) Manufacturers:
 1. Mirafi, Type 140N.
 2. Amoco, Type 4545.
 3. Engineer approved equal.

2-1.01.03 Securing Pins. The following shall be used for the securing and pinning of filter fabric.

- a) Steel Rods or Bars Conforming to the Following:
 1. 3/16-inch diameter.
 2. Pointed at one end, head on other end sufficiently large to retain washer.
 3. Minimum length: 12 inches.
- b) Steel Washers for Securing Pins:
 1. Outside diameter: Minimum 1.5 inches.
 2. Inside diameter: 1/4 inch.
 3. Thickness: 1/8 inch.
- c) Steel Wire Staples:
 1. U-shaped.
 2. 10-gauge.
 3. Minimum 6 inches long.

2-1.02 Polyethylene Vapor Barrier. Polyethylene vapor barriers beneath concrete slabs or slab base course material shall be Product Standard PS17, 10 mil minimum thickness, and shall be installed under the RO Building where noted, Chemical Sump, and Brine Receiving Station.

2-1.03 Engineered Fills. To the maximum extent available, excess suitable material obtained from structure and trench excavation shall be used for Engineered and non-Engineered fills and embankments. Additional material shall be provided from Contractor's off-site source. No borrow pits shall be opened on site unless such pits are specifically indicated on the Drawings.

2-1.03.01 Structural Fill

On-site materials meeting the requirements of this section may be used as Structural Fill. All Structural Engineered fill material placed in fills and embankments shall be free from rocks or stones larger than the required size in their greatest dimension, brush, stumps, logs, roots, debris, and other organic or deleterious materials. The maximum organic content of general fills and embankment materials shall be 3%. The maximum size of stone in Engineered fills and embankments shall be 3 inches. On-site materials meeting the requirements of Select Imported Granular Fill section may be used as Structural Engineered fill below equipment pads and foundations.

2-1.03.02 Select Imported Granular Structural Fill

Select imported Granular Fill or on-site granular materials meeting the requirements in this section may be used as Engineered Fill below equipment pads and foundations. Imported granular fill should consist of granular material that is well graded between coarse and fine sizes. It shall contain no clay balls, roots, organic matter or other deleterious materials. The maximum size of stones in engineered fills shall be 3 inches.

2-1.04 Pipe Zone Backfill, Bedding and Trench Backfill.

2-1.04.02 Pipe Bedding.

Pipe Bedding shall meet the requirements of CALTRANS CLASS 2 aggregate base. The material shall consist of sand, gravel, crushed aggregate or native free-draining material with maximum particle size of ¾".

2-1.04.01 Pipe Zone Backfill.

Pipe bedding shall consist of sand or similar granular material having a minimum sand equivalent of 5 and a maximum particle size of ¾ inch.

2-1.04.02 Trench Backfill.

Trench backfill shall be Engineered Fill.

2-1.05 Gravel Base Beneath Slabs. "Gravel Base Beneath Slabs" is defined as material to be placed directly beneath floor slabs of building as shown on the Drawings. The material shall meet the quality requirements specified for ASTM C33 concrete coarse aggregate and shall be graded No. 7 coarse aggregate.

Earthwork (Custom)

Section 02200-6

2-1.06 Imported Gravel Mulch. Imported Gravel Mulch may be used throughout the facility to provide non-structural, non-engineered pathways and cover. Imported Gravel Mulch should consist of imported clean, durable crushed rock. Imported Gravel Mulch shall be well-graded between $\frac{3}{4}$ " and 1", contain no roots, organic matter or other deleterious materials, have a maximum particle size of 1 inch, and shall provide a uniform layer over compacted subgrade. Color to be "Desert Gold". Refer to Landscape Drawings. Gravel Mulch layer to be a minimum of 2" thick on top of scarified and compacted subbase layer. Apply weed inhibitor herbicide on top of sub-base per Section 02900.

2-1.07 Aggregate Base. Aggregate base shall be used under AC and PCC Pavement sections, and shall meet Caltrans specifications for Class 2 aggregate base.

