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## SECTION 02100

## DIVERSION AND CONTROL OF WATER

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

## SD-04 Drawings

Diversion and Control of Water; GA.

Within 10 days after receipt of Notice to Proceed, the Contractor shall submit a diversion and control of water plan showing the method that he proposes to use to divert water from each working area, in accordance with paragraph GENERAL.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 REQUIREMENTS

## 3.1.1 General

All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in the detention basin as a result of either rainfall or flow from upstream of basin. Runoff from the watersheds is rapid and, during periods of rain, intermittent freshets may be expected. Within 10 days after receipt of Notice to Proceed, the Contractor shall submit a diversion and control of water plan showing the method that he proposes to use to divert water from each working area. The plan shall show sequence of the construction, complete layout of drainage facilities, temporary diversion dams, pumps, diversion channels, etc. Contractor's submitted plans, and diversion and control of water methods will in no way release the contractor from the fulfillment of his obligations or place the Government, in any manner, responsible for any losses due to failure or inadequacy of the diversion and control method used. The responsibility for damage to any part of the permanent work shall be as set forth in the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. Damage to all work (including temporary construction), utilities, materials, equipment, and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

## 3.1.2 Diversion Requirements

The Blue Diamond Detention Basin is an on-line structure located at Blue Diamond natural wash. The Contractor is responsible for the diversion and control of all runoff entering the construction area. The runoff will include water originating from Blue Diamond wash and from upstream, urban runoff, adjacent drainages; and in addition any and all seepage and

groundwater originating within the work. The work site may be inundated because of runoff. The Contractor shall be responsible for protection of work site during times of runoff by his own means and shall be approved by the Contracting Officer.

### 3.1.3 Drainage Ditches

The location and depth of any drainage ditch to be constructed under this contract shall be subject to the approval of the Contracting Officer. Special precautions shall be taken to avoid impairing the permanent subgrade. Damaged subgrade shall be replaced in accordance with SECTION 02250 FILLS AND SUBGRADE PREPARATION by and at the expense of the Contractor.

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## SECTION 02150

## CLEAR SITE AND REMOVE OBSTRUCTIONS

## PART 1 GENERAL

## 1.1 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Sections 01130 ENVIRONMENTAL PROTECTION and 02200 EXCAVATION.

## 1.2 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

## 3.1 REQUIREMENTS

## 3.1.1 General

Except as otherwise specified, and/or indicated, areas to be cleared will be limited to actual excavation areas, and areas on which fills and/or structures are to be placed. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, turf, or vegetation which can be left in place.

## 3.1.2 Existing Structures and Obstructions

The Contractor shall clear and grub the site, fill, and excavation areas, and remove and dispose of all existing structures and obstructions for project construction, except as those structures which are identified to be protected in place as shown on the drawings. Obstructions which are designed or specified to be removed but which are not designated or specified to be removed by others shall be removed by the Contractor. Except as otherwise specified, obstructions designated to be removed by others will be removed in sufficient time to preclude interference with the Contractor's operations.

## 3.1.3 Clearing

Trees smaller than 38 millimeters in diameter and other vegetation, except as specified, shall be cut off 0.15 meters below the indicated subgrade or ground level whichever is lower. Other vegetation shall be cut off flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures, and installations under construction, or to remain in place, and to provide for the safety of employees and others. All rubbish, waste dumps, and debris areas shall be cleared.

## 3.1.4 Grubbing

Grubbing shall consist of removing all trees, stumps, roots, logs, and other objectionable vegetable matter in the required fills, foundation

areas, and all excavation areas. In grubbing out stumps and roots, all roots or other timber more than 38 millimeters in diameter shall be removed to 1 meter below the depth of the required excavation or existing ground level, whichever is lower. Trees and stumps shall be pulled, not cut off.

### 3.1.5 Environmental Assessment Requirements

The Contractor shall notify the contracting Officer 14 calendar days prior to start of clearing and grubbing activities in accordance with Section 01200 GENERAL REQUIREMENTS, Paragraph 3.9.5.4.

