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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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35 41 00

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35 41 00

LEVEE CONSTRUCTION
11/18, CHG 1: 02/20

****
NOTE: This guide specification covers the requirements for levee construction. This section was originally developed for USACE Civil Works projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections.

This guide specification includes paragraphs for construction activity that may have their own UFGS Guide Specifications. These include Section 31 00 00 EARTHWORK, Section 31 66 10 ROCK FOUNDATION PREPARATION and Section 31 11 00 CLEARING AND GRUBBING among others. If those Guide Specifications are to be referenced, remove the appropriate paragraphs from this section or those as is appropriate.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

****
NOTE: This guide specification includes the installation of settlement gages for the

determination of increases in quantities of embankment materials resulting from settlement of the embankment foundation during construction and for payment to the Contractor for such increases in quantities. These provisions should be included in a project specification when it is determined that settlement in the range of 5 percent or more of the planned embankment height is anticipated over a considerable portion of the embankment foundation area. They will also be used when gages are needed for engineering control purposes, required in critical locations or called for if adverse contractual relationships are expected. When settlement gages are to be used the following information will be indicated on the plans:

1. The location of the gages as well as the stations at which zero settlement will be assumed.

2. The detail construction of the foundation settlement gages to be used. Any applicable type of gage may be selected.

The requirements for rock as prescribed herein are intended to be used on embankments involving rock fill sections. Where rock for slope protection is specified, Section 35 31 19 STONE, CHANNEL, SHORELINE/COASTAL PROTECTION FOR STRUCTURES should be used.

Approval of testing laboratory is addressed in ER 1110-1-8100, dated 31 Dec 1997, Laboratory Investigations and Testing.

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1.1 [LUMP SUM] [UNIT] PRICES

****

NOTE: If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title ([LUMP SUM] [UNIT] PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 20 00 as appropriate.

****

1.1.1 Clearing, Grubbing, and Stripping

****

NOTE: If Section 31 66 10 ROCK FOUNDATION PREPARATION or Section 31 11 00 CLEARING AND GRUBBING is included in the project specifications, this paragraph title Clearing, Grubbing, and Stripping should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 31 66 10 or Section 31 11 00 as appropriate.

****

1.1.1.1 Payment

Payment will be made for clearing, grubbing and stripping at the contract [lump sum] [unit price] for clearing, grubbing and stripping. This price will constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the work specified herein. Payment for refilling of holes resulting from grubbing will be included in the contract [lump sum] [unit price] for clearing, grubbing and stripping. No separate or direct payment will be made for stockpiling and disposition of stripped materials. All costs in connection therewith will be considered as a subsidiary obligation of the Contractor. If regrowth of vegetation or trees occurs after clearing and grubbing and before placement of embankment, and the Contractor is required to clear and grub again prior to embankment construction, no payment will be made for this additional clearing and grubbing.

1.1.1.2 Measurement

****

Note: If clearing, grubbing, and stripping is to be paid for with a unit price bid item include the method of measurement. Delete this paragraph if payment is by lump sum.

****

Clearing, grubbing, stripping, stockpiling and the disposition of the materials from these operations will [not] be measured for payment.[Refilling of grubbing holes will not be measured for payment.]

1.1.1.3 Unit of Measure

Unit of measure: [lump sum] [unit price].

1.1.2 Demolition and Removal of Existing Structures

1.1.2.1 Payment

Payment will be made for demolition or removal of existing drainage structures, pavements, foundations, superstructure, walls, fences, or any other manmade object at the contract [lump sum] [unit price] for demolition and removal of existing structures. This price will constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the work specified herein. Payment for refilling of holes resulting from removal of structures will be included in the contract [lump sum] [unit price] for demolition and removal of existing structures. No separate or direct payment will be made for stockpiling and disposition of removed materials. All costs in connection therewith will be considered as a subsidiary obligation of the Contractor.

1.1.2.2 Measurement

****

NOTE: If removal or demolition of existing drainage structures is to be paid for with a unit price bid item include the method of measurement. Delete this paragraph if payment is by lump sum.

****

Plugging or removal of existing structures required from these operations will [not] be measured for payment.

1.1.2.3 Unit of Measure

Unit of measure: [lump sum] [unit price].

1.1.3 Excavation

****
NOTE: If Section 31 00 00 EARTHWORK is used, this item should be deleted.

If excavation will not be measured or paid for separately, select the following paragraph and delete subparagraphs PAYMENT, MEASUREMENT, and UNIT OF MEASURE. Delete the following paragraph if excavation is to be measured and paid for separately. If significant quantities of rock excavation is anticipated measurement and payment for rock excavation should be addressed separately. A definition of rock excavation should also be included.
****

No separate measurement or payment will be made for Excavation. All costs in connection with excavation will be considered a subsidiary obligation of the Contractor.

1.1.3.1 Payment

Payment will be made for Excavation at the contract unit price which includes full compensation for all equipment, labor, materials, and incidentals necessary to complete the work specified.[No separate payment will be made for stockpiling.]

1.1.3.2 Measurement

Excavation will be measured for payment by use of the average end area method. The basis of measurement will be a survey of the area prior to the excavation[and clearing and grubbing] and a second survey of the same area after the completion of the excavation. For areas where lines and grades are shown on the drawings, measurement will be limited to those lines and grades. Slides caused by fault of the Contractor, over excavation, and excavation performed for will not be measured for payment.

1.1.3.3 Unit of Measure

Unit of measure: cubic meters yards.

1.1.4 Fill Material

****
NOTE: There are restrictions in guidance for the use of Hydraulic fill in levee construction. Designer should refer to EM 1110-2-1913 for guidance.
****

1.1.4.1 Payment For Embankment Fill

Payment will be made for material placed as required in embankments, backfills and ramps, and including additional material placed by reason of foundation settlement and by reason of soft material in the foundation being forced outward from the section during construction, for [Embankment Material Type [_____],] [Semicompacted Fill] [Uncompacted Fill] [Hydraulic Fill]. Payment will constitute full compensation for furnishing all plant, labor, equipment and material, [except earth material,]and performing all operations necessary for foundation preparation and placing and compacting the material [, materials testing,] [and moisture control]. [This payment is in addition to any payment for excavating and transporting of the material as required in paragraph EXCAVATION.]

1.1.4.2 Measurement of Fill Material

****
NOTE: The last sentence of the following paragraph (in brackets) should be deleted if surveys are taken "after" clearing and grubbing operations. The last sentence should be included if surveys are taken "prior" to clearing and grubbing operations.
****

Submit a copy of the records of each compliance survey the next work day following the survey.

1.1.4.2.1 Fill Materials Specified for Embankment

Fill materials specified for embankment will be measured for payment by the cubic meter yard, and quantities will be determined by the average end area method. The basis for measurement will be cross sections of the areas to be filled taken [prior to] [after] clearing, grubbing, and stripping operations and the [theoretical cross sections] [actual cross sections] of the embankments constructed within the specified tolerance[plus additional fill placed as the result of displacement or settlement of foundation material as calculated below].[Cross sections will be performed at significant breaks in grade except that the maximum distance between cross sections will not exceed [_____] meters feet.] Embankments not constructed to design grade and section including allowable tolerance as indicated on the Contractor's compliance survey will not be accepted.[Volumes occupied by drainage structures will not be included in measurement of embankment for payment.] [Material removed as a result of the clearing, grubbing, and stripping operations will not be included in measurement of embankment for payment.]

1.1.4.2.2 Fill Due to Soft Material in the Foundation

The basis for measurement of fill placed by reason of soft material in the foundation being forced outward from the section will be a survey of the area taken prior to fill placement and a second survey of the same area after completion of fill placement. The cross sections will extend [_____] meters feet beyond the toes of the fills.[A cross section will be taken at each settlement measurement location.]

1.1.4.2.3 Levee Settlement

****
NOTE: The designer can choose to measure settlement

using settlement gages.
****

Measurement of additional fill material placed in each settlement measurement range, shown on the drawings by reason of foundation settlement, will be based on measurements [taken on the respective settlement gage] at the respective settlement measurement locations as specified and will be determined as follows:

a. The settlement measured at each settlement measurement location will be considered to apply to the foundation area throughout the length of the settlement ranges shown on the drawings.

b. The foundation settlement under the embankment at each transverse cross section within a settlement range will be considered to vary uniformly between break points in the cross section.

c. At each breakpoint, the settlement allowance will be based upon the proportion that the specified fill height at the break point bears to the specified fill height at the settlement measurement locations, in accordance with the following formula.

S = h X sm/hm, where	
S	settlement to be computed at a break point
h	specified gross fill height at S
sm	measured or adjusted vertical change at settlement measurement location
hm	specified gross fill height at settlement measurement location

d. Symbols used in the formula and the break points are [shown on a typical settlement cross section on the drawing] [included in these specifications].

1.1.4.2.4 Forfeiture of Payment for Settlement of Foundation

Failure to utilize settlement gages in strict accordance with the specifications and drawings will result in total forfeiture of any payment which will otherwise be due the Contractor for settlement of the foundation. Payment for settlement of the foundation will be totally forfeited for the reach attributable to the each settlement measurement location in each case for the following reasons: embankment over a settlement measurement location is constructed to a height in excess of the specified construction lines plus the tolerance permitted; settlement plates have been set and cannot be found after completion of the embankment; failure to take the settlement measurement within [_____] hours after the final cross sections have been taken over the completed embankment.

1.1.4.3 Unit of Measure

Unit of measure: cubic meters yards.

1.1.5 Mortar and Concrete for Foundation Preparation

****

NOTE: If Section 31 66 10 ROCK FOUNDATION PREPARATION, specifically paragraphs DENTAL CONCRETE or DENTAL MORTAR is a part of the project specifications, this section should be deleted.
****

1.1.5.1 Payment

Payment will be made for costs associated with mortar and concrete used in foundation and abutment preparation, which includes full compensation for furnishing all labor, equipment, material, and incidentals, and performing all operations necessary for placement of concrete and mortar for foundation and abutment preparation.

1.1.5.2 Measurement

Mortar and concrete used in filling spaces beneath rock overhangs and around protrusions will be measured for payment as the actual volumes of such mortar and concrete in cubic meters yards as determined by field surveys made before and after placement of the mortar and concrete.[No measurement will be made for the mortar used in filling the open joints and cracks in the rock surface.][Measurement of mortar or concrete used in filling the open joints and cracks in the rock surface will be made by the square meter yard based on the horizontal projection of the area obtained from a survey performed before application.][Measurement of mortar or concrete used in filling the open joints and cracks in the rock surface will be the bags of cement used.]

1.1.5.3 Unit of Measure

Unit of measure: cubic meters yards.

[1.1.6 Settlement Gages

No separate payment will be made for furnishing, installing, and maintaining settlement gages during embankment construction as specified herein, if used, including measurements required to be made by the Contractor, and will be at the expense of the Contractor. No separate payment will be made for compaction of fill around and over the settlement gages or for interference with the Contractor's operations resulting from the settlement gage installations.

]1.2 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 43	(2005; R 2018) Standard Specification for Sizes of Aggregate for Road and Bridge Construction

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D698	(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2937	(2017; E 2017; E 2018) Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D4253	(2016; E 2019) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

ASTM D4254	(2016) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643	(2017) Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D5195	(2014) Density of Soil and Rock In-Place at Depths Below the Surface by Nuclear Methods
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

1.3 DEFINITIONS

****
NOTE: Add applicable definitions.
****

1.3.1 Clearing

Clearing consists of the removal and satisfactory disposal of all [above ground and below ground]trees, downed timber, snags, slash, brush, garbage, trash, debris, fencing, and other items occurring in the designated areas to be cleared.

1.3.2 Grubbing

Grubbing consists of the removal and satisfactory disposal of stumps, roots larger than [_____] mm inches in diameter, and matted roots from the designated grubbing areas. Grubbing also includes filling of holes from the grubbing operation.

1.3.3 Stripping

Stripping consists of the removal and satisfactory disposal of crops, weeds, grass, and other vegetative materials to the ground surface[and topsoil to a depth of [_____] mm inches].

1.3.4 Satisfactory Materials

****
NOTE: Use of CH material should be avoided if possible. As a minimum, constraints should be set governing their use.
****

Satisfactory materials consists of materials classified in accordance with ASTM D2487 as CL,[CH,] CL-ML, ML, SC, SP, SW, [_____] free from: roots and other organic matter; contamination from hazardous, toxic or radiological substances; trash, debris; and frozen materials. Not all satisfactory materials can be used in levee. Only the satisfactory materials stated above, meeting the additional or modified requirements of paragraph TYPES OF FILL MATERIALS, can be used for levee construction.

1.3.5 Unsatisfactory Materials

Do not use unsatisfactory materials in any levee or other required fill. Unsatisfactory materials includes all other materials that are not defined above as satisfactory materials. Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include, man-made fills (unless excavated, sorted/separated/stockpiled, and tested); trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material.

1.3.6 Embankment

The term "embankment" as used in these specifications is defined as the earth [and rock]fill portions of the levee structure or other fills related to the levee structure, including [cut-off trench] and includes all types of earth fill [and filter materials]for the levee [and cut-off trench,] and all other fills within the limits of the levee as shown on the project drawings. [Stone and other rock materials used for slope protection are described in paragraph [_____]].

1.3.7 Backfill

Backfill as used in this section is defined as that fill material which cannot be placed around or adjacent to a structure until the structure is completed or until a specified time interval has elapsed after completion.

1.3.8 Excavation

Excavation consists of removal of material to the lines and grades shown on the drawings, or as otherwise directed or approved by the Contracting Officer and as described in paragraph [_____] EXCAVATION in PART 3 EXECUTION.

1.3.8.1 Over-excavation

Excavation performed beyond lines and grades shown on the plans that is made at the convenience of contractor. No separate payment will be made for over-excavation or for additional embankment materials needed to backfill the over-excavation.

1.3.8.2 Additional Excavation

Excavation performed beyond lines and grades shown on the plans that is performed at the direction of the Government, and to be paid at unit prices for excavation and backfill, or as negotiated.