2-1.08 Control Density Fill (CDF). Refer to Section 02252 Control Density Fill.

2-2. MATERIAL TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the Quality Control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of fill or other specified material, and one additional gradation test shall be made for each additional 500 tons [450 Mg] of each material delivered (imported) to the jobsite or suitable onsite material incorporated in Engineered fill. One additional gradation test shall be performed for each additional 2,000 tons Engineered fill material delivered to the jobsite or suitable onsite material incorporated in Engineered fill. In addition, one set of initial Atterberg Limits test shall be made for each fill material containing more than 20 percent by weight pass the No. 200 sieve and for materials specified by Atterberg Limits. One additional Atterberg Limits test shall be made for each additional 500 tons [450 Mg] of each material delivered to the job site or otherwise incorporated as Engineered fill. One additional Atterberg Limits test shall be made for each additional 2,000 tons of Engineered fill material delivered to the jobsite or suitable onsite material incorporated in Engineered fill.

All material testing on CDF shall be made by an independent testing laboratory at the expense of Contractor.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of Owner. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Field Tests. For planning purposes, the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job

conditions and number of failed tests. Test results shall be submitted as indicated in the General Conditions, Section -29 Equipment and Material section.

Two moisture-density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of fill or other material proposed.

For area fills and embankments, an in-place field density and moisture test for each 1000 cubic yards [764 m³] of material placed.

One in-place field density and moisture test for every 100 to 200 cubic yards [76 to 153 m³] of structure backfill or select fill.

One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.

At least one test for every full shift of compaction operations on mass earthwork.

Additional gradation, proctor, and relative density tests whenever the source or quality of materials changes.

Testing of CDF shall be per Section 02252 Control Density Fill.

PART 3 - EXECUTION

3-1. SITE PREPARATION.

It shall be the responsibility of the Contractor to examine the site of the work and to make all investigations necessary, both surface and subsurface, to determine the character of materials to be encountered and all other existing conditions affecting the work.

All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments and sites to be occupied by permanent construction shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of Contractor.

3-2. EXCAVATION.

3-2.01. General.

- a) The Contractor shall perform all excavations necessary or required for the construction of the facilities covered by these specifications. Excavations

Earthwork (Custom)
Section 02200-8

may be performed by either hand or machine methods and shall be made to the depths as indicated by the Contract Drawings and of sufficient size to provide adequate space for working in accordance with safety regulations and practice and the Contract Drawings. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

- b) Excavations shall include the removal and disposal of all materials of whatever nature and quantity including water, rock, decomposed granite, or any other type of soil or material, subsurface obstructions and overhead obstructions which may interfere with the operation of equipment used on the work, for no additional compensation. Excavation shall immediately precede subsequent construction and shall not remain open longer than necessary for construction. Excavations for foundations shall be made only after construction of subgrade, as hereinafter described, has been completed. Over-excavations for foundations shall be filled with Engineered Fill.
- c) No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so that they do not interfere with proper compaction.
- d) Weather Limitations. Excavating and grading shall be performed only when the weather conditions do not adversely affect the quality of the finished product. Any graded or excavated areas that are damaged by the effect of rain, or other weather conditions, during any phase of the construction, shall be re-excavated, regraded, and recompact to conform to the herein-specified requirements, without additional cost to the District.
- e) It shall be the responsibility of the Contractor to meet with the Engineer regarding the equipment and methods to be used in the construction of the work, and for approval of the order and schedule of work.
- f) Dust Abatement. The Contractor shall furnish all labor, equipment and means required and shall carry out protective measures wherever and as often as necessary to prevent his operations from producing dust in amounts damaging to property or causing nuisance. The Contractor shall be responsible for any damage resulting from dust originating from his operations. The dust abatement measures shall be continued until all required resurfacing is completed or until the Contractor has completed arrangements with the proper authorities whereby he is relieved of

further responsibility. All compensation to be received for dust abatement shall be included in the prices named for appropriate items of the bidding sheet.