### 3.2 DISPOSAL OF CLEARED, GRUBBED, AND REMOVED MATERIAL

All material removed, except material specified and/or indicated to be salvaged, is designated as scrap, and shall be disposed of at the disposal site indicated. Unsuitable materials from clearing operations may be temporarily used for diversion and control of water. Disposal shall be in accordance with the requirements of Section 01130 ENVIRONMENTAL PROTECTION.

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## SECTION 02200

## EXCAVATION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2487 (1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

## CORPS OF ENGINEERS (COE)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

## 1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

## SD-01 Data

Excavation Plan; FIO.

The Contractor shall submit his excavation plan to the Contracting Officer in conformance with paragraph GENERAL.

Blast Data; FIO.

The Contractor shall submit the pertinent data on the location, depth and area of the blast; diameter, spacing, depth, over-depth, pattern and inclination of blast holes; the type, strength, amount, distribution and powder factor for the explosives used per hole and per blast; the sequence and pattern of delays, and description and purpose of special methods.

Haul Route Plan; GA.

The Contractor shall submit a haul route plan for removal of required excavated materials and for placing required fill materials

## SD-04 Drawings

Shop Drawings; GA.

The Contractor shall submit for approval shop drawings showing proposed method of bracing which he intends to use to protect existing property.

Explosive Storage Locations; GA.

The Contractor shall submit to the Contracting Officer drawings showing the location, access to and type of construction of the proposed storage magazine for explosives, and cap house.

#### SD-09 Reports

Post-Blast Reports; FIO.

The Contractor shall prepare and furnish a separate Post-Blast Report of each blast.

### PART 2 PRODUCTS (NOT APPLICABLE)

### PART 3 EXECUTION

#### 3.1 GENERAL

Excavation shall consist of the removal of every type of material encountered (except materials covered by the provisions of Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS in the designated areas or from areas directed. The material to be removed may include but is not limited to hardpan, silt, sand, gravel, cobbles and boulders, cemented silt/sand/gravel/cobbles/boulders with various degrees of cementations, caliche, asphalt, and other materials. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Measurement for payment shall be made in accordance with Section 01250 MEASUREMENT AND PAYMENT. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation may require ripping or other rock-excavation techniques, including blasting, and shall be performed in a manner which will not impair the subgrade. Except as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 25.4 millimeters from indicated grade, except at areas to receive concrete where finished surfaces of subgrade shall not vary more than 12.5 millimeters from indicated grade. Prior to commencing excavation, the Contractor shall submit his excavation plan to the Contracting Officer. All subgrade excavations will be inspected by the Contracting Officer prior to placement of any fill materials. Rock or cemented material from required excavation to be used in project fills shall be crushed or otherwise reduced in size to meet fill gradation requirements prior to placement or stockpiling. Suitable materials from required excavation to produce soil aggregates for Roller Compacted Concrete shall be crushed and processed to meet required gradations.

#### 3.2 BLASTING

Any method used to excavate the channel using explosives shall be subject to the approval by the Contracting Officer.

##### 3.2.1 General Requirements

The drilling and blasting program and methods shall be the minimum necessary to break up the rock (caliche) into bulldozer-manageable sized pieces for removal. Only the minimum strength explosive that will accomplish the fracturing will be allowed. If multiple charges are deemed necessary, they will be sequenced to produce good breakage of the rock and reduce airblast (sonic impacts) and ground vibrations to minimal levels. In the design of the blasting pattern, no blastholes will be permitted within 61 meters of an active tortoise burrow. A qualified desert tortoise

ecologist is required to be present during all blasting operations to ensure that there are no occupied burrows and/or to remove tortoises from the surface or burrows within the 61 meter limit. The desert tortoise ecologist will provide a short report with field notes to the Contracting Officer. The desert tortoise ecologist will be provided by the Contractor at his own expense. Additional restrictions may be imposed during the hibernation period (15 November through 15 March) to protect hibernating tortoises, if necessary and directed by the Contracting Officer. The Contractor shall strictly comply with all State and local regulations regarding construction blasting (e.g., Uniform Standard Specifications for Public Works Construction Off-Site Improvements, Clark County Area, Nevada, Third Edition, subsections 107.10, 203.03.03, and 208.03.01, and Engineer Manual (EM) 1110-2-3800, including all notice and reporting requirements). Under no circumstances shall blasting be performed within 30.5 meters of concrete that has been placed less than seven days. Blasting within 30.5 meters of concrete older than seven days will be permitted only if approved by the Contracting Officer.