1.3.9 Classification of Soils

Materials used to construct the embankments and for backfills will be

classified in accordance with ASTM D2487 (Unified Soil Classification System). Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.3.10 Degree of Compaction

1.3.10.1 Cohesive Material

****
Note: If a higher compactive effort than is attainable by ASTM D698 is desired, ASTM D1557 may be utilized and references to ASTM D698, relative to compactive effort, should be changed to ASTM D1557.
****

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in [ASTM D698] [ASTM D1557], abbreviated hereinafter as percent laboratory maximum density.

1.3.10.2 Cohesionless Material

****
Note: Factors such as (but not limited to) site specific materials, availability of testing equipment and local practice may make it more practical to utilize methods other than ASTM D4253 and ASTM D4254 to control the degree of compaction of cohesionless material. If other methods are utilized the appropriate sections of the specifications should be modified to reflect method selected. The other methods used include comparison of in-place density to either the maximum Proctor density or the maximum density obtained by ASTM D4253 (if vibratory table is available).
****

Degree of compaction is expressed as a percentage of the relative density in accordance with ASTM D4253 and ASTM D4254.

1.4 SYSTEM DESCRIPTION

****
NOTE: This section should describe all appropriate activities to be performed to accomplish the completed projects as planned, including any special work items that must be conducted.
****

The work covered by this section consists of furnishing all equipment, labor, materials, and incidentals, and performing all operations necessary for the clearing, grubbing, and stripping of the areas specified herein or indicated on the drawings, and for the removal and disposal of cleared, grubbed, and stripped materials,[removal or plugging of existing drainage structures,] and refilling of holes resulting from grubbing; excavation of borrow areas [and existing levees,] and for all other required excavations or excavations incidental to the construction of levees[, channels] [, ditches] [, structures] [, and ponding areas] as specified and shown;

foundation preparation and the construction of levee embankments, including new levee, enlargement of existing levee, backfill of inspection trenches, cutoff trenches, berms, road crossings, backfill at drainage structures, and other incidental earthwork as may be necessary to complete the levee as specified herein and as shown on the drawings. All work under this section will comply with the requirements of EM 385-1-1.

1.4.1 Embankment and Backfill Materials

****

NOTE: All available sources of materials for embankment and backfill should be designated.

****

At least [30] [_____] days prior to delivery of any Contractor-furnished material to the site of the work, submit soil classification test results, moisture-density curves, gradation curves, and laboratory results of the required tests of the proposed material. Materials for embankment and backfill construction will be obtained from [the borrow sources] [sources provided by the Contractor] [required excavation]. Materials obtained from required excavation which meet or which can be processed to meet the requirements for each embankment material, or any other material required for this project, as specified herein, may be utilized [in the appropriate zone of] [in] the embankment or as backfill. Submit to the Contracting Officer the source or sources intended to provide materials for embankment construction. If a source is selected other than a commercial quarry or other commercial entity from which earth or rock material will be directly purchased and where the Contractor or his subcontractor will perform the borrow excavation, a written statement will be provided to the Contracting Officer indicating permission to utilize the area. It is the Contractor's responsibility to obtain Federal, State, and local permits which may be required for excavation and reclamation of the borrow area. A copy of the plan and procedures to be utilized for reclamation will be furnished to the Contracting Officer as required in Section [_____], paragraph [_____]. The Contracting Officer will require material samples from any proposed borrow source to be submitted as indicated in paragraph FIELD QUALITY CONTROL.

1.4.2 Haul Roads

****

NOTE: Haul roads are highly project specific. Contractor should be given as much latitude as feasible to determine his traffic patterns. Haul roads must be safe, not interfere with public traffic, environmentally friendly and generally must be restored to preconstruction conditions.

****

Locate and construct haul roads [as indicated and] [as] [approved by the Contracting Officer] [within the project boundaries shown on the drawings].[Prior to the commencement of construction submit for approval a site plan detailing the location of all haul roads within the project limits.] [Locate haul road[s] between the borrow site[s] and the levee embankment within the limits [shown on the drawings] [approved by the Contracting Officer].] [Mark the limits of the borrow haul road in the field using construction fencing or similar methods approved by the Contracting Officer. Areas on each side of the borrow haul road corridor must not be disturbed.] Construct haul roads to maintain the intended

traffic, be free draining, and remain in good condition throughout the contract period.[Any haul road which crosses any creek or drainage channel must be constructed, and maintained so as to not flood either upstream areas by restricting stream flows or flood downstream areas by the release of any stored water in the event that the crossing fails for any cause.] Remove haul roads constructed during the contract duration after work is completed and the impacted area restored to its preconstruction conditions.[Plow and/or scarify or otherwise loosen all access and haul roads other than existing roads to a minimum of [_____] mm inches deep and leave the surface in a smooth condition.] All haul roads within the right-of-way that will remain as public thoroughfares after construction must be cleaned daily and maintained in the preconstruction condition. Consider all costs associated with these haul roads as a subsidiary obligation of the Contractor.

1.4.3 Ramps and Crossings

Construct ramps and crossings at the locations shown on the drawings by placement of a fill as specified in paragraph [_____]. Construct ramps and crossings by adding material to the levee crown and slopes. Provide ramps that have a [_____] meter foot crown width, a grade not to exceed [_____] percent, and 1V on [_____]H side slopes.

1.4.4 Runways

****
NOTE: Runways are temporary haul roads over a levee.
****

Where material is hauled over an existing levee for construction, the Contractor, at no extra cost, will be permitted to construct temporary runways over the levee by the addition of material to the levee cross section. For the construction of runways, if the Contractor so desires, the existing levee may be cut, [but not to exceed a depth of [_____] meters feet below the crown] [not to exceed [_____] meters feet below the project flowline] [or 100-year level] [not to excavate below elevation [_____] or one half the height of the levee, whichever is less], and provided that the cut is made with side slopes not steeper than 1V on 1H, and with a minimum width of haul road of [_____] [7.6] m [_____] [25] feet for one-way traffic, and [_____] [18.3] m [_____] [60] feet for two-way traffic. Cutting into the existing levee at intervals of less than [_____] [152] m [_____] [500] linear feet for the [_____] [7.6]-m [_____] [25]-foot bottom widths or less than [_____] [304] m [_____] [1,000] linear feet for the [_____] [18.3]-m [_____] [60]-foot bottom widths will not be allowed, and no more than [_____] runways will be open at one time. Stockpile, as directed by the Contracting Officer, sufficient suitable levee embankment material to construct emergency closure of the cuts.

1.4.5 Closure of Runways

Where runways have been cut through the levee, the Contracting Officer reserves the right to order their closure at no additional cost to the Government at any time that such runways may endanger the security of the levee. Just prior to restoration of the runway, the bottom of any cut made in the levee must be broken to a depth of [_____] [300] mm [_____] [6] inches and the side slopes thoroughly scarified. The restoration must be made with suitable embankment material, placed and compacted as provided in paragraph [_____]. Remove material used in the construction

of the approach ramps of the runways and use for fill, if satisfactory. If not used for fill, dispose the material by placing it in abandoned portions of the borrow areas or by any other method specified in paragraph disposal of material.[No section of the levee will be degraded or weakened to provide runways nor will existing runways remain open during the nonwork season described in [GENERAL CONTRACT REQUIREMENTS], [paragraph] [Clause] EXCLUSION OF PERIODS IN COMPUTING COMPLETION SCHEDULES, unless otherwise approved in writing by the Contracting Officer.]

1.4.6 Stockpiling

****

NOTE: Cost of stockpiling embankment fill material should be included in the price for placing fill in the levee embankment.

****

Any on-site stockpiling of embankment materials will be in accordance with paragraph [_____] Stockpiles.[No payment will be made for such stockpiling nor for the reloading and hauling of these materials to their final position.]

1.4.7 Slides and Foundation Failures

When sliding occurs in any part of the embankment and backfills prescribed in this section after they have been placed, but prior to final acceptance of all work under the contract, either cut out and remove the slide from the embankment and then rebuild that portion of the embankment, or construct a stability berm of such dimensions, and place in such manner as prescribed by the Contracting Officer. When the slide is caused through the fault of the Contractor, the repair will be made at no cost to the Government.

1.4.8 Drainage Requirements

****

NOTE: Modify the following paragraph for specific job conditions such as fill placed in/under water.

****

Submit written evidence consisting of an authenticated copy of the [conveyance] [easement] under which the Contractor acquired the property rights and access thereto, prepared and executed in accordance with applicable State and local requirements. Do not block or restrict the flow in a natural drain, existing culvert, ditch or channel at any time without obtaining prior written approval from the Contracting Officer. This approval will not relieve the Contractor from responsibility for any damage caused by the operation. Monitor the [river] [canal] [stream] flow and provide sufficient free discharge areas so that conditions are not worsened upstream or downstream by possible floods during construction. Surface water will be directed away from excavations and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes, and grading will be provided and maintained as necessary during construction. Protect excavated slopes and backfill surfaces to prevent erosion and sloughing. Perform excavation so that the site and the area immediately surrounding the site and affecting operations at the site will be continually and effectively drained. If private property is to be used for drainage, submit written evidence that the right has been

obtained from the property owner for drainage on his property.

1.5 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Plan Of Operations; G[, [_____]]

Submit complete and detailed descriptions of proposed earthwork plan. This plan must include, but not be limited to, the Contractor's proposed sequence of construction for all earthwork including backfill and embankment items; methods and types of equipment to be utilized for all earthwork operations, including transporting, placing and compacting; quantity, type and final disposition of stockpiled materials; location and drainage of

proposed stockpiles; proposed disposition of all excavated materials, including items which are anticipated to be disposed of off-site. Submit the earthwork plan to the Government not less than 30 days prior to initiating any earthwork operation.

Embankment And Backfill Materials; G[, [_____]]

At least 30 days prior to delivery of any Contractor-furnished material to the site of the work, submit soil classification test results, moisture-density curves, gradation curves, and laboratory results of the required tests of the proposed material.

Excavation; G[, [_____]]

Submit complete and detailed descriptions of proposed excavation plan. Obtain approval of the detailed plan from the Contracting Officer prior to starting the work. If necessary, modify the plan as required to meet field conditions, and the modifications must be approved prior to use. This plan must include:

a. Proposed methods for preventing interference with, or damage to, existing underground or overhead utility lines, trees designated to remain and other man-made facilities or natural features designated to remain within or adjacent to the construction rights-of-way.

b. Provision for coordinating the work with other Contractors working in the construction rights-of-way or on facilities crossing or adjacent to this work.

c. The proposed methods for controlling surface and ground water in the borrow areas and required excavations.

d. Stockpiling plan for embankment material before it is transported to the project site showing locations, stockpile heights, slopes, limits, and drainage around the stockpile areas.

e. A complete listing of equipment used for excavation and to transport the excavated material.

f. The proposed sequence of work for excavating the borrow areas with plan and cross sectional views showing starting and final work locations and clearing, grubbing and stripping limits.

g. The proposals for conserving arable land and for making optimum use of available borrow, including the Contractor's proposed methods for grading the bottom of the borrow areas after completing use of the borrow areas.

h. The proposed haul road and haulage patterns, and plan for implementing dust control measures.

i. Proposed disposition of all excavated materials, including items which are anticipated to be disposed of off-site.

SD-02 Shop Drawings

Drainage Requirements

SD-03 Product Data

Shoring, Sheeting, and Bracing; G[, [_____]]

Borrow Areas; G[, [_____]]

Filter Sand; G[, [_____]]

Nuclear Density; G[, [_____]]

SD-06 Test Reports

Measurement of Fill Material; G[, [_____]]

Submit a copy of the records of each compliance survey the next work day following the survey.

1.6 PROJECT SITE CONDITIONS

****
NOTE: The following paragraphs are commonly included with Division 02, EXISTING CONDITIONS. If those sections are to be used, the following paragraphs should be deleted.
****

1.6.1 Protection of Man-Made Facilities and Natural Features

Trees within the clearing area will be felled in such a manner as to avoid damage to trees left standing and trees outside the clearing area, existing buildings, man-made facilities and natural features, with due regard to the safety of employees and others, and in compliance with EM 385-1-1. Excavation will follow the same requirements specified above for felling trees and will be in compliance with EM 385-1-1. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained will be protected from damage during excavation. When utility lines that are to be removed are encountered within the area of operations, notify the applicable utility companies in sufficient time for measures to be taken to prevent interruption of the services.

1.6.2 Historical, Archeological, and Cultural Resources

Historical, archeological, and cultural resources within the Contractor's work limits [are known to exist] [may exist]. If, during construction activities, the Contractor observes items that may have historical or archeological value, such observations will be reported immediately to the Contracting Officer so that appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in the destruction of these resources and prevent the workers from trespassing on or otherwise damaging such resources.

1.6.3 Subsurface Data

Subsurface soil boring logs are [shown on the drawings] [included in these specifications] [found in the Project Geotechnical Report]. Subsurface investigation reports and samples of materials obtained from subsurface investigations may be examined at the [_____] District Office. These data

represent subsurface information at the boring locations; however, variations may exist in the subsurface between boring locations. The Contractor is ultimately responsible for subsurface interpretation across the entire project site. Groundwater levels indicated on the soil boring logs were levels found at the time of exploration. The groundwater table can vary significantly depending on time of year, variation from normal precipitation, and river stage or tide level. Contractor is ultimately responsible for subsurface interpretation across the entire project site.

1.7 MERCHANTABLE TIMBER

****
NOTE: The following paragraphs are commonly included with Division 02, EXISTING CONDITIONS. If those sections are to be used, the following paragraphs should be deleted.
****

Merchantable timber remaining within the areas to be cleared on or after the date of award of this contract may be disposed of as the Contractor sees fit, as long as such merchantable timber is either removed from the rights-of-way or is satisfactorily disposed of in accordance with the paragraph DISPOSITION OF CLEARED, GRUBBED, AND STRIPPED MATERIAL DISPOSITION OF EXCAVATED MATERIAL and the Contractor complies with all applicable State and local regulations and laws.

1.8 SEQUENCING

1.8.1 Clearing and Grubbing

****
NOTE: If the specification for this project includes Section 31 11 00, CLEARING and GRUBBING, the following paragraph should be deleted.
****

Complete all clearing and grubbing work at least [100] [_____] meters [300][_____] feet in advance of embankment construction.[In locations where work on drainage structures is performed prior to embankment construction, complete all clearing and grubbing for the structure at least [_____] meters feet on each side of the structure, measured along the levee centerline and [_____] meters feet perpendicular to the structure.] If regrowth of vegetation or trees occurs after clearing and grubbing and before placement of embankment, the Contractor will be required to clear and grub again prior to embankment construction.