- g) Site Grading. Grading of site shall include all excavations, fill construction, access roads, and final grading, all in accordance with these specifications, and as shown on the drawings and as directed by the Engineer. The entire site within the area affected by construction shall be cleared and bladed. Surfaces shall be cut or filled, to the extent indicated, to finish grade stakes set by the Engineer. Finish surfaces shall slope uniformly between spot elevations or finish contour lines shown on the drawings and away from structures. Grading tolerance will be plus or minus .05 feet from surface elevations indicated.
- h) Lines, Grades and Measures. All lines and grades will be established by the Engineer and the Contractor shall provide him with such assistance and materials as may be required. The Contractor shall carefully preserve all survey stakes and reference points so far as possible. Should any stakes or points be removed or destroyed unnecessarily by any act of the Contractor or his employees, they may be reset at the Contractor's expense.

The Contractor shall inform the Engineer a reasonable length of time in advance of the times and places at which he intends to work in order that lines and grades may be furnished, inspection provided, and necessary measurements for records and payments may be made with minimum inconvenience.

- i) Sub-grade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon. When unsatisfactory soil bearing conditions, such as soft mud, quicksand, or other unstable materials are encountered at the elevation of the bottom of the structure or manhole, the base shall be made firm and solid by removing said unstable material to sufficient depth and replacing same with crushed rock, gravel, or other approved material, well compacted into place in a manner approved by the Engineer.
- j) Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches [150 mm] clearance is provided for outside plastering.
- k) Maintenance of Utilities

Earthwork (Custom)
Section 02200-10

Insofar as practical during the progress of the work, the property of any owner of a public utility pipeline or conduit, sewer, culvert, storm drain, drainage ditch, flood control channel, overhead wires or cables, or underground wires or cables, or any other structure or facility shall not be disturbed but shall be supported and protected against injury and maintained in good operating condition at the expense of the Contractor. In no case shall any such property be disturbed or removed without the consent of the owner and approval of the Engineer. The Contractor shall be responsible for making good all damage due to his operations and the provisions of this section shall not be abated even in the event such damage occurs after backfilling, or is not discovered until after completion of backfilling.

The Contractor shall explore the location and depth of underground facilities, sewers, and storm drains sufficiently in advance of pipe laying or other construction operations so that changes in line or grade, or both, can be made in the pipeline without delay of the Contractor's construction schedule, without relaying or reconstructing previously installed pipe or other facilities and to avoid wherever possible moving, altering, or reconstruction of the obstructing underground facilities, sewers, or storm drains.

The locations of existing underground utilities and structures, insofar as they are known from information furnished by the respective utility companies and agencies and other sources, have been shown on the drawings.

It shall be the responsibility of the Contractor to verify the location of these obstructions and to locate any other underground utilities and structures which might necessitate a change in the line and grade of the new work. If the Contractor, while performing the work of construction, discovers utility facilities not identified by the District in contract plans or specifications, he shall immediately notify the District in writing.

In no case shall any utility that has been damaged, whether shown or not shown on the plans, be backfilled without the Contractor notifying the utility company of the damage.

Pursuant to Section 4215 of the Government Code, the District shall compensate the Contractor for the costs of locating, repairing damage not due to the failure of the Contractor to exercise reasonable care, and removing or relocating main or trunkline utility facilities not indicated in the plans and specifications with reasonable accuracy, and for

equipment on the project necessarily idled during such work. The Contractor shall not be assessed liquidated damages for delay in completion of the project, when such delay was caused by the failure of the District or the owner of the utility to provide for said removal or relocation of such utility facilities. Nothing herein shall be deemed to require the District to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the construction.

l) Utility Construction

If the work requires, as shown on the drawings or as specified, or as required for the Contractor's convenience, that the surface and overhead facilities, underground facilities, sewers and storm drains should be moved, altered, relocated, reconstructed, or temporarily supported, in order that the facilities included in the contract can be constructed, the Contractor shall make all arrangements therefore with the respective owners and shall bear all expenses for moving, altering, relocating, or temporarily supporting the facilities.

In addition, the District may require the moving, altering, or reconstructing of obstructing underground facilities, sewers, or storm drains, and compensation therefore will come under extra work where such work is ordered in writing by the Engineer.