### 3.2.2 Blasting

Prior to drilling for each blast, unless excepted by the Contracting Officer, the Contractor shall submit on an approved form the pertinent data on the location, depth and area of the blast; diameter, spacing, depth, overdepth, pattern and inclination of blast holes; the type, strength, amount, distribution and powder factor for the explosives used per hole and per blast; the sequence and pattern of delays, and description and purpose of special methods. The loading of holes shall be done in the presence of a Government inspector. Acceptance by the Contracting Officer of blasting data will not relieve the Contractor of his responsibility to produce satisfactory results as set forth in these specifications. Drilling and blasting shall be done only to the depth, amount, and at such locations, with explosives of such quantity, distribution and density that will not produce unsafe or damaged foundation surfaces or damage material beyond the prescribed excavation limits. When a drilling and blasting program results in damage to the excavation, the Contractor will be required to devise and employ methods which will prevent such damage. The revision may include special methods such as presplit and zone blasting, shallow lifts, reduction in size of individual blasts, small diameter blast holes, closely spaced blast holes, reduction of explosives, greater distribution of explosives by use of decking and primacord or variation in density of explosives.

### 3.2.3 Overshooting

The Contractor shall control the blasting procedures so as not to overshoot. Any material outside the authorized excavation section side slopes which may be shattered or loosened because of blasting shall be removed and/or re-compacted by the Contractor at his expense. Shattered or loosened material below the bottom limits of the required excavation shall be uniformly distributed and compacted or otherwise disposed of in a manner satisfactory to the Contracting Officer. The Contractor shall discontinue any method of blasting which leads to overshooting or is dangerous to the public, destructive of natural or man-made features, or is injurious to wildlife and habitat.

### 3.2.4 Equipment

The Contractor shall provide suitable vibration monitoring equipment to measure and record the ground motions associated with each blast. The

monitoring equipment will be placed to monitor the effects of the blasting at the 60.960 meter distance.

### 3.2.5 Notifications

The Contractor shall notify each property owner and public utility company having structures or facilities in proximity to the site of the work of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury.

### 3.2.6 Qualifications

During blasting operations, the Contractor shall have on site, and in immediate charge of the blasting, a licensed blaster acceptable to the Contracting Officer who has had no less than 3 years of experience in controlled blasting and rock excavation operations. Powder handlers shall have had no less than one year continuous experience in preparation and loading of powder charges.

### 3.2.7 Post-Blast Reports

In addition to the reporting requirements required above, a separate Post-Blast Report of each blast shall be prepared and furnished to the Contracting Officer on an approved form. The report shall indicate the location of the blast by specific stationing or coordinates, depth of round, pounds of explosives used by type and grade, total number of loaded holes, total pounds per delay, quantity and kind of explosive in each hole, maximum measured blast vibration, and any other blast information directed by the Contracting Officer.

### 3.2.8 Explosives

#### 3.2.8.1 Safety

The contractor shall fully comply with Section 29, Blasting, U. S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1.

#### 3.2.8.2 Storage

The Contractor shall submit to the Contracting Officer, for approval, drawings showing the location, access to and type of construction of the proposed storage magazine for explosives, and cap house. The explosives storage magazine and other facilities may be located on project lands if a satisfactory location can be found and is approved by the Contracting Officer. The Contractor shall maintain the explosive storage area at his own expense.