1.8.2 Stripping

After inspection and acceptance of cleared and grubbed areas, stripping may proceed. All stripping work must be completed not more than [_____] meters feet in advance of embankment construction.

PART 2 PRODUCTS

****
NOTE: After "PART 2 PRODUCTS" above, insert the following "(NOT APPLICABLE)", if there are no subparagraphs in PART 2. PART 2 material requirements should be added for contracts in which

the Contractor is required to supply materials.
****

2.1 HAUL ROAD MATERIALS

[_____].

2.2 TYPES OF FILL MATERIALS

****
NOTE 1: The types of fill materials used for levee construction usually depend on the availability of materials from required construction excavation and the nearby borrow sources. The material types listed below as satisfactory materials are often used in levee construction.

2: Separate paragraphs, such as those below, should be included for EACH material type that is to be placed under a contract. The plans should clearly show, with labels, the location of the fill types. Embankment fills should include, but not be limited to, the levee, berms, inspection trench, cutoff trenches and any other specified fill or backfill. This allows the Designer and Specifications Engineer to use multiple fill types within the same contract and clearly indicate locations of each type. The types of satisfactory materials should be edited for each type of fill. The bid schedule should include a line for each type of fill. Where multiple fills are placed in layers or zoning, the measurement, payment and tolerance paragraphs should be edited to specify the interfaces of the multiple fill types.

Omit the following soil types which are not applicable to the specific project.
****

2.2.1 [Select Fill

Obtain select fill embankment material from [the borrow site provided by the Government] [sources provided by the Contractor] [required excavation]. Provide select fill material consisting of satisfactory materials classified in accordance with ASTM D2487 as [_____].]

2.2.2 [Impervious Fill

****
NOTES: Caution should be exercised regarding the use of high plasticity clay and silt (CH, MH) soils with Plasticity Indices greater than about 40 (30 in dry climates and 50 in humid climates). Spreading and compacting CH or MH materials can also present constructability problems due to difficulty maintaining proper moisture content. These soils are susceptible to shrinkage and cracking upon drying. Seasonal cycles of swelling and shrinkage can also result in loss of shear strength, which may ultimately result in slope instability. Chemical

treatment, such as lime, has been used to reduce the PI and potential for cracking.

Compact Impervious Fill material using self-propelled or towed sheeps-foot rollers.

****

Provide material consisting of satisfactory impervious material classified as lean clay (CL),[fat clay (CH),] low plasticity silt (ML),[high plasticity silt (MH),] [sand containing more than 30 percent of clay (CL),] and borderline clay and silt (CL-ML) in accordance with ASTM D2487.]

2.2.3 [Pervious Fill

****

NOTE: The designer should define the types of material which are acceptable as Pervious Fill.

****

Provide material consisting of satisfactory pervious material classified as well graded sand (SW), poorly graded sand (SP)), poorly graded gravel (GP) or well graded gravel (GW) in accordance with ASTM D2487.]

2.2.4 [Random Fill

Provide random fill consisting of any satisfactory materials[other than those classified in ASTM D2487 as [_____]] [and any silt or sand with a uniformity coefficient (Cu) less than 6].[Random fill may consist of select fill, impervious fill, and pervious fill, or a combination of them.]]

2.2.5 Random Rock

****

NOTE: Random rock is sometimes used in levee construction to build up an underwater levee toe foundation or to buttress a slope in a constricted area. Due to its high permeability, random rock or pervious fill should not be used alone as levee fill material. The designer should select the types of acceptable rock material and the maximum allowable percent fines.

****

Provide random rock consisting primarily of [_____] (shale, siltstone, sandstone, granite or limestone) obtained from a source provided by the Contractor. Provide random rock that is free of silt, clay, or other earth material in quantities greater than [_____] [5] percent by weight, and containing no debris or organic material. Random rock must be reasonably well-graded and the largest stones must have a maximum dimension not exceeding [_____] [450] mm [_____] [18] inches. Control rock production at the source such that not more than 20 percent of the material has a maximum dimension between adjacent earth fill choke off with a layer of finer random rock material. Random rock placed within 1 meter 3 feet of any structure must have a maximum size of 125 mm 5 inches.

[2.2.6 Coarse Drainage Gravel

****

NOTE: It is important to use appropriate filter criteria in the design of the drainage features. Selection of the gradation for the coarse and fine drainage materials should be developed with consideration of filter compatibility with native soils and the materials to be obtained for use.
****

Obtain coarse gravel material for the [rectangular and trapezoidal] toe drains [landside seepage berms] [road stone] from a source [provided by the Contractor]. Provide coarse drainage gravel that is non-calcareous, composed of tough durable particles, and does not contain any organic material or soft, friable particles in quantities. Blast furnace slag will not be permitted. The gravel material in-place must meet the quality requirements of [AASHTO M 43, Size No. 57][ASTM C33/C33M No. 57].

][2.2.7 Fine Drainage Gravel

****
NOTE: Identify source of materials. It is important to use appropriate filter criteria in the design of the drainage features. Selection of the gradation for the coarse and fine drainage materials should be developed with consideration of filter compatibility with native soils and the materials to be obtained for use.
****

Obtain fine drainage gravel material for the [rectangular and trapezoidal] [toe drains] [landside seepage berms] [road stone] from a source [provided by the Contractor]. Provide fine drainage gravel material that is non-calcareous, composed of tough durable particles, and does not contain organic material. The fine drainage gravel in-place must meet the requirements of [AASHTO M 43, Size No. 8][ASTM C33/C33M].

][2.2.8 Filter Sand

****
NOTE: It is important to use appropriate filter criteria in the design of the drainage features. Selection of the gradation for the coarse and fine drainage materials should be developed with consideration of filter compatibility with native soils and the materials to be obtained for use.
****

At least [30] [_____] days prior to delivery of any Contractor-furnished material to the worksite, submit soil classification test results and a gradation curve for each of the proposed filter materials to be used. Fine aggregate for the filter sand in-place must meet the quality requirements of ASTM C33/C33M grading for fine aggregate with additional limits on the allowable percentage passing the No. 200 sieve as specified below.

SIEVE SIZE U.S. STANDARD SQUARE MESH	PERCENTAGE BY WEIGHT PASSING INDIVIDUAL SIEVE
9.5 mm3/8-inch	100
4.75 mmNo. 4	95-100
1.18 mmNo. 16	50-85
150 µmNo. 100	2-10
75 µmNo. 200	0-5

Additionally, the filter sand must not contain any organic matter or soft friable particles.

]2.2.9 Bedding

Bedding material, placed as a backing layer must consist of satisfactory pervious fill material satisfying the material requirements presented in [Section 31 36 00 GABIONS] and [Section 35 31 19 STONE, CHANNEL, SHORELINE/COASTAL PROTECTION FOR STRUCTURES].

2.2.10 Topsoil

Provide topsoil consisting of organic soil and place on the levee slopes as shown on the contract drawings and as specified in Section [32 92 23 SODDING] [_____].

[2.2.11 Semicompacted Fill

****
NOTE: The designer should list the material types that are acceptable for semicompacted fill, which can be defined in terms of previously defined fill types or basic material types.
****

Provide material for semicompacted fill consisting of satisfactory materials classified in accordance with ASTM D2487 as [_____].

][2.2.12 Uncompacted Fill

****
NOTE: The designer should list the material types that are acceptable for uncompacted fill, which can be defined in terms of previously defined fill types or basic material types.
****

Provide material for uncompacted fill consisting of satisfactory materials classified in accordance with ASTM D2487 as [_____].

][2.2.13 Hydraulic Fill for Berms and Depressed Areas

****

NOTE: Caution should be used when specifying hydraulic fill. Hydraulic fill is to be used only in stability berms, pit fills, and seepage berms. Hydraulic fill will normally not be used in construction for levee embankment. In addition to requiring a large levee footprint, the levee embankment constructed by hydraulic fill is susceptible to soil liquefaction, and excessive seepage. Hydraulic fill also erodes quickly in a situation where a levee is overtopped or where an impervious covering is penetrated. See the appropriate Engineering Manuals for further guidance.

Tie this back to Section 01 45 0001 45 00.00 40 QUALITY CONTROL requirement for inspection and validation of CQC laboratories by the government.

****

Place fill shown on the drawings as hydraulic fill by hydraulic methods in accordance with the plan of operations approved by the Contracting Officer. Thirty (30) days prior to commencement of haul road construction or placing embankment and backfill, whichever is earlier, submit for approval a Plan of Operations for accomplishing all embankment and backfill construction and for the location and construction of haul roads. This plan must include, but not be limited to, the proposed sequence of construction for embankment and backfill items, and methods and types of equipment to be utilized for all embankment and backfill operations, including transporting, placing, and compaction. This plan must also include the names and addresses of the [commercial testing labs] [engineering firms] which will perform the soil testing and inspection and describe how all required soils testing will be performed. The dredged material must have, as placed, not less than [_____] percent by weight passing U.S. Standard Sieve No. [_____] and not less than [_____] percent by weight passing a U.S. Standard Sieve No. [_____].

][2.3 MANUFACTURED PRODUCTS

****

NOTE: Add applicable requirements.

****

[_____].

][2.4 GROUTS AND DENTAL CONCRETE

Provide grouts and dental concrete as specified in concrete Section [_____] CONCRETE, except that the slump must be [_____] mm inches for dental concrete.

][2.5 STABILIZERS

****

NOTE: Add applicable requirements.

****

[_____].

][2.6 INSTRUMENTATION

[2.6.1 Piezometers and Observation Wells

Install piezometers and observation wells as shown.

][2.6.2 Settlement Markers and Survey Monuments

Install survey monuments and settlement markers as shown.

][2.6.3 Settlement Gages

Provide settlement gages as shown.

]]PART 3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Lines and Grades

Construct embankment and backfill to the lines, grades, and cross sections indicated on the drawings, unless otherwise directed by the Contracting Officer. The Government reserves the right to increase or decrease the foundation widths and embankment slopes or to make such other changes in the embankment or backfill sections as may be deemed necessary to produce a safe structure. Changes in quantities resulting from such revisions will not constitute justification for change in contract unit prices, except as provided for in FAR 52.211-18 Variation in Estimated Quantities Clause. Increases in height of section, made to compensate for settlement or consolidation of the embankment material subsequent to the completion of the embankment, will not exceed [_____] percent of the height above the foundation at the levee centerline indicated. Provide end slopes and side slopes of partial fill sections no steeper than [one vertical on [_____] horizontal] [, unless otherwise shown on the drawings].

3.1.2 Conduct of the Work

Maintain and protect the embankment and backfill in a satisfactory condition at all times until final completion and acceptance of all work under the Contract.[If, in the opinion of the Contracting Officer, the hauling equipment causes horizontal shear planes or slicken sides, rutting, quaking, heaving, cracking, or excessive deformation of the embankment or backfill, limit the type, load, or travel speed of the hauling equipment on the embankment or backfill.] The Contractor may be required to remove, at no additional payment, any embankment material placed outside of prescribed slope lines. Replace approved embankment or backfill material which is lost in transit or rendered unsuitable after being placed in the embankment or backfill and before final acceptance of the work in a satisfactory manner and no additional payment will be made therefore.

Excavate and remove from the embankment or backfill any material which is unsatisfactory, dispose of such material, and refill the excavated area as directed, all at no cost to the Government.

3.2 CLEARING

Accomplish clearing within the [limits][construction limits shown on the drawings] of existing ground to receive embankment [and structures],

together with strips [1.5] [_____] meters [5] [_____] feet wide, beyond and contiguous thereto, existing levees to be degraded, ponding areas, ditches, structures, traverses, channels, riprap, revetment, borrow areas and ramps. Clear trees, downed timber, snags, slash, brush, garbage, trash, debris, fencing and other items [[_____] mm inches above] [flush with] the existing ground surface. Protect trees and vegetation designated to be left standing or to remain from damage from construction operations. Limit clearing of borrow areas to the minimum area required for construction operations.

3.3 GRUBBING

Accomplish grubbing within the [limits][construction limits shown on the drawings] of existing ground to receive embankment [and structures], together with strips [1.5] [_____] meters [5] [_____] feet wide, beyond and contiguous thereto, existing levees to be degraded, ponding areas, ditches, structures, traverses, channels, riprap, revetment, borrow areas and ramps. Accomplish grubbing to a depth of at least [1] [_____] m [3] [_____] feet below the existing ground surface. Fill holes caused by grubbing operations and removal of pipes and drains, excluding holes in borrow areas, channels and ditches [above required grade], with satisfactory material as specified in paragraph [_____]. Place material in [_____] mm inch layers to the elevation of the adjacent ground surface and each layer compacted to a density at least equal to that of the adjoining undisturbed material.

3.4 STRIPPING

The entire area within the [limits][construction limits shown on the drawings] of existing ground to receive embankment and structures, together with strips [1.5] [_____] meters [5] [_____] feet wide, beyond and contiguous thereto, existing levees to be degraded, ponding areas, and ditches [shown on the drawing must be stripped to remove crops, weeds, grass, and other vegetative materials to the ground surface [and topsoil to a depth of [_____] mm inches]].

3.5 DISPOSITION OF CLEARED, GRUBBED, AND STRIPPED MATERIAL

****
NOTE: Delete undesirable options for Disposition of Cleared, Grubbed, and Stripped Materials.
****

Except as otherwise specified or indicated on the drawings, dispose all materials resulting from clearing and grubbing operations at the Contractor's option, by windrowing or stockpiling within construction limits, burying within construction limits, burning, chipping, removal from the site, or a combination thereof. Do not bury or place any material resulting from clearing and grubbing operations within the levee foundation or any structural foundation. Make a reasonable effort to channel merchantable material into the commercial market and to make beneficial use of the materials resulting from clearing and grubbing. [Temporarily stockpile the topsoil material resulting from the stripping operations within the rights-of-way.]

3.5.1 Windrows

Place cleared, grubbed and stripped material [as shown on the drawings] in a neat windrow or in piles with tree limbs trimmed sufficiently to make

the windrow as small as practicable. Do not extend cleared, grubbed or stripped material beyond the construction limits.