Pipelines determined to be abandoned may be destroyed if conflicting with the contract work and properly disposed of. Exposed ends of abandoned pipelines shall be plugged for watertightness as approved by the Engineer.

3-2.02. Seismic Investigation. In suspected or known fault areas, Contractor shall make excavation available to the property owner or his geologist for seismic investigations as required under the Alquist-Priolo Geologic Hazard Zones Act. Such investigation shall involve no delay to the Contractor.

3-2.03. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.04. Excavated Materials. Excavated materials shall be piled neatly along the side of the trench in such a manner as to be in compliance with safety standards and soils report recommendations.

Earthwork (Custom)
Section 02200-12

Through all cultivated areas, topsoil without vegetation removed from the upper 5-7 feet of excavations may be replaced as backfill provided it is controlled and stored separately from other fill, and is blended with on-site soils resulting in engineered fill with less than 3% organic content. Where topsoil replacement is required, excavated topsoil shall be stored separately from other materials and in general shall be replaced as backfill in the same parcel of land from which it came. Topsoil without vegetation may also be used in landscape areas or disposed of.

3-2.04. Unauthorized Excavation. Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced with concrete or lean concrete at the expense of Contractor. If structural concrete replacement is chosen, it shall be with concrete placed at the same time and monolithic with the concrete foundation.

3-2.05. Preservation of Trees. No trees shall be removed outside excavated or filled areas unless their removal is authorized by Owner. Trees left standing shall be adequately protected from damage by construction operations.

3-2.06. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.07. Dewatering. Dewatering systems including all wells, pumps, piping, valving and related equipment shall be provided to remove and dispose of all surface water and groundwater and all water, regardless of the source, entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations including over-excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 24 inches, beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Dewatering discharges shall be conveyed to the Sun City Regional Water Reclamation Facility Ponds located west of the project site as shown on Drawing C-10-117. The Contractor shall provide all necessary pumps, piping, equipment, and/or tanker trucks to convey dewatering discharges to the ponds.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit used for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

Contractor shall prepare and submit a dewatering plan for Engineer review and approval.

3-2.08. Sheeting, Bracing and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported as necessary to prevent caving or sliding.

Steel sheet piling or other excavation support systems shall be furnished and installed as necessary to limit the extent of excavations for the deeper structures and necessary backfill under adjacent shallower structures, and to protect adjacent structures, utilities and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for and install adequate protection systems for prevention of damage to existing facilities.

Site conditions that alter shoring submittals such as blasting, groundwater, differing soils, etc., must be reviewed for adequate shoring by Contractor or his Engineer.

Excavation support systems and sheeting and shoring shall be all removed after completion of work unless otherwise directed or permitted by the Engineer.

Unless the excavation support is required to be left in place, the design of the excavation support system shall be such as to permit complete removal while maintaining safety and stability in the excavation at all times. Excavation support systems to be left in place shall be designed and constructed of only steel and pressure treated timber elements. Untreated timber shall not be used.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state where the project is located.

3-2.09. Stabilization. Sub-grades for concrete structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in such a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the Drawings.

3-2.10. Overexcavation

Earthwork (Custom)

Section 02200-14

Overexcavation involves the removal and replacement of on-site native materials as engineered fill to provide uniform support for shallow foundations or subgrade preparation.

3-2.10.01 Overexcavation of Structural Areas. Due to site conditions, structural areas such as building pads, shallow foundations and equipment foundations shall be overexcavated to a minimum of 7 feet below existing grade or 3 feet below the bottom of spread footings, whichever is greater. In areas where foundations or slab-on-grades are proposed to be deeper than 10 feet below the existing grade, refer to the Drawings for sub-base and excavation requirements.

3-2.10.02 Overexcavation of Paving Areas. Non-structural areas such as roadways, truck aprons, sidewalks or other flatwork areas shall be overexcavated to a minimum of 2 feet below existing grade, or 2 feet below the finished subgrade, whichever is greater. Excavation for the roadways, drives, and parking areas shall conform to the lines, grades, cross sections, and dimensions indicated on the Drawings and shall include the excavation of all unsuitable material from the subgrade.