### 3.3 PRESERVATION OF PROPERTY

All excavation operations shall be conducted in such a manner that concrete structures, embankments, utilities or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such improvements or to support the improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the

property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval shop drawings showing proposed method of bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressures exerted by (and the condition and nature of) the materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such manner as not to disturb or damage the finished concrete or other facility.

#### 3.4 EXCAVATION FOR STRUCTURES

Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with COE EM 385-1-1.

#### 3.5 EXCAVATION OUTLET CONDUIT AND BASIN BYPASS PIPE

Outlet conduit excavation consists of the removal of all materials within the lines and grades indicated. Excavation basin bypass pipe at fill sections consist of removing fill materials when compacted fill reached to the elevation 1 meter above top of the pipe.

#### 3.6 EXCAVATION INSPECTION TRENCH

Inspection trench excavation consists of the removal of all materials within the lines and grades indicated. Additional excavation other than that shown on the project plans may be directed by the Contracting Officer.

#### 3.7 EXCAVATION BASIN

The line and grades of the basin excavation, as shown on the drawings, are approximate. The finished contours of this area shall be based on the quantities of fill material and aggregate material required to construct the required fills and dam embankment. No part of the basin area shall be excavated below the finished contours shown on the drawings. If the actual quantities deviate from the estimated quantities, basin area will be expanded, and contracting officer will direct additional basin excavation based on the required quantities and final grading plan. The basin excavation shall produce a regular reservoir shape resembling that shown by the finished contours on the drawings. The basin excavation area shall be regular in shape, graded smoothly and graded to drain. Side slopes shall not be steeper than one vertical to ten horizontal and shall be uniform for the entire length or any one side, unless otherwise directed.

#### 3.8 EXCAVATION FOUNDATION

Excavation foundation consist of the removal of all materials within footprint of the dam embankment and spillway/stilling basin, including excavation for placement of spillway toe stone, drain material and filter material to the lines and grades shown on the drawings. The finished surface shall be reasonably smooth, free from irregular surface changes, and shall not vary more than 50 millimeters above or below the indicated grade, except that either extreme of such tolerance shall not be continuous over an area greater than 50 square meters.

### 3.9 EXCAVATION TOE

Excavation toe consists of the removal of all materials to the lines and grades indicated.

### 3.10 REMOVAL OF UNSATISFACTORY SOILS

The removal of soils which are unsatisfactory or unsuitable for foundation of the dam embankment, outlet conduit, basin bypass conduit, or structures may be required in certain areas. Unsatisfactory or unsuitable materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487, as Pt, OH, OL, CH, MH, and materials that are too wet to support construction equipment. The Contractor will be required to excavate any such areas to the depth directed and backfill the areas with compacted fill conforming to the requirements of the Section 02250 FILLS AND SUBGRADE PREPARATION.

### 3.11 DISPOSITION AND DISPOSAL OF EXCAVATED MATERIALS

Excavated materials suitable for required fills shall be placed in temporary stockpiles or used directly in the work. Excess excavated material suitable for fill but not utilized as part of the construction shall be disposed of by spreading and compacting the material over portions of the excavated basin surface or other areas on the site as directed by the Contracting Officer. Unsatisfactory material shall become the property of the Contractor and shall be removed from the site. No excavated material or waste of any kind shall be disposed of at any place beyond the limits of the work under this contract without the expressed authority of the Contracting Officer. Prior to placing material in fill areas and any approved stockpile area(s), the areas shall be cleared of trash and vegetation. Vegetation shall be cut off at the existing ground line. Clearing shall conform to the applicable requirements of Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS. Any stockpiles shall be placed in a manner to preclude ponding of water.

#### 3.11.1 Hauled Excavation Material

The Contractor shall have a haul route plan for removal of required excavated materials and for placing required fill materials. This haul route plan shall be submitted to the Contracting Officer for approval. The Contractor will be responsible for obtaining all permits and licenses necessary to haul material off-site. The Contractor will provide to the Contracting Officer three copies of the proposed street haul route plan for transport of all excess excavated material.