3.5.2 Burning

Subject to applicable Federal, State and local burning restrictions, the Contractor may burn material within the contract rights-of-way. Conduct burning operations to prevent damage to adjacent man-made facilities and natural features. The Contractor is responsible for any damage to life and property resulting from fires that are started by the Contractor's employees or as a result of the Contractor's operations. Furnish, at the site of burning operations, adequate fire fighting equipment to properly equip personnel for fighting fires. Guard fires at all times and provide constant surveillance until they have been extinguished. Remove all unburned material (material not reduced to ash) from the site or dispose of by [_____].

3.5.3 Burying

Subject to applicable Federal, State and local burying restrictions, the Contractor may bury the cleared and grubbed material in the area(s) as shown on the drawings or in [_____]. Do not bury material within [_____] meters feet of any standing timber. Cover all buried material with a minimum of [_____] mm inches of earth.

3.5.4 Chipping

All cut timber, down timber, dead timber, branches, and brush may be chipped. Haul the chips to stockpiles indicated on the drawings or to other locations approved by the Contracting Officer or remove from site of work. Deposit chips in these areas in piles or windrows [above] [below] elevation [_____] NGVD.

3.5.5 Removal from Site of Work

The Contractor may elect to remove all or part of the cleared and grubbed materials from the site of the work[in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS]. The Contractor may opt either to retain any such materials of value or dispose of them by sale or otherwise. The Government is not responsible for the protection and safekeeping of any materials retained by the Contractor. [Materials resulting from the clearing and grubbing operations must be removed from the site [weekly] [monthly].][Remove such materials from the site of the work before the date of completion of the work.]

3.6 REMOVAL OR PLUGGING OF ABANDONED PIPE AND CONDUITS

****

NOTE: The terms and conditions in any permits and environmental commitments obtained by the Government must be made a part of the contract. The designer must include technical requirements necessary to comply with these terms and commitments.

****

Remove abandoned pipes and conduits to the limits shown on the drawings or abandon in place by grouting or filling with concrete as shown on the plans a minimum distance of [_____] meters feet from [_____]. Prior to plugging, clean the interior of the pipe to be plugged and place the

concrete in such a manner as to insure a dense, well bonded plug.

3.7 SHORING, SHEETING, AND BRACING

****

NOTE: Add applicable minimum requirements for the shoring, sheeting and bracing plan based upon site specific conditions.

****

Submit a detailed shoring, sheeting and bracing plan [_____] days prior to the beginning of any excavation so supported. The plan for shoring, sheeting and bracing will be prepared and certified by licensed professional engineer, registered in [_____]. All shoring must be designed so that it is effective to the bottom of the excavation, and must be based upon calculation of pressures exerted by the earthen materials to be retained, including the condition and nature of those materials as well as any surcharge loads imparted to the excavation by slopes, equipment, traffic, or stored materials. Include in the plan drawings and design computations of the proposed shoring, sheeting, and bracing, and documentation, showing details of the coordination and approval of shoring, sheeting, and bracing by the applicable parties. Obtain approval of the detailed plan from the Contracting Officer prior to starting the work. If necessary, modify the plan as required to meet field conditions, and the modifications must be approved prior to use. Install shoring, sheeting, and bracing where required for the protection of existing natural features and man-made facilities, for the safety of workers and the public, in compliance with EM 385-1-1, and to insure the integrity of the embankment. Design, furnish and install sheet piling, cribbing, bulkheads, bracing, shores or whatever means that may be necessary to support earthen material carrying structures and other improvements, and maintain such piling, cribbing, bulkheads, bracing, shores in position until they are no longer needed. Do not use shoring, sheeting and bracing in lieu of the required excavation slopes. Design and properly install shoring, sheeting, and bracing to withstand anticipated loads. Remove all shoring, sheeting and bracing as embankment and backfill operations progress so that the backfill is placed directly against the undisturbed excavation face. Shoring deemed necessary by the Contracting Officer must remain in place during the backfill operations. Remove shoring in such a manner as not to disturb or damage the completed work or any adjacent property. If any problems are encountered during excavation, stop excavation operation and notify the Contracting Officer.

3.8 DEWATERING AND DIVERSION

Accomplish surface and groundwater control in coordination with the required excavation and embankment construction. Surface and/or groundwater control may necessitate the use of temporary diversion ditches, cofferdams and/or dewatering by the use of pumping. Methods for care of surface water and for controlling the surface and groundwater levels will be subject to approval of the Contracting Officer. Borrow pits must be drained and kept dry during excavation, as excavation will not be permitted in water nor will excavated material be scraped, dragged or otherwise moved through water. Drain borrow areas by ditching, sump pumping, or other approved methods. Drain borrow areas excavated under this contract and flooded from rains or high river stages and allow to dry as quickly as practicable after the high river stage has passed.

Minimize surface runoff from entering the work areas. Complete the

necessary ditching or earthwork shaping at the end of each workday or as necessary to prevent surface runoff from entering the work area. Drain excess precipitation that collects in the work areas and allow to dry as quickly as practicable before work resumes.

3.9 EXCAVATION

Excavation will consist of removal of material in preparing the foundations to the lines and grades shown on the drawings, removal of material from ditches and channels to the lines and grades shown on the drawings, removal of objectionable materials and obtaining required fill materials from the borrow areas.[Blasting will [not] be permitted.] Over excavation will be backfilled to grade with satisfactory material and compacted to a density of at least that of the surrounding material. Backfill and compact excavation beyond the lines shown on the plans in accordance with adjacent materials as directed.

[3.9.1 Inspection Trench

Excavate an inspection trench and maintain free of standing water to the dimensions and locations shown on the drawings or as indicated by the Contracting Officer. Excavate the trench at least [_____] meters feet in advance of but not more than [_____] meters feet in advance of construction. When the inspection trench excavation is complete, notify the Contracting Officer's representative in order to examine the foundation stratigraphy in the side walls and bottom of the inspection trench.

]3.9.2 Structures

Provide excavations for structures conforming to the dimensions and elevations indicated for each structure and footing, except as specified hereinafter, and include trenching for utility and foundation drainage systems to a point [_____] meters feet beyond each structure and all work incidental thereto[except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces]. Excavation must extend a sufficient distance from walls and footings to allow for placing and removal of forms. Replace satisfactory material removed below the depths indicated without specific direction of the Contracting Officer at no additional cost to the Government and fill in accordance with paragraph OVER EXCAVATION above.[Backfill over excavation below required invert elevations or bottoms of footings with concrete at no additional cost to the Government. Do not construct footings on unsatisfactory material as determined by the Contracting Officer.] [Remove and replace excessively wet and/or soft material in subgrades resulting from water ponding in footing excavations with [lean concrete] [satisfactory material compacted to the density of the surrounding undisturbed material]].

3.9.3 Channels

Excavate channels at the locations and to the lines and grades shown on the drawings and in accordance with paragraph TOLERANCES.

3.9.4 Ditches

Excavate drainage ditches at the locations and to the lines and grades shown on the drawings and in accordance with paragraph TOLERANCES.

3.9.5 Slopes and Surcharges

Temporary excavation slopes for any channel, structure excavation, or other required excavation must not be steeper than the specified finished slope or the specified construction slope. Any field deviations from this provision must be approved by the Contracting Officer. Temporary slopes must be benched such that the average slope is not steeper than the specified slope. In addition, do not surcharge temporary, permanent, or construction slope with excavated or stockpiled material or with heavy construction equipment which would have the same effect as the surcharge material. Maintain the toe of stockpiled material a minimum distance back from the top of the finished excavation equal to the depth of the excavation. Determine the maximum height of such stockpile without causing instability of the excavation slope and provide justification for such in the Excavation Plan submittal.

3.9.6 Borrow Areas

Submit a written statement to the Government not later than [_____] days after receipt of Notice to Proceed indicating the Contractor's intention to use the specified Government-furnished borrow area(s), Contractor-furnished borrow area(s), dredged borrow areas, or a combination of these borrow areas.

3.9.6.1 Government-Furnished

Excavate borrow areas to the extent necessary to obtain satisfactory material within the lines and grades as shown on the drawings. When the material necessary for the construction of the embankment and berms cannot be obtained from adjacent borrow areas, obtain it from other Government-furnished borrow areas. [The permissible depth(s) in the borrow areas are indicated on the drawings.] Backfill any excavation below the depths and slopes specified herein or shown on the drawings, at the Contractor's expense, to the specified permissible excavation line, with satisfactory [material(s)] [cohesive material] [or] [other material] as specified by the Contracting Officer to a density of at least that of the surrounding material. Drain borrow areas and keep dry during excavation. In so far as is practicable, do not remove unsatisfactory materials in borrow areas unless otherwise directed by the Contracting Officer.

3.9.6.2 Contractor-Furnished

Proposed borrow areas will be subject to approval by the Contracting Officer. Any borrow sources proposed, accepted and approved by the Contracting Officer must meet all applicable Federal, State and local requirements including written evidence to the Contracting Officer that the Contractor has obtained property rights and access to the material therein. [Proposed sources located within [_____] meters feet landward and [_____] meters feet riverward of the levee between Stations [_____] and [_____] will not be permitted.] No payment will be made for Contractor-furnished borrow areas.

3.9.6.3 Dredged

Dredging operations may be conducted to obtain material for the pervious zones or the random zones subject to the requirements and the conditions specified herein. Dredging operations may be conducted at approved locations in the present stream bed of [_____] or as shown on the

drawings. Dredging operations will not be permitted within [_____] meters feet of the levee centerline and no material will be obtained within [_____] meters feet of any revetment, stabilized channel line, bridge pier and/or abutment.

3.9.7 Cut-Off Trenches

Excavate and maintain cutoff trench free of standing water to the dimensions and locations shown on the drawings. Excavate the trench at least [_____] meters feet in advance of but not more than [_____] meters feet of construction.

3.9.8 Existing Levees and Spoil Banks

Remove existing levees and spoil banks as shown on the drawings. In areas where the existing levee is located within the random or berm zone of the levee, incorporate it into the embankment. Remove portions of existing embankments which lie within the impervious zone of the levee. Utilize existing levees located within the rights-of-way landward of the levee and berms to be constructed, as borrow material, but only after equal protection has been provided by construction of the new levee. When excavated for borrow material, remove the existing levee to the adjacent ground surface in a uniform manner, and shape to maintain drainage in accordance with the adjacent natural drainage pattern. [When lower levels of flood protection would be caused by levee construction provide the Contracting Officer a plan to maintain existing levels of protection during the construction period.]

3.9.9 Toe Drains

Excavate toe drains to the dimensions and the locations indicated on the drawings.

3.9.10 Utilities

Shape excavations for pipe beds to fit the contour of the pipe over a width of not less than 0.6 of the pipe diameter, or as shown on the drawings.

3.9.11 Rock

Clean rock and other hard foundation materials of loose debris and cut to a firm surface, either level, stepped, or serrated, as shown on the drawings. Remove loose disintegrated rock and thin strata. Rock excavation will not be measured for payment.[Rock excavation will not be paid for as a separate bid item.]

3.9.12 Riprap and Bedding

Perform excavations for riprap and bedding at the locations and to the lines and grades shown.

3.10 TOLERANCES

Allow a tolerance of [_____] mm inches above or below the prescribed grade in the excavation for channels, ditches, inspection trenches, cutoff trenches, excavations for riprap and bedding, and mandatory borrow areas. Allow a tolerance of [_____] mm inches below the prescribed grade in the excavation for all other borrow areas.

Construct all embankments and backfills to the grades, lines, and cross-sections shown on the drawings. At all points a tolerance of [100] [_____] mm [4] [_____] inches above or below the prescribed grade will be permitted in the final dressing, provided that any excess material is so distributed that the crown of the levee drains and that there are no abrupt humps or depressions in any surfaces. For topsoil, a tolerance of [_____] mm inches above the thickness as shown on the drawings will be permitted.

3.11 SLIDES

In case sliding or slope failure occurs in any part of the excavations prescribed in this section after they have been excavated, but prior to final acceptance of all work under the contract, repair the slide or slope failure as directed by the Contracting Officer. In case the slide or slope failure is caused through the fault or negligence of the Contractor, repair at no cost to the Government.

3.12 TRAVERSES

Leave traverses unexcavated between borrow areas at the locations [and to the cross sections] shown on the drawings. [Provide traverses with minimum top widths of [_____] meters feet with side slopes no steeper than 1 on 3 or as shown on the drawings.]

3.13 STOCKPILES

Provisions of paragraph SLOPES AND SURCHARGES are applicable to all stockpiled materials. Upon completion of construction operations, remove and dispose of all remaining stockpiled material by the disposal methods specified in paragraph DISPOSITION OF EXCAVATED MATERIALS.

3.14 SURFACE DRAINAGE OF COMPLETED AREAS

Grade the areas shown on the drawings designated as "GRADE FOR SURFACE DRAINAGE", the borrow areas, and the finished embankment areas to the lines and grades shown on the drawings. Provide surface that is free from sharp ridges, gullies, potholes, sinkholes, and any other surface irregularities. A tolerance of [_____] mm inches above or below the prescribed grade will be allowed provided that the surface drains in the direction as indicated on the drawings.

3.15 MAINTENANCE OF WORK

3.15.1 Debris Removal

Maintain all ditch and channel excavations free from leaves, brush, sticks, trash, and other debris until final acceptance of all work under the contract at no additional cost to the Government.

3.15.2 Sediment Removal

Prior to final acceptance of all work under this contract, remove sediments from ditch or channel excavations to restore design grade and section at no additional cost to the Government.

3.16 DISPOSITION OF EXCAVATED MATERIALS

3.16.1 Satisfactory Materials

Incorporate satisfactory excavated material in the appropriate zones of the embankment. Provide satisfactory material consisting of material as defined in paragraph DEFINITIONS, subparagraph SATISFACTORY MATERIALS. When direct placement is not practicable, satisfactory material from the excavation [may] [must] be stockpiled for subsequent use in parts of the work for which it is specified herein and/or as indicated on the drawings. Dispose satisfactory materials in excess of the quantity necessary to construct backfills and embankments as specified for unsatisfactory materials.