3-2.10.03 Overexcavation of Pipe Trenches. Trenches to be used for piping shall be overexcavated to a minimum of 6 inches below the invert of the piping. If trench is still soft and spongy as determined by District Representative, overexcavate an additional 6-inches.

3-2.11. Cutting. In cutting or breaking up street surfacing, the Contractor shall use equipment acceptable to the authorities concerned. The pavement to remain in place shall be trimmed with an approved cutting device in such manner as to leave a vertical face with sound, unfractured pavement. All pieces of pavement resulting from cutting or breaking up street surfacing shall be removed from the trench area prior to trenching.

3-3. ENGINEERED FILLS AND EMBANKMENTS.

Fills and embankments not required or indicated to be designated fills shall be constructed as general Engineered fills and embankments, and shall consist of Engineered Structural Fill. All fills and embankments shall be constructed to the lines and grades indicated on the Drawings. Construction of fills and embankments shall begin from the lowest elevation in a given excavation or area and progress upward. Materials shall be deposited in approximately horizontal layers not to exceed 8 inches [200 mm] in uncompacted thickness. Unless otherwise specified herein, the following governing standards apply:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction (minimum).	90%

Moisture content relative to the optimum. 0% to +5%.

Backfilling of excavations and construction of fills and embankments during freezing weather shall not be done. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-3.01. General Sub-Grade Preparation. After preparation of the fill or embankment site, the sub-grade shall be scarified and moisture conditioned to 0 to 5% above optimum moisture content to a minimum depth of 12 inches [300 mm], leveled and rolled so that surface materials of the sub-grade will be at a moisture content and as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

Unless otherwise directed by Engineer, the sub-grade shall be proof-rolled by a rubber-tired roller, a fully-loaded dump truck, or other suitable heavy rubber-tired equipment acceptable to Engineer. A minimum of four passes of the proof-rolling equipment shall be provided such that the last two passes are made perpendicular to the first two passes.

All soft, yielding, or otherwise unsuitable material shall be removed and replaced with compacted fill.

3-3.02. Roadway Sub-Grade Preparation. After shaping to line, grade, and cross section, the subgrade shall be compacted to a depth of at least 12 inches [300 mm] and shall meet the following:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction and moisture content relative to the optimum.	95%.
Moisture content relative to the optimum.	0% to +5%

This operation shall include any reshaping and wetting or drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

3-3.03. Placement and Compaction. All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches [200 mm] in un-compacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Earthwork (Custom)
Section 02200-16

Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried to achieve the moisture content relative to optimum as specified above, and shall be thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to the required degree of compaction at the required moisture content. If the material fails to meet the density specified, compaction methods shall be altered. The changes in compaction methods shall include, but not be limited to, changes in compaction equipment, reduction in uncompacted lift thickness, increase in number of passes, and better moisture control.

Wherever a pipe is to be installed within a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than 12 inches [300 mm] above the top of pipe elevation before the trench for pipe installation is excavated.

Jetting of backfill is not permitted. The on-site soils are suitable for backfill of utility trenches from one foot above the pipe to the surface, provided the material is free of organic and deleterious substances.

3-3.04. Borrow Pits. Borrow pits are not permitted.

3-4. FILL AND BACKFILL MATERIALS.

3-4.01 Fill Below Structures – Foundation Support. Beneath structural foundations, place materials per Drawings and specifications. Fill area with “Gravel Beneath Slabs” material on top of 12” Select Imported Granular Structural Fill compacted to 95% relative compaction on top of Engineered Fill compacted to 90% relative compaction. The depth of Engineered Fill to be based on overexcavation requirements.

3-4.02 Structure Backfill. Backfill around structures with Engineered Fill compacted to 90% relative compaction.