3.16.2 Unsatisfactory Materials

Unsatisfactory materials will be as defined in paragraph DEFINITIONS, subparagraph UNSATISFACTORY MATERIALS. Permanently dispose unsatisfactory materials from the excavations prescribed in this section by [removal from the site to a Contractor-furnished disposal area] [placing in the disposal area shown on the drawings] [placing in abandoned portions of the borrow areas]. [Shape the material so that its surface is free from abrupt changes in grade and slope to drain.] [No additional payment will be made for [Contractor-furnished disposal areas] [placing in abandoned portions of the borrow areas].] [Shape the material so that its surface is free from abrupt changes in grade and slope to drain.] [No additional payment will be made for Contractor-furnished disposal areas.]

3.17 PREPARATION OF FOUNDATION, PARTIAL FILL SURFACES AND ABUTMENTS

****

NOTE: If Section 31 66 10 ROCK FOUNDATION PREPARATION is to be used, the following sections may be deleted or modified as appropriate.

****

3.17.1 Earth

****

NOTE: Modify and or add to this paragraph to be compatible with the embankment construction procedures. If uncompacted or semicompacted fill is being utilized major modifications may be required.

****

After excavation (as described in paragraph EXCAVATION) or stripping (as described in paragraph CLEARING, GRUBBING AND STRIPPING) of the embankment foundation [and excavation of the [cut-off trench][inspection trench]] to the extent indicated or otherwise required, break down the sides of stump holes, test pits, and other similar cavities or depressions to flatten out the slopes, and scarify the sides of the cut or hole to provide bond between the foundation material and the fill. [Scarify the slopes and bottom of the cut-off trench as directed.] Perform all scarifying and breaking of ground surface parallel to the centerline of the levee. Unless otherwise directed, fill each depression with the same material type that is to be placed immediately above the foundation. place the fill in layers, moistened, and compacted in accordance with the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION for the specific material type. Compact materials which cannot be compacted

by roller equipment because of inadequate clearances with power tampers in accordance with the paragraph COMPACTION for the specific material type.

After filling of depressions [and cut-off trench] and immediately prior to placement of compacted fill in any section of the embankment, thoroughly loosen the foundation of such section by scarifying, plowing, discing or harrowing to a minimum depth of [_____][150] mm[_____][6] inches, and adjust the moisture content to the amount specified in paragraph MOISTURE CONTROL for the appropriate type of material. [After removal of roots or other debris turned up in the process of loosening, compact the entire surface of the embankment foundation area by [_____] complete coverages of the compaction equipment as specified for the appropriate type of fill.] Immediately prior to placement of compacted fill on or against the surfaces of any partial fill section, remove all soft or loose material, all material containing cracks or gullies, and all material that does not conform with the specified zoning of the embankment. Loosen the remaining surface of the partial fill by scarifying, plowing, discing or harrowing to a minimum depth of [_____] [150] mm [_____] [6] inches, and adjust the moisture content as specified in paragraph MOISTURE CONTROL for the appropriate type of material. Compact the surface of the partial fill section upon which fill is to be placed as specified for the appropriate type of fill. No separate payment will be made for loosening and rolling the foundation area, the abutment area, or the surfaces of partial fill sections, but the entire cost thereof will be included in the applicable contract price for fill.

3.17.2 Rock Foundation

Excavate all rock surfaces upon which or against which embankment materials are to be placed (as described in paragraph EXCAVATION) or strip (as described in paragraph CLEARING, GRUBBING AND STRIPPING).

Prior to the placement of embankment material upon or against a rock surface, fill all open joints and cracks in that surface with mortar to the depths cleaned. Fill those portions of such rock surfaces where, in the opinion of the Contracting Officer, the compaction of the embankment materials cannot be accomplished satisfactorily with power tampers or other specified compaction equipment, with mortar or concrete as directed to the extent necessary to permit satisfactory use of the compaction equipment. Do not leave a thin coat of mortar on smooth, intact rock surfaces[as shown on Drawing No. _____ Foundation Preparation and Treatment]. Remove large rock overhangs and protrusions and lay back rock surfaces to a slope no steeper than 4V on 1H by the use of pre-splitting or line drilling techniques in such a manner as to minimize damage to the underlying rock, or fill the spaces beneath overhangs and around protrusions with tamped concrete so that satisfactory compaction of embankment materials can be accomplished. Rock surfaces must not be more than 0.67 m 2 feet in height, and provide benches of sufficient width as necessary so that the average slope of any rock face is not steeper than [_____]V on [_____]H. Mortar and concrete, including forming as necessary, must conform with the applicable provisions of Section [03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE] [_____].

3.17.3 [Benching

Benching into existing levee embankment and abutments is required in order to place and compact the material in horizontal layers. The vertical face cut into the existing embankment or abutment resulting from the benching operation must be a minimum of [_____] mm inches in height but can not

exceed [_____] mm inches in height.]

3.17.4 [Preloading

****
NOTE: Insert applicable language for preloading as required. Identify the extent of the area over which preloading will be required by designating the stationing along the centerline of the levee. Indicate the length of time the preload will be left in place or define the settlement conditions which must occur before construction in the preloaded area can proceed. Address whether or not the preload embankment will become part of the permanent levee.
****

Preloading of the levee foundation will be required between Station [_____] and Station [_____]. The preload embankment will be constructed to the cross section shown on the drawings for the applicable location. No additional construction is permitted after completion of the construction of the preload embankment in the preloaded areas [for [_____] days] [until the required settlement has occurred]].

3.17.5 [Settlement of Foundation

****
NOTE: Modify the following as necessary for determining foundation settlement, which may be achieved by installing settlement gages.
****

The Contractor [must] [may elect to] furnish and install settlement gages, at the settlement measurement locations shown on the plans, for determination of settlement of the foundation during construction within the settlement measurement ranges shown on the drawings. [Locate each settlement measurement location on the prepared foundation at a point directly under the crown of the planned levee section prior to placing of fill material. Level gage beds by removing the minimum amount of earth necessary to produce an even foundation and in such manner that the density of gage beds will remain at the same density as the undisturbed adjacent ground. Leveling of gage beds by the addition of fill will not be permitted. Maintain gages and extend, if necessary, during the construction. The type and arrangement of the gages are as shown on the drawings. Make such measurements and determine such elevations on the gages prior to the placing of fill material and again within 72 hours [or longer] after final cross sections have been taken over the completed embankment at the locations of the gages.] [Perform a cross section at the settlement measurement location prior to the placing of fill material to establish the elevation of the foundation/embankment interface.] Settlement measurements will be [verified] [subject to verification] by the Contracting Officer.]

3.18 TEST FILL STRIPS

****
NOTE: Test strips are needed when the volume of the project is large, the compaction requirement will be obtained by specifying the type of compaction equipment and the number of passes on each lift

(i.e. a method or procedure specification is being utilized) and there is not sufficient information on the compaction characteristics of the proposed fill materials and equipment to be used for the project. On projects where the levees are small (no greater than 5 meters 15 feet high) and on levee raising projects where fill placement zones are narrow (3.3 meters (10 feet), some of the larger compaction equipment specified herein (such as 50-ton rubber tired roller and some tamping rollers) are not appropriate. Consistently Contractors propose using smaller equipment with shorter tamping feet. Test fills, therefore, may also be an appropriate means of evaluating performance and setting placement and compaction criteria to assure satisfactory result.
****

3.18.1 [General

Before beginning embankment construction, construct test strip(s) for [_____] fill materials to demonstrate that the equipment and compaction procedure will achieve the moisture density relationship as specified. The test strips may be incorporated as part of the final embankment, if the fills meet the requirements of the specifications. Construct the test strips using materials from the borrow sources which have been approved by the Contracting Officer. Perform a test strip for each of the following type of fill materials [_____]. Each test strip must be of sufficient size to allow compaction equipment to achieve normal operating speed over a [_____] [17] meter [_____] [50] foot length. The test strip must be a minimum of two (2) times wider than the compaction equipment. Construct each test strip with a minimum of 4 lifts. Prior to the construction of the test strips, proof roll the foundation (subgrade) as specified in paragraph [_____] and install [a][an] 200 mm 8 inch thick subbase layer. Provide a subbase layer consisting of the same material to be used in the test strip and spread and compact to the same requirements. Construct the test strips in accordance with the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION for the specific material type. Place and spread the fill material in layers in accordance with the applicable provisions of paragraphs PLACEMENT AND SPREADING for the specific material type. Compact each layer of the fill with a minimum of four (4) complete coverages using the specified compaction equipment, and as many additional coverages as may be required to achieve the specified density. Even if the results from the test strips show that the required densities can be obtained with less than four coverages by the compaction equipment, compaction of the impervious and random fills with a minimum of (4) complete coverages is still required. If the use of the proposed compaction equipment causes shearing of the fill, laminations in the fill, or results in inadequate compaction, the Contracting Officer may direct that such roller be removed from the fill and that another appropriate tamping roller be used.]

3.18.2 Testing and Reporting Requirements for Test Strips

Prior to construction of the test strips, perform [_____] laboratory compaction test[s] for each type of material used in test strips. Perform compaction tests in accordance with the requirements specified in paragraph MATERIALS TESTING. Submit test results to the Contracting Officer before construction of the test strips. After placement and spreading of the fill in the test strip, but prior to compaction, obtain

five samples from each lift for moisture content determination in accordance with ASTM D2216. Use nuclear density testing equipment in accordance with ASTM D6938. In addition, the following condition applies:

a. Prior to using the nuclear density testing equipment on the site, submit to the Contracting Officer a certification that the operator has completed a training course approved by the nuclear density testing equipment manufacturer[, the most recent data sheet from the manufacturer's calibration, and a copy of the most recent statistical check of the standard count precision.

b. Provide nuclear density testing equipment capable of extending a probe a minimum of 150 mm 6 inches down into a hole.]

After compaction of the fill, perform a minimum of [_____] [5] in-place nuclear density and moisture content tests (in accordance with ASTM D6938) and one (1) sand cone density test (in accordance with ASTM D1556/D1556M) on each lift. Obtain one sample from each test strip for classification testing as specified in paragraph MATERIALS TESTING. All testing and sampling locations will be determined by the Contracting Officer. The Contractor's QC personnel will monitor and document construction and testing of the test strips. Documentation must include weather conditions, soil type, spreading and compaction equipment type, lift thickness, number of coverages, moisture content, dry density, and a plan showing approximate location of sampling and testing. Provide documentation of the test strip construction procedures and results of all testing to the Contracting Officer. Do not commence full scale embankment construction until the equipment and placement methods are approved by the Contracting Officer.

3.19 PLACEMENT AND SPREADING

3.19.1 General

[Prior to beginning embankment placement on the levee foundation, notify the Government that the foundation is ready to receive fill.] [Do not place fill on any part of the embankment foundation until such areas have been inspected and given final approval in writing by the Contracting Officer.]

3.19.1.1 Gradation and Distribution

The gradation and distribution of materials throughout each zone of the levee must be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material of the same class. If lenses, pockets, or layers of materials differing substantially in texture or gradation from surrounding material occur in the spread material, mix the layer by harrowing or any other approved method to blend the materials. During the placing and spreading process, maintain at all times a force of workers adequate to remove all roots, debris, and oversize stone from all embankment materials. Remove all stones and rock fragments larger than [2/3 of the placement lift thickness measured by the greatest dimension] [75 mm 3 inches in any dimension] [at the source prior to hauling to] [from] the fill. Do not place fill upon a frozen surface, nor incorporate snow, ice, or frozen earth in the embankment.

3.19.1.2 Foundations and Partial Embankment Fills

Keep the foundations and all partial embankment receiving fills thoroughly drained. Placing operations will be such as to avoid mixing of materials from adjacent sections as much as practicable.

3.19.1.3 Equipment Traffic

Route equipment traffic on any embankment zone to distribute the compactive effort as much as practicable. Ruts formed in the surface of any layer of spread material will be filled before that material is compacted. If, in the opinion of the Contracting officer, the compacted surface of any layer of material is too smooth to bond properly with the succeeding layer, loosen the surface by scarifying or other approved methods before material from the succeeding layer is placed.

3.19.2 Placement on Surfaces Containing Frozen Materials

Do not place embankment on a foundation which contains frozen material, [or which has been subjected to freeze-thaw action]. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment, and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. Remove all material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to nights, holidays, weekends, or winter shutdowns of earthwork operations, to a depth that is acceptable to the Contracting Officer and replace with new material. Alternatively, thaw, dry, rework and recompact the material to the specified criteria before placing additional material. The Contracting Officer will determine when placement of fill must cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for the determination. Levee embankment material must not contain frozen clumps of soil, snow or ice.

3.19.3 Placement of Embankment and Backfill Against Rock

Clean all rock surfaces upon which or against which embankment materials are to be placed in accordance with paragraph PREPARATION OF FOUNDATION, PARTIAL FILL SURFACES AND ABUTMENTS, subparagraph ROCK. In restricted areas where material can not be placed in large lifts with normal spreading and compaction equipment, spread material in lifts not exceeding [_____] mm inches and compact with mechanical hand tampers, vibrating plates, or other approved methods and equipment.

3.19.4 Placement of Embankment and Backfill Against Structures

Do not place embankment or backfill on or against concrete less than [14][7] days after placement or 70 percent of the design strength, without prior approval of the Contracting Officer. Do not use crawler-type tractors, vibratory equipment and other similar compaction equipment within [_____] [1] meter [_____] [4] feet of any completed or partially completed structure. Accomplish compaction within [_____] [1] meter [_____] [4] feet of completed or partially completed structures by the use of mechanical hand tampers, vibrating plates, or other approved methods and equipment. Ensure that compaction operations do not damage any existing utilities. Any damage caused by the Contractor's operation must be repaired at the Contractor's expense.

3.19.5 Select Fill

****
NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the last bracketed sentence should be selected and the following should be substituted into the appropriate paragraphs below. [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]
****

Place and spread select fill material in layers not more than 200 mm 8 inches in uncompacted thickness, except that within [_____] [1] m [_____] [4] feet of [_____] structures, reduce the uncompacted layer thickness to [150] [_____] mm [6] [_____] inches. [Layers should be started full out to the slope stakes and must be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]

3.19.6 Coarse Drainage Gravel and Filter Sand

Place and spread coarse drainage gravel and filter sand in layers not more than [_____] [300] mm [_____] [12] inches in uncompacted thickness, except that within [_____] [1] m [_____] [4] feet of the [_____] structures, reduce the uncompacted layer thickness to [_____] [150] mm [_____] [6] inches. Control the method of placement of all gravel and sand material to minimize segregation of particle sizes and contamination with other embankment materials.

3.19.7 Impervious Fill

****
NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the last bracketed sentence should be selected.
****

Place and spread the impervious fill material in layers not more than [_____] [200] mm [_____] [8] inches in uncompacted thickness, except that within [_____] [1] m [_____] [4] feet of [_____] structures, reduce the uncompacted layer thickness to [_____] [100] mm [_____] [4] inches. [Layers should be started full out to the slope stakes and must be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]

3.19.8 Pervious Fill

****
NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the last bracketed sentence should be selected.
****

Place and spread the pervious fill material in layers not more than [_____] [200] mm [_____] [8] inches in uncompacted thickness, except that within [_____] [1] m [_____] [4] feet of [_____] structures, reduce the uncompacted layer thickness to [_____] [150] mm [_____] [6] inches. [Layers should be started full out to the slope stakes and must be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]

3.19.9 Random Fill

****
NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the last bracketed sentence should be selected.
****

Place and spread random fill material in layers not more than [_____] [200] mm [_____] [8] inches in uncompacted thickness, except that within [_____] [1] m [_____] [4] feet of [_____]structures, reduce the uncompacted layer thickness to [_____] [150] mm [_____] [6] inches. [Layers should be started full out to the slope stakes and must be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]

[3.19.10 Random Rock

Place random rock within the limits indicated on the drawings in such a manner as to produce a reasonably well graded mass of stone with a minimum percentage of voids. Place random rock in layers that will will produce a compacted [_____] [600] mm [_____] [24] inch thick layer as shown on the drawings.[Provide sufficient dewatering of the foundation beneath the random rock zone to allow the random rock material to be placed and compacted as specified herein to produce a firm, dense surface upon which to place select earth fill.] Grade the outside slope of the random rock zone to produce a reasonably even surface, within a tolerance of plus or minus [_____] [300] mm [_____] [12] inches measured [vertical] [normal] to the slope from the lines indicated on the drawings, upon which slope protection layers can be placed.

][3.19.11 Fine Drainage Gravel Placed Around Structures

Place fine drainage gravel placed for drainage around [_____] structures in horizontal layers not exceeding [_____] mm inches in loose lift thickness, or within [_____] [1] m [_____] [4] feet when hand operated compactors are used. After placing, uniformly spread, moisten or aerate each layer as necessary to obtain the specified moisture content, thoroughly mix and compact as specified. Do not backfill until construction below finish grade has been approved, forms removed, and the excavation cleaned of trash and debris. Use power driven hand operated compactors along the closure structure for compaction within [_____] [0.7] m [_____] [2] feet of concrete structures. Do not place backfill against concrete prior to 7 days after placement. As far as practicable, bring backfill up evenly on each side of the structure and slope to drain away from the structure.

][3.19.12 Semicompacted Fill

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NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the last bracketed sentence should be selected.
****

The location and extent of the semicompacted fill are as shown on the drawings. Do not place semicompacted fill in water. Place and spread semicompacted fill material in layers not more than [_____] [300] mm [_____] [12] inches in uncompacted thickness, [except that within [_____] [1] m [_____] [4] feet of [_____] structures, reduce the uncompacted layer thickness to [_____] [150] mm [_____] [6] inches].[Layers must be started full out to the slope stakes and must be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to compaction.]

][3.19.13 Uncompacted Fill

****
NOTE: If it is desired that the first layer of fill over the foundation be of a different thickness than subsequent layers, then the second bracketed sentence should be selected.
****

Place uncompacted fill in approximately horizontal layers not exceeding [_____] mm inches in thickness. Uniformly spread, distribute, and manipulate the layers during placement such that individual loads of material deposited on the fill will not remain intact, and large, open voids in the fill will be eliminated. Do not place lifts in a manner which causes shrinkage cracks and open voids from developing in previously placed lifts.[Start layers full out to the slope stakes and must be carried in lifts approximately horizontal and parallel to the centerline with sufficient crown or slope to provide satisfactory drainage during construction.] [Place or spread the materials for [_____] fill in layers, the first layer not more than [_____] mm inches in thickness and the succeeding layers not more than [_____] mm inches in thickness prior to

compaction.][Compaction other than that obtained by the controlled movement of the hauling and spreading equipment over the area will not be required.][Where material must be placed in water, dump therein until it reaches an elevation [_____] mm foot above the water surface, or until a stable fill surface is obtained before layer construction will be required. The material deposited under water must be placed in such a manner to ensure that any soft material will be forced progressively outward from the section and not be trapped within the base of the embankment.][Do not place material containing more than [_____] [15] percent fines passing the No. 200 sieve below the water surface.]

]3.19.14 Hydraulic Fill

3.19.14.1 Discharge Pipe

At all times when the dredge discharge pipe is being washed out or when the discharge consists of a high percentage of water with only a minimum amount of solid material being pumped, close all control plates at the bottom openings along the spill-pipe sections of the discharge pipe lines immediately and remain in a closed position until the pumping operation produces a minimum of [10] [_____] percent solid materials in the discharge.

3.19.14.2 Discharge Pipe Outlets

During placement operations of the fill, provide free outlets to conduct discharge water away from the embankment at intervals of not more than [610] [_____] m [2,000] [_____] feet, for 300-mm 12-inch dredges or smaller; [915] [_____] m [3,000] [_____] feet, for 325 to 400 mm 13- to 16-inch dredges; and [1219] [_____] m [4,000] [_____] feet, for dredges over 400 mm 16 inches. The size of dredges are determined by the minimum inside diameter of the discharge pipe. No obstruction to free flow will be permitted in these outlets or at any point in the fill area, between the end of the discharge pipe and the outlet. Construct a retaining dike, transverse to the fill area center line, immediately beyond each outlet and do not breach until the end of the discharge pipe has approached the retaining dike to within 76 m 250 feet, in the case of 300 mm 12-inch dredges or smaller; 114 m 375 feet, in case of 325 to 400 mm 13- to 16-inch dredges; or 152 m 500 feet, in the case of dredges over 400 mm 16 inches.

3.19.14.3 Control of Materials in Hydraulic Construction

In general, distribute the materials in the fill in a way to produce a section of relatively uniform permeability. In order to maintain uniform permeability of the fill, do not place strata and large pockets of gravel, not containing sufficient fines. Whenever they occur promptly blend with finer materials. Take necessary precautions to prevent damage from discharge water or other causes.

3.19.14.4 Rehandling Hydraulic Material

Rehandling of hydraulic material to bring the fill area to required grade and cross section must conform to paragraph [_____]. If, in the opinion of the Contracting Officer, the rehandled material is too dry to permit its placement by compacted fill method, then the soil placement must conform to paragraph [_____].

3.20 MOISTURE CONTROL

3.20.1 General

The materials in each layer of the fill must contain the amount of moisture, within the limits specified below or as directed by the Contracting Officer, necessary to obtain the required compaction. Rework material that is not within the specified moisture content limits after compaction to obtain the specified moisture content, regardless of density.

3.20.1.1 Insufficient Moisture for Suitable Bond

If the top or contact surfaces of a partial fill section become too dry to permit suitable bond between these surfaces and the additional fill to be placed thereon, loosen the dried materials by scarifying or discing to such depths as may be directed by the Contracting Officer, dampen the loosened material to an acceptable moisture content, and compact this layer in accordance with the applicable requirements of paragraph COMPACTION.

3.20.1.2 Excessive Moisture for Suitable Bond

If the top or contact surfaces of a partial fill section become too wet to permit suitable bond between these surfaces and the additional fill to be placed thereon, scarify and dry the wet material, assisted by discing or harrowing, if necessary, to such depths as may be directed by the Contracting Officer. Dry the material to an acceptable moisture content, and compact in accordance with the applicable requirements of paragraph COMPACTION.

3.20.1.3 Drying Wet Material

Material that is too wet must [be spread on the embankment and permitted to dry,] [be dried in the borrow area prior to bringing to the levee embankment] be assisted by discing or harrowing, if necessary, until the moisture content is reduced to an amount within the specified limits.

3.20.1.4 Increasing Moisture in Dry Material

The moisture content of material that is too dry, [will be adjusted on the levee embankment] [will be adjusted in the borrow area prior to bringing to the levee embankment]. Add water to the fill material and by harrowing, or other approved methods, work the moisture into the material until a uniform distribution of moisture within the specified limits is obtained. Control the amount of water applied on a layer of fill on the levee embankment so that free water will not appear on the surface during or subsequent to rolling. Should too much water be added to any part of the embankment, delay the rolling on that section of the embankment until the moisture content of the materials is reduced to an amount within the specified limits. If it is impracticable to obtain the specified moisture content by wetting or drying the material on the fill, the Contractor may be required to pre-wet or dry back the material at the source of excavation or in the borrow area.

3.20.2 Select Fill

The moisture content after compaction must be within the limits of [_____] percentage points above optimum to [_____] percentage point below optimum moisture content as determined by ASTM D698.

3.20.3 Impervious Fill

The moisture content after compaction must be within the limits of [2] [_____] percentage points above optimum to [2] [_____] percentage point below optimum moisture content as determined by ASTM D698.

3.20.4 Pervious Fill

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NOTE: Saturation of the pervious fill may not be appropriate if the fill is placed in a zone or area (trenches, etc.) which can not readily drain.

****

Place, work and compact each layer of material in a saturated condition.

3.20.5 Random Fill

****

NOTE: The moisture control of random earth must be conformed to the requirements of the material type it most closely approximates in behavior.

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[The moisture content after compaction must be within the limits of [_____] percentage points above optimum to [_____] percentage point below optimum moisture content as determined by ASTM D698.] [The moisture content must be that which will facilitate obtaining the specified compaction.]

3.20.6 Coarse Drainage Gravel and Filter Sand

Control the moisture content such that hauling, spreading, and compacting equipment can operate with normal procedure without excessive rutting of the fill. If the material is too wet or too dry to facilitate proper compaction, wet or dry the coarse drainage gravel or filter sand as required by the procedures specified in paragraph [_____].

3.20.7 Fine Drainage Gravel

Place, work, and compact fine drainage gravel in a saturated condition. The moisture content after compaction must be as uniform as practicable throughout any one layer of fine drainage gravel.

3.20.8 Semicompacted Fill

[Place semicompacted fill within plus or minus [_____] percent of optimum moisture content.] [Semicompacted fill will be placed at their in situ moisture content.] [Control the moisture content of semicompacted fill such that hauling, spreading, and compacting equipment can operate with normal procedure without excessive rutting of the fill.] [The moisture content must be that which will facilitate obtaining the specified compaction.]

3.20.9 Uncompacted Fill

Uncompacted fill will be placed at their in situ water content.[Control the moisture content such that hauling, spreading, and compacting

equipment can operate with normal procedure without excessive rutting of the fill.]

3.20.10 Hydraulic Fill

No moisture control is required for Hydraulic Fill.

3.21 COMPACTION

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NOTE: The designer should edit the following paragraphs to account for the use of either an end product specification (i.e., the Contractor is required to obtain a specified degree of compaction) or a method specification (i.e., when the Contractor is required to compact the embankment by a specified number of coverages of a specified/approved roller and is not responsible for the obtained degree of compaction). If the method specification is used and the required degree of compaction is not achieved within the specified number of passes using the specified compaction equipment, the Contractor should be paid for additional rolling for compaction under a separate bid item as specified in paragraph ADDITIONAL ROLLING FOR COMPACTION.

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3.21.1 Compaction Equipment

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NOTE: If an end-product (production) specification is to be used, the following paragraphs may not be necessary at the judgment of the designer and specification writer.

With reference to the use of compaction equipment in this paragraph, the following precautions should be noted:

1. Specifications should be written to ensure that the type of compaction equipment will be used is best suited to obtain the desired compaction of the material being used. When the size of the contract can justify the costs a requirement should be included in the specifications for the performance evaluation of each type of compaction equipment conforming with the specifications and intended for use by the Contractor at an early stage of embankment construction. This equipment evaluation should be accomplished through analysis of test fill areas that are carefully constructed under representative working conditions with materials and moisture contents as specified. Test fill areas may either be separate or part of the permanent work, and for clarity to prospective bidders, payment under a separate item is recommended to equitably cover costs of required variations in equipment coverages, possible changes in equipment loading or foot sizes, as well as intensified field soils

testing. The following paragraphs are provided to serve as examples of the information that should be included within the specifications.

2. For tamping rollers that are either towed or self-propelled, with drums capable of being ballasted with fluid, the provision for a pressure relief valve and safety head is optional, and should be included at the discretion of the designer based on local experience and practice. Over-pressurization of fluid ballasted compaction drums to the level of a safety hazard has been rare, but has occurred on several occasions at locations of high elevation and temperature.

3. In compacting materials consisting of shales, sandstones, weathered rock and similar random materials, consideration should be given to specifying sheepfoot-type tamping equipment that has been modified by replacing the standard feet with "chisel" point tamper feet generally referred to as "shale breakers". The end areas of these modified tamper feet range from 650 to 1000 square mm 1 to 1-1/2 square inches and tend to break up weathered rock to prevent the bridging effect sometimes created by large rock particles.

4. For compaction of sand and gravel fills or filter and drainage layers, equipment characteristics for both a large and small vibratory roller have been provided for optional selection by the designer, depending upon location, selected lift thickness, gradation, grain shape, and durability properties of the materials. The smaller roller, which utilizes an upper limit of 40 kN/m 9000 lbs. per foot of drum length applied force, should be specified for materials which exhibit degradation under compaction. Other options, based on construction experience may also be exercised. For example, it has been found that improved trafficability can often be achieved when compacting clean, fine grained, uniform sands by specifying a drum driven self-propelled vibratory roller.

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Compaction equipment must conform to the following requirements and be used as prescribed in subsequent paragraphs.