3-4.03 Roadway Backfill. Overexcavated roadway areas shall be backfilled with Engineered Fill. Engineered Fill shall be placed in lifts no greater than 8 inches and shall be compacted to 90% relative compaction. The upper 12” of Engineered fill below base materials shall be compacted to 95% of the maximum dry density. Aggregate base to placed above Engineered Fill and compacted to 95% relative compaction.

3-4.04 Curbs, Gutters, Sidewalk and Other Flatwork Backfill. Overexcavated curb, gutter, sidewalk and concrete flatwork areas shall be backfilled with Engineered Fill. Engineered Fill shall be placed in lifts no greater than 8 inches and shall be compacted to 90% relative compaction. Aggregate base to placed above Engineered Fill and compacted to 90% relative compaction.

3-4.05 Pipe Bedding, Pipe Zone and Pipe Trench Backfill. Pipe Bedding and Pipe Zone to be backfilled the width of the trench with Pipe Bedding, Pipe Zone backfill materials compacted to a minimum of 90% of the maximum dry density or Controlled Density Fill. Pipe Trench shall be backfilled with Engineered Fill compacted to 90% relative compaction.

3-5. DESIGNATED FILLS

Designated fills are all fills designated by a name and included as subparagraph under this heading. Fills required or indicated to be designated fills shall be constructed using the specific materials and placement requirements as specified. In addition to the specific requirements specified herein, all requirements for general fills and embankments shall apply. These requirements include, but are not limited to organic or deleterious materials, subgrade preparation, lift thickness, and moisture conditioning requirements. All designated fills shall be constructed to the lines and grades indicated on the Drawings. Backfilling and construction of fills during freezing weather shall not be done except by permission of Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-5.01. Select Imported Granular Fill (Engineered). Granular fills shall be placed on suitably prepared sub-grades in uncompacted lift thickness of 6 inches or less and compacted by vibration. Granular fills shall be compacted to not less than 95% relative compaction percent compaction and relative density as determined by ASTM D4253 and D4254. If the thickness of the granular fill is less than 6 inches, the compaction shall be by a minimum four passes (round trips) of a self-propelled or walk-behind type vibratory roller operating in full vibration mode in accordance with manufacturer's instructions.

Where select imported granular fills are covered with concrete, the top surface shall be graded to the required sub-grade elevation. The completed fill shall be covered by a vapor barrier as indicated by the drawings.

3-5.02. Structure Backfill. Structure backfill shall consist of Engineered fill and shall be deposited in uniform horizontal layers not to exceeding 8 inches in uncompacted thickness. and shall meet the following requirements:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction.	90%
Moisture content relative to the optimum.	-2% to +2%.

Earthwork (Custom)
Section 02200-18

Compaction of structure backfill shall be performed in such a manner that damage to the structure is prevented. The compaction equipment used within 8 feet [2.4 m] of the walls and for the top 8 feet of backfill shall have no restriction on type. Upper limit of equipment weight shall be 1 ton. Compaction of structure backfill by inundation with water will not be permitted.

No backfill shall be deposited or compacted in water.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters, or other surface construction or structures. In addition, wherever a pipe is to be installed within structure backfill, the structure backfill shall be placed and compacted to an elevation not less than 12 inches [300 mm] above the top of pipe before the trench for pipe installation is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

3-5.04. Gravel Base Beneath Slabs. The gravel base beneath slabs shall be placed in uncompacted lift thickness of 6 inches or less and compacted with a minimum of four passes (round trips) of a self-propelled or walk-behind type vibrating roller. The roller shall be operated in the full vibrating mode and in accordance with the manufacturer's instructions.

3-5.05. Controlled Density Fill. Refer to Section 02252 Control Density Fill

3-6. FILTER FABRIC INSTALLATION.

Filter fabric shall be placed as specified herein and at the locations specified or otherwise indicated on the Drawings.

Filter fabric shall be protected at all times during construction from contamination by foreign material and damage. Any contaminated or damaged filter fabric shall be replaced with new filter fabric at no additional cost to the Owner. The work shall be scheduled so that covering of the filter fabric is accomplished within 7 calendar days after placement of the filter fabric.