3.21.1.1 Tamping Rollers

[3.21.1.1.1 Towed

Provide tamping rollers consisting of a heavy duty double drum unit, with a drum diameter not less than 1.5 m 60 inches, and an individual drum length of not less than 1.5 m 60 inches. Provide drums that are capable of being ballasted with water or a combination of sand and water. Each drum must have staggered feet uniformly spaced over the cylindrical surface to provide approximately three tamping feet for each 0.19 square meter 2 square feet of drum surface. Provide tamping feet that are 175 to

225 mm 7 to 9 inches in clear projection from the cylindrical surface of the roller and have a face area of not less than 3226 square mm 5 square inches nor more than 4516 square mm 7 square inches. The roller must be equipped with cleaning fingers, designed and attached to prevent the accumulation of material between the tamping feet. Maintain these cleaning fingers at their full length throughout the periods of use of the roller. The weight of the roller must be a minimum of 5200 kg/m 3500 psf of linear drum length weighted, and no more than 2975 kg/m 2000 psf of drum length empty. Yoke the two drums comprising one roller unit such that they will oscillate when traversing uneven surfaces. The design and operation of the tamping roller will be subject to the approval of the Contracting Officer who has the right at any time during the prosecution of the work to direct such repairs to the tamping feet, minor alterations in the roller and variations in the weight as may be found necessary to secure optimum compaction of the earth fill materials. The Contractor may be required to add ballast to the roller to the maximum capacity specified by the manufacturer of the roller. Draw the roller by a crawler-type or a rubber-tired tractor at a speed not to exceed 5.6 km 3.5 miles per hour. Discontinue the use of the rubber-tired tractor if the tires leave ruts that prevent uniform compaction by the tamping roller. If tamping rollers are used in tandem, not more than two rollers in tandem will be permitted and in such case, one trip of the tandem rollers over any surface will be considered as two passes. When tamping rollers are used in tandem, the tamper foot spacing must be offset so that the circumferential rows on the rear drums are in line with the mid-point of the circumferential rows on the forward drums.

]3.21.1.1.2 Self-Propelled

[Conditioned upon satisfactory performance, self-propelled tamping rollers may be used in lieu of tractor-drawn tamping rollers. Self-propelled rollers exceeding the empty weight requirement may be used provided that by the substitution of tamping feet, having a face area not exceeding [_____] [9030 square mm 14 square inches], the nominal foot pressure on the tamping feet of the self-propelled roller can be adjusted to approximate the nominal foot pressure of the towed roller for the particular working condition required for the towed rollers. The tamping feet must be 175 to 225 mm 7 to 9 inches in clear projection from the cylindrical surface of the roller. For self-propelled rollers, in which steering is accomplished through use of rubber-tired wheels, the tire pressure must not exceed [_____] [276 kPa 40 psi]. [Operate self-propelled rollers at a speed not to exceed 5.6 km 3.5 miles per hour.] [Self-propelled tamping rollers may be used in lieu of tractor drawn tamping rollers provided the foot pressure on the tamping feet of the self-propelled roller are approximately the same as the foot pressure on the towed roller.] For self-propelled rollers steered with rubber-tired wheels, the tire pressure must not exceed [_____] [276 kPa 40 psi]. Operate self-propelled rollers at speeds not exceeding 5.6 km 3.5 miles per hour. The Contracting Officer has the authority to limit or eliminate the use of self-propelled rollers if they are found to cause shearing or laminations of the compacted fill.]

3.21.1.2 Vibratory Rollers

Equip vibratory rollers for compacting rock fills, pervious sand and gravel fills, or filter and transition drainage layers with a smooth steel compaction drum and operate at a frequency of vibration during compaction operations between 1100 and 1500 vpm. Vibratory rollers may be either towed or self-propelled with an unsprung drum weight that is a minimum of

60 percent of the rollers' static weight. Towed rollers must have at least 90 percent of their weight transmitted to the ground through the compaction drum when the roller is standing in a level position hitched to the towing vehicle. Rollers for compacting rockfill, [sand and gravel fills, or filter and drainage layers] must have a minimum static weight of 90 kN 20,000 pounds, a minimum dynamic force of 180 kN 40,000 pounds when operating at 1400 vpm, and an applied force not less than 130 kN/m 9,000 pounds per foot of compaction drum length.[Rollers for compacting sand and gravel fills or filter and drainage layers must have a minimum static weight of 36 kN 8,000 pounds, a minimum dynamic force of 71 kN 16,000 pounds when operating at 1400 vpm, and an applied force not less than 22 kN 5,000 pounds nor greater than 130 kN/m 9,000 pounds per foot of compaction drum length.] The level of amplitude and vibration frequency during compaction will be maintained uniform throughout the embankment zone within which it is operating. Operate rollers at speeds not to exceed 2.4 km/h 1.5 mph. The equipment manufacturer must furnish sufficient data, drawings, and computation for verification of the above specifications, and the character and efficiency of this equipment will be subject to approval.

3.21.1.3 Rubber-tired Rollers

Provide rubber-tired rollers that have a minimum of four wheels equipped with pneumatic tires. The tires must be of such size and ply as to be capable of being operated at tire pressures between 550 and 690 kPa 80 and 100 psi at an 11,340 kg 25,000 pound wheel load. The roller wheels must be located abreast and designed so that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels must be such that the distance between the nearest edges of adjacent tires will not be greater than 50 percent of the rated tire width of a single tire at the operating pressure for an 11,340 kg 25,000 pound wheel load. The roller must have a body suitable for ballast loading such that the load per wheel may be varied, as directed by the Contracting Officer, from 8,165 to 11,340 kg 18,000 to 25,000 pounds. Tow the roller at a speed not to exceed 8 km 5 miles per hour. The character and efficiency of this equipment will be subject to the approval of the Contracting Officer.

3.21.1.4 Hand Operated Compactors

Perform compaction of material, in areas where it is impracticable to use a roller or tractor compaction, using approved hand operated power compactors.

3.21.1.4.1 Power Tampers

Power tampers must be hand operated equipment capable of compacting material in confined areas. Provide compactors that are either an internal combustion or pneumatic activated tamper. Tampers must have sufficient weight and striking power to produce the specified compaction. The character and efficiency of this equipment will be subject to the approval of the Contracting Officer.

3.21.1.4.2 Vibratory Plate Compactor

Vibratory compactors operated by hand in confined areas must utilize the oscillating cam principal and must deliver an impact of not less than 9 kN 2000 lbf at a rate of approximately 2000 impulses per minute. The character and efficiency of this equipment will be subject to the approval

of the Contracting Officer.

3.21.1.5 Crawler-type Tractors

Crawler-type tractors used for spreading or compaction must have a minimum weight of [_____] [9,070] kg [_____] [20,000] pounds, exert a minimum unit tread pressure of [_____] [41.4] kPa [_____] [6] psi, and operate at a maximum speed of [_____] [5.6] km [_____] [3.5] miles per hour.

3.21.1.6 Sprinkling Equipment

Provide sprinkling equipment consisting of tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable width of surface.

3.21.1.7 Miscellaneous Equipment

Provide scarifiers, disks, spring-tooth or spike-tooth harrows, spreaders, and other equipment that is suitable for use in embankment construction and approved by the Contracting Officer. Equipment used for blending fill material must be capable of penetrating the full loose lift thickness of the specific material type.

3.21.2 Compaction of Select Fill

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NOTE: Experience indicates that by the time the surface lift has been laid down, sufficient compactive effort has occurred due to hauling and spreading equipment such that one, two, or even three passes of a heavy disk plow is not sufficient for penetrating the full depth of lift. A harrow equipped with closely spaced spikes (teeth) has been found to effectively penetrate the semi-compacted surface lift in one pass, but this type of device has minimal ability to blend and mix the fill material. It was found that a suitably designed spiked-tooth harrow working in combination with a heavy disk plow can reliably produce the desired result. This note applies to all types of fill placement for which moisture and blending are required.

****

After a layer of material has been dumped and spread, harrow it to break up and blend the fill materials to obtain uniform moisture distribution. Perform harrowing with a heavy disk plow, or other approved harrow, to the full depth of the layer. When the moisture content and the condition of the layer are satisfactory, compact the lift [to a minimum of [95] [_____] percent of the maximum dry density as determined by the Contractor in accordance with ASTM D698] [with not less than [six] [_____] complete coverages of an approved tamping roller or [four] [_____] complete coverages of an approved 45 metric ton 50-ton rubber-tired roller traversing in a direction parallel to the axis of the levee]. In areas which are not accessible by roller, place the fill in layers not more than 100 mm 4 inches in uncompacted depth and compact with an approved hand operated compactor to a density equal to that obtained in other areas which are accessible to rollers. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a

section when there is sufficient area to permit these operations to proceed simultaneously. Operate compaction equipment such that the strip being traversed by the roller overlaps the rolled adjacent strip by not less than [_____] [1] m [_____] [3] feet.

3.21.3 Compaction of Random Fill

****
NOTE: Random fill must be compacted in accordance with the requirements of the material type it most closely approximates in behavior.
****

After a layer of material has been dumped and spread, harrow it to break up and blend the fill materials to obtain uniform moisture distribution. Perform harrowing with a heavy disk plow, or other approved harrow, to the full depth of the layer.[If one pass of the harrow does not accomplish the breaking up and blending of the materials, additional passes of the harrow are required, but in no case will more than [_____] [three] passes of the harrow on any one layer be required for this purpose.] When the moisture content and the condition of the layer are satisfactory, compact the lift [to a minimum of [95] [_____] percent of the maximum dry density as determined by the Contractor in accordance with ASTM D698] [with not less than [six] [_____] complete coverages of an approved tamping roller or [four] [_____] complete coverages of an approved 45 metric ton 50-ton rubber-tired roller traversing in a direction parallel to the axis of the levee]. In areas which are not accessible by roller, place the fill in layers not more than 100 mm 4 inches in uncompacted depth and compact with an approved hand operated compactor to a density equal to that obtained in other areas which are accessible to rollers. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously. Operate compaction equipment such that the strip being traversed by the roller overlaps the rolled adjacent strip by not less than [_____] [1] m [_____] [3] feet.

3.21.4 Compaction of Impervious Fill

After a layer of material has been dumped and spread, harrow it to break up and blend the fill materials to obtain uniform moisture distribution. Perform harrowing with a heavy disk plow, or other approved harrow, to the full depth of the layer.[If one pass of the harrow does not accomplish the breaking up and blending of the materials, additional passes of the harrow are required, but in no case will more than [_____][three] passes of the harrow on any one layer be required for this purpose.] When the moisture content and the condition of the layer are satisfactory, compact the lift [with not less than [six][_____] complete coverages of an approved tamping roller traversing in a direction parallel to the axis of the levee]. In areas which are not accessible by roller, place the fill in layers not more than 4 inches in uncompacted depth and compact with an approved hand operated compactor to a density equal to that obtained in other areas which are accessible to rollers. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously. Operate compaction equipment such that the strip being traversed by the roller overlaps the rolled adjacent strip by not less than [_____] [1] meter [_____] [3] feet.

3.21.5 Compaction of Pervious Fill

After a layer of material has been dumped and spread, harrow it as required to break up and blend the fill materials to obtain uniform moisture distribution. Perform harrowing with a heavy disk plow, or other approved harrow, to the full depth of the layer.[If one pass of the harrow does not accomplish the breaking up and blending of the materials, additional passes of the harrow are required, but in no case will more than [_____] [three] passes of the harrow on any one layer be required for this purpose.] When the moisture content and the condition of the layer are satisfactory, compact the lift to a [minimum [80] [_____] percent relative density in accordance with ASTM D4253 and ASTM D4254] [with not less than [six] [_____] complete coverages of an approved vibratory roller]. In areas which are not accessible by roller, place the fill in layers not more than 100 mm 4 inches in uncompacted depth and compact with an approved hand operated compactor to a density equal to that obtained in other areas which are accessible to rollers. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously. Operate compaction equipment such that the strip being traversed by the roller overlaps the rolled adjacent strip by not less than [_____] [1] m [_____] [3] feet.

[3.21.6 Compaction of Random Rock

After the random rock has been placed and spread to the thickness specified herein, and oversized rock has been removed or broken down, compact by not less than [_____] [3-6] complete coverages of the specified [crawler tractor] [vibratory roller]. [Each coverage of the tractor must consist of sufficient trips to provide complete coverage of the area by the treads of the tractor. The tractor coverages specified are in addition to spreading operations.] [Operate the vibratory roller such that the strip being traversed by the roller overlaps the rolled adjacent strip by not less than [_____] [1] m [_____] [3] feet.]

][3.21.7 Compaction of Semicompacted Fill

After a layer of material has been dumped and spread, harrow it as required to break up and blend the fill materials to obtain uniform moisture distribution. Perform harrowing with a heavy disk plow, or other approved harrow, to the full depth of the layer. When the moisture content and the condition of the layer are satisfactory, compact the new layer of fill by the controlled movement of the hauling equipment over the area of the fill. Equipment will be routed so as to prevent excessive rutting of the fill surface. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously.

]3.21.8 Compaction of Uncompacted Fill

No compaction other than that obtained by the controlled movement of the hauling equipment over the area of the fill is required. Route equipment to prevent excessive rutting of the fill surface.

[3.21.9 Compaction of Hydraulic Fill

Hydraulic fill will be compacted as uncompacted fill. If the rehandled hydraulic fill is too dry to permit its placement by uncompacted full

method, then compact the fill material using the method specified in paragraph [_____] [COMPACTION OF SEMICOMPACTED FILL].

][3.21.10 Compaction of Random Fill Within the MSE Walls

Place and compact random earth fill within the limits of the Mechanically Stabilized Earth (MSE) walls in accordance with [the vendor's requirements, subject to the approval of the Contracting Officer] [requirements specified in Section [_____]].

]3.21.11 Compaction of Coarse Drainage Gravel and Filter Sand

Place coarse drainage gravel placed in the drains in maximum [_____] [300] mm [_____] [12] inch loose lifts and compact by not less than four (4) complete coverages with a [static] [vibratory] roller. Compact each lift of gravel within confined spaces which is not accessible to rollers by at least [_____] [3] complete coverages with a vibratory plate compactor [and as many additional coverages as necessary to achieve the same density obtained with full-size compaction equipment]. Compact filter sand placed along the existing rock fill in accordance with the requirements for the adjacent select earth fill material.

3.21.12 Compaction of Fine Drainage Gravel

Place fine drainage gravel placed in the drains in maximum [_____] [300] mm [_____] [12] inch loose lifts and compact by not less than four (4) complete coverages with a [static] [vibratory] roller. Compact each lift of gravel within confined spaces which is not accessible to rollers by at least three [_____] [3] complete coverages with a vibratory plate compactor [and as many additional coverages as necessary to achieve the same density obtained with full-size compaction equipment].

3.21.13 Compaction Adjacent to Structures and Utilities

Do not operate heavy equipment for spreading and compacting fill within [_____] [1] m [_____] [4] feet of structures or utilities, except as otherwise specified herein. Compact material within [_____] [1] m [_____] [4] feet using appropriate hand operated compactors specified herein.

[3.21.14 Additional Rolling for Compaction

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NOTE: Use the following paragraph only when a method specification is utilized. A bid item for "Additional Rolling for Compaction" should be included in the bid form so that payment can be made. Measurement and payment information should also be added to paragraph [UNIT][LUMP SUM] PRICES or Section 01 20 00 PRICE AND PAYMENT PROCEDURES as applicable.

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If the Contracting Officer determines that the desired compaction of any portion of the embankment is not achieved by the number of coverages specified, additional complete coverages will be made over the surface area as directed by the Contracting Officer. Payment for additional rolling directed by the Contracting officer will be made in accordance with Bid Item No. [_____] ADDITIONAL ROLLING FOR COMPACTION; however, no payment will be made for additional rolling not specifically directed by

the Contracting Officer.

][3.21.15 Topsoil

Place topsoil on the embankment surfaces as shown on the contract drawings and as specified in SECTION [32 92 23 SODDING] [_____].

]3.22 FIELD QUALITY CONTROL

****

NOTE: FAR 46.312 Construction Contracts establishes a requirement for Contractor Quality Control (CQC) in construction contracts and ER 1180-1-6 requires that a CQC section based on Section 01 45 00 01 45 00.00 40 QUALITY CONTROL be included in contracts of $1,000,000 or more. Use of Section 01 45 0001 45 00.00 40 for contracts of less than $1,000,000 is discretionary. This part of the specifications must be consistent with the CQC section.

Use caution when applying nuclear gages for in-place density measurement of cohesive and cohesionless soils. Soils consisting of mica, halloysite, some other chemical composition, or oversize rocks and large voids would affect the measurement accuracy of wet density. The chemical composition and "non-free" water of the sample may also dramatically (sometimes over 10 percent) affect the measurement of moisture content (see the paragraph entitled "Interferences" in ASTM D2922 and D3017. Also see paragraph 5-10.d.(2).(b). entitled "Nuclear Method" in EM 1110-2-1911). When water content can not be accurately measured using nuclear method, a computer controlled microwave oven system for water content measurement combined with nuclear method for wet density has been successfully used by some districts. Sand Cone or similar field density tests should be performed periodically at the same location as Nuclear Tests to assure nuclear testing is providing accurate information.

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3.22.1 Clearing, Grubbing, and Stripping

Establish and maintain quality control for clearing, grubbing, and stripping operations to assure compliance with contract requirements, and maintain records of the quality control for all construction operations including but not limited to the items indicated below. Furnish these records, as well as the records of corrective actions taken, to the Government in accordance with Section 01 45 0001 45 00.00 40 QUALITY CONTROL.

3.22.1.1 Clearing

Station to station limits, transverse clearing limits from applicable centerline; percentage of area complete; types of materials cleared.

3.22.1.2 Grubbing

Station to station limits, transverse grubbing limits from applicable centerline; percentage of area complete; type of material; filling of grubbed holes.

3.22.1.3 Stripping

Station to station limits, transverse stripping limits from applicable centerline; percentage of area complete; type of material; depth of stripping.

3.22.2 Excavation

Establish and maintain quality control for excavation operations to assure compliance with contract requirements, and maintain records of the Contractor's quality control for all construction operations including but not limited to the following:

a. Equipment; type, size, suitability for the work,

b. Lines, grades and tolerances,

c. Segregation/Disposition of materials,

d. Disposal and/or stockpiling of materials,

e. Unsatisfactory materials,

f. Conditions that may induce seepage or weaken the foundation or embankment,

g. Stability of excavations,

h. Quantity surveys.

Furnish records of inspections and tests, as well as the records of corrective actions taken, to the Government in accordance with Section 01 45 0001 45 00.00 40 QUALITY CONTROL.

3.22.3 Embankment

3.22.3.1 General

As a part of the Contractor Quality Control (CQC) system required by SECTION 01 45 0001 45 00.00 40 QUALITY CONTROL, establish and maintain field quality control for foundation preparation, embankment and backfill operations to assure compliance with contract requirements and maintain detailed records of field quality control for all operations including but not limited to the following:

3.22.3.1.1 Earthwork Equipment

Type, size, number of units and suitability for construction of the prescribed work.

3.22.3.1.2 Foundation Preparation

Methods of preparing the foundations in advance of embankment and backfill

construction and methods for providing drainage of the foundation and partially completed fills.

3.22.3.1.3 Construction

Layout, maintaining existing drainage, moisture control, thickness of layers, spreading and compacting.

3.22.3.1.4 Grade and Cross Section

Crown width, crown slope, side slopes, and grades.

3.22.3.1.5 Roads and Ramps

Location of temporary roads to fields or buildings, location and placement of fills for ramps in accordance with specified dimensions and grades.

3.22.3.1.6 Grade Tolerances

Check fills to determine if placement conforms to prescribed grade and cross section.

3.22.3.1.7 Slides

Location and limits; methods and equipment used where remedial work has been directed.

3.22.3.1.8 Quantity Surveys

Accuracy and timeliness.

3.22.3.2 Materials Testing

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NOTE: Types of tests and frequency of testing should be detailed below. Types of tests and frequency of testing will be dependent upon the types of materials utilized, configuration of foundation and embankment, placement and compaction procedures required, moisture control requirements etc. Testing requirements are material type specific rather than embankment fill type specific. It is desirable to present the testing frequency and type in tabular form.

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Perform sufficient testing to insure that the fill is being constructed as specified. Consider the testing program specified below the minimum acceptable frequency of testing. This does not relieve the Contractor from the responsibility of performing additional testing, if required to ensure compliance with these specifications.

[3.22.3.2.1 Soil Classification Tests

Perform soil classification tests in accordance with ASTM D2487. Perform one initial classification test for each different classification of material to be utilized as embankment fill or backfill. As prescribed in ASTM D2487, perform grain size analyses in accordance with ASTM D422 and Atterberg limits in accordance with ASTM D4318 on each different

classification. Submit additional tests for every [[_____] cubic m][20,000 cubic yards] of embankment or backfill material. Perform soil classification tests on foundation material as required to determine the acceptability of the in-situ soils. Additional tests will be required if noticeable changes in the material occur.

][3.22.3.2.2 Cohesive Material Testing

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NOTE: Edit the following to comply with the method selected to determine the optimum properties (i.e., density and moisture content, LL, PL, PI).

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3.22.3.2.2.1 Moisture Density Relationships

Determine the moisture-density relations for each different classification of cohesive material utilized in accordance with [_____] [ASTM D698], [Method A] [Method B] [Method C].[Prior to placing any fill material containing cohesive material, perform a minimum of [_____] five-point [_____] compaction test on representative samples of the material to be used as fill.] During fill placement perform a minimum of one additional moisture-density test for every [[_____] cubic m][20,000 cubic yard] placed. Additional tests will be required each time a new material is encountered.[The moisture-density curves will be compiled to form a family of curves which will be utilized to estimate optimum properties (maximum dry density and optimum moisture content) to be used with field density test.]

3.22.3.2.2.2 Water (Moisture) Content Tests

Perform determination of water content in accordance with ASTM D2216.[ASTM D4643 may be used when rapid moisture content results are needed. Confirm all rapid results obtained by ASTM D4643 by a test on a duplicate sample performed in accordance with ASTM D2216. In the event of disagreement between the results, ASTM D2216 will govern.] One water content test will be performed for each [_____] cubic m cubic yards of material placed [or each lift of material whichever is less].[These test will be in addition to the water content tests performed in conjunction with in-place density tests.] Retest backfill and fills not meeting the required specifications for water content after corrective measures have been applied.

3.22.3.2.2.3 In-place Density Testing for Cohesive Materials

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NOTES: The designer should pick the method or methods of In-place density which are acceptable. If uncompacted fill is specified density control may not be required.

Use caution when applying nuclear gages for in-place density measurement of cohesive and cohesionless soils. Soils consisting of certain chemical composition, or oversize rocks and large voids would affect the measurement accuracy of wet density. When water content can not be accurately measured using nuclear method, a microwave oven system for water content measurement may be used.

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Determine the in-place density of the cohesive materials in accordance with [ASTM D1556/D1556M] [, ASTM D2167] [, ASTM D6938] [, ASTM D2937] [, or] [ASTM D5195]. Perform at least one (1) in-place density test on [[each lift of material][shift][day] or] every [_____] cubic m cubic yards of completed fill whichever is more frequent with the horizontal locations randomly staggered in the fill.[At each field density test location, obtain soil samples and perform one [one-point] [two-point] compaction test, one moisture content, [one grain size analysis,] [and one Atterberg limits test,] [if applicable,] on the sample.] [The results of the [one-point] [two-point] compaction test and the moisture content test will be utilized to obtain the optimum properties to compare to the results of the in-place density test.] [For use with the family of curves to determine the optimum properties of the material, perform a [one-point] [two-point] compaction test in conjunction with each in-place density. Use a portion of the soil from the in-place field density test and soil obtained immediately adjacent to the field density test location for a [one-point] [two-point] compaction test. The minus 19 mm 3/4-inch portion of the soil must be subjected to [_____] compactive effort using a 150 mm 6-inch compaction mold in accordance with the procedures presented in ASTM D [_____] [ASTM D698] [ASTM D1557]]. Retest fill not meeting the required specifications for in-place density after additional compaction has been completed.[When nuclear method is used for in-place density testing according to ASTM D6938, include a sand cone correlation test in accordance with ASTM D1556/D1556M for the first test and every fifth test thereafter for each material type. Perform the sand cone test adjacent to the location of the nuclear test, including a nominal 150 mm 6 inch diameter sand cone, and including a minimum wet soil weight of 2.7 kg 6 pounds extracted from the hole. Do not use nuclear density testing equipment during rain. Submit the density correlations with test results. For each transmittal including density test data, include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:

a. Test Identification Number.
b. Test location.
   Station.
   Coordinates.
c. Elevation of Lift.
d. Lift number (if appropriate).
e. Photo number (if appropriate).
f. Meter serial number and operators initials.
g. Standard count for each test.
h. Material type.
i. Probe depth.
j. Moisture content by each test method and the deviation.
k. Wet density by each test method and the deviation.
l. Pass/Fail.
m. Retest.
n. Comments.]

][3.22.3.2.3 Cohesionless Material Testing

3.22.3.2.3.1 Compaction Tests

Run not less than one relative density test for every [3,000] [_____] cubic m 3,900 [_____] cubic yards of cohesionless fill in accordance with ASTM D4253 and ASTM D4254.

3.22.3.2.3.2 In-Place Density Tests

Determine the in-place density of the cohesionless materials in accordance with [ASTM D1556/D1556M] [, ASTM D2167] [, ASTM D6938] [, ASTM D2937] [, or] [ASTM D5195]. Run not less than one (1) field in-place density test on [each lift of material or] every [_____] cubic m cubic yards of completed embankment fill or backfill whichever is less. Randomly stagger horizontal locations in the fill.[When nuclear method is used for in-place density testing according to ASTM D6938, include a sand cone correlation test in accordance with ASTM D1556/D1556M for the first test and every tenth test thereafter for each material type. Perform the sand cone test adjacent to the location of the nuclear test, including a nominal 150 mm 6 inch diameter sand cone, and including a minimum wet soil weight of 2.7 kg 6 pounds extracted from the hole. Submit the density correlations with test results. For each transmittal including density test data, include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:

a. Test Identification Number.
b. Test location.
   Station.
   Coordinates.
c. Elevation of lift.
d. Lift number (if appropriate).
e. Photo number (if appropriate).
f. Meter serial number and operators initials.
g. Standard count for each test.
h. Material type.
i. Probe depth.
j. Moisture content by each test method and the deviation.
k. Wet density by each test method and the deviation.]

[3.22.3.2.3.3 Water (Moisture) Content Tests

Perform determination of water content in accordance with ASTM D2216.[ASTM D4643 may be used when rapid moisture content results are needed. Confirm all rapid results obtained by ASTM D4643 by a test on a duplicate sample performed in accordance with ASTM D2216. In the event of disagreement between the results, ASTM D2216 will govern.] One water content test will be performed for each [_____] cubic m cubic yards of material placed[or each lift of material whichever is less].[These test will be in addition to the water content tests performed in conjunction with in-place density tests.] Retest backfill and fills not meeting the required specifications for water content after corrective measures have been applied.

]][3.22.3.2.4 Additional Testing

The Contracting Officer may request additional tests if there is reason to doubt the adequacy of the compaction, or special compaction procedures are being used, or materials change or if the Contracting Officer determines that the Contractor's testing is inadequate or the Contractor is concentrating backfill and fill operations in a relatively small area.

]3.22.3.3 Materials

Suitability of materials for use in embankment and backfill.

3.22.3.4 Fill Placement

Layout, maintaining existing drainage, moisture control, thickness of layers, removal of oversized material, spreading and compaction for embankment and backfill.

3.22.3.5 Grade and Cross Section

Surveys to verify that the dimensions, slopes, lines and grades conform to those shown on the drawings.[Surveys to monitor settlement gages to measure foundation settlement.]

3.22.3.6 Testing by the Government

During the life of this contract, the Government [or its Contractors] will perform quality assurance tests. The performance of such tests may temporarily delay the Contractor and must not be the basis for additional compensation and/or time. Make available to the government [or its Contractors] the equipment to perform these test.

3.22.3.7 Reporting

On a daily basis, furnish the inspection records and all material testing results, [the quantity of fill placed,] as well as the records of corrective action taken, in accordance with Section 01 45 0001 45 00.00 40 QUALITY CONTROL.

-- End of Section --