The subgrade for placement of filter fabric shall be smooth and free of irregularities and undulations. Filter fabric shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. Type A and B filter fabric shall be overlapped a minimum of 2 feet between adjacent roll ends and adjacent strips.

All filter fabric placed shall be fixed to the subgrade to prevent filter fabric slippage or movement during placement of subsequent materials. Pins or staples shall not be used

to fix the filter fabric to the subgrade when a geomembrane is to be placed on top of the filter fabric.

The Contractor shall exercise extreme care during filter fabric installation to prevent damage to the prepared supporting subgrade surface. The Contractor shall exercise care to prevent the entrapment of rocks, clods of earth or other material which could damage the filter fabric, clog the filter fabric or hamper seaming. Any filter fabric surface showing damage from penetration or distress caused by foreign objects shall be repaired or replaced.

No foot traffic will be allowed on the filter fabric except with approved smooth-sole shoes. The Contractor shall not use the filter fabric surface as a work area or storage area for tools and supplies.

Tracked or rubber-tired construction equipment shall not be operated directly upon the filter fabric until a minimum thickness of 6 inches of the cover material is placed over the filter fabric. Turning of construction vehicles shall be minimized to avoid distorting or damaging the filter fabric. All damaged filter fabric shall be replaced at Contractor's expense.

3-7. VAPOR BARRIER INSTALLATION.

Vapor Barrier shall be placed between granular subbase materials as indicated on the Drawings.

Vapor Barrier material shall be protected at all times during construction from contamination by foreign material and damage. Any contaminated or damaged Vapor Barrier material shall be replaced with new filter fabric at no additional cost to the Owner. The work shall be scheduled so that covering of the material is accomplished within 7 calendar days after placement of the filter fabric.

The subgrade for placement of Vapor Barrier material shall be smooth and free of irregularities and undulations. Vapor Barrier material shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.

All Vapor Barrier material placed shall be fixed to the subgrade to prevent material slippage or movement during placement of subsequent materials.

The Contractor shall exercise extreme care during Vapor Barrier material installation to prevent damage to the prepared supporting subgrade surface. The Contractor shall exercise care to prevent the entrapment of rocks, clods of earth or other material which could damage the Vapor Barrier material. Any Vapor Barrier material surface showing

Earthwork (Custom)
Section 02200-20

damage from penetration or distress caused by foreign objects shall be repaired or replaced.

No foot traffic will be allowed on the Vapor Barrier material except with approved smooth-sole shoes.

Tracked or rubber-tired construction equipment shall not be operated directly upon the Vapor Barrier material until a minimum thickness of 6 inches of the cover material is placed over the Vapor Barrier material. All damaged Vapor Barrier material shall be replaced at Contractor's expense.

3-8. FINAL GRADING AND PLACEMENT OF TOPSOIL.

After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth. Any additional topsoil required to provide the required minimum thickness shall be at no additional cost to the Owner.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-9. DISPOSAL OF EXCAVATED MATERIALS.

Suitable excavated materials may be used in fills and embankments as needed. All materials removed from the excavations in excess of that stored temporarily as above specified shall be immediately hauled away and used in backfilling elsewhere, or, if not used, shall be disposed off site at the expense of Contractor. The disposal area shall be acquired by the Contractor. No materials shall be disposed of either temporarily or permanently on privately or publicly owned property unless the Contractor shall first obtain permission therefore from the owner or agency concerned. The Contractor shall furnish satisfactory evidence to the Engineer that such consent has been obtained and that the Contractor shall be responsible for all damages and claims that may arise in connection therewith.

All debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, Contractor.

3-10. SETTLEMENT.

Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from Engineer or Owner.

END OF SECTION

PROTECTIVE SYSTEM
DESIGN CERTIFICATE – 1

I, the undersigned professional engineer licensed in the state where the earthwork is located, hereby certify that the protection system for the _____(structure name) excavation at _____ (structure location) has been designed by me, is appropriate for the _____ (structure name) as represented to me, and is in compliance with the Contract Documents.

Name: _____ State of License: _____

Signature: _____ P.E. Number _____

Date: _____

(Seal)