### 3.12 OVERCUT

Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to the Section 02250 FILLS AND SUBGRADE PREPARATION, or concrete conforming to the Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE. All excavating, backfilling, compacting of backfill, and concreting occasioned thereby shall be by the Contractor at no additional cost to the Government. Any overcut under outlet structure shall be backfilled with concrete.

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## SECTION 02241

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## SECTION 02241

## AGGREGATE BASE COURSE

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/cu.m.)
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 4318	(1993) Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

## 1.2 DEFINITIONS

## 1.2.1 Aggregate Base

Aggregate base as used herein is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

## 1.2.2 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated

hereinafter as percent laboratory maximum density.

### 1.3 GENERAL

The work specified herein consists of the construction of an aggregate base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-01 Data

Plant, Equipment, Machines, and Tools; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

#### SD-09 Reports

Sampling and Testing; FIO. Field Density; FIO.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

#### SD-18 Records

Waybills and Delivery Tickets; FIO. Coarse Aggregate; FIO.

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used. A notification stating which type of coarse aggregate is to be used.

### 1.5 WAYBILLS AND DELIVERY TICKETS

Copies of waybills and delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, waybills and certified delivery tickets shall be furnished for all aggregates actually used in the construction.

### 1.6 WEATHER LIMITATIONS

Base shall not be constructed when the atmospheric temperature is less than 2 degrees C. Base shall not be constructed on subgrades that are frozen or contain frost. If the temperature falls below 2 degrees C, completed areas shall be protected against any detrimental effects of freezing.

### 1.7 PLANT, EQUIPMENT, MACHINES, AND TOOLS

#### 1.7.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. The equipment shall be adequate and have the capability of producing the results specified.

#### 1.7.2 Steel-Wheeled Rollers

Steel-wheeled rollers shall be the self-propelled type weighing not less than 9 metric tons, with a minimum weight of 135 kilograms per millimeter width of rear wheel. Wheels of the rollers shall be equipped with adjustable scrapers. The use of vibratory rollers is optional.

#### 1.7.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have four or more tires, each loaded to a minimum of 13,600 kilograms and inflated to a minimum pressure of 1035 kPa. The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Towing equipment shall also be pneumatic-tired.

#### 1.7.4 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

#### 1.7.5 Tampers

Tampers shall be of an approved mechanical type, operated by either pneumatic pressure or internal combustion, and shall have sufficient weight and striking power to produce the compaction required.

#### 1.7.6 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 3.05 meter straightedge for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

### 1.8 STOCKPILING MATERIALS

Materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at locations designated. Before stockpiling of material, storage sites shall be cleared, and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

### 1.9 SAMPLING AND TESTING

#### 1.9.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government.

Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the locations and times directed to insure that materials and compaction meet specified requirements. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

#### 1.9.2 Test Results

Results shall verify that materials comply with this specification. When a material source is changed, the new material will be tested for compliance.

When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer.

#### 1.9.3 Sampling

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75.

#### 1.9.4 Sieve Analysis

Before starting work, at least one sample of material shall be tested in accordance with ASTM C 136 and ASTM D 422 on sieves conforming to ASTM E 11.

After the initial test, a minimum of one analysis shall be performed for each 1000 metric tons of material placed, with a minimum of three analyses for each day's run until the course is completed.

#### 1.9.5 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318.

#### 1.9.6 Laboratory Density

Tests shall provide a moisture-density relationship for the aggregate. Tests shall be conducted in accordance with ASTM D 1557.

#### 1.9.7 Wear Tests

Wear tests shall be performed in accordance with ASTM C 131. One test shall be run per 1000 square meters of completed base course. A minimum of one test per aggregate source shall be run.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Aggregates

Aggregates shall consist of stone, crushed stone, crushed gravel, angular sand, or other approved material. Aggregates shall be durable and sound, free from lumps of clay, organic matter, objectionable coatings, and other foreign material. Material retained on a 4.75 mm sieve shall be known as coarse aggregate and that passing the 4.75 mm sieve shall be known as binder material.

2.1.1.1 Coarse Aggregate

Only one type of coarse aggregate shall be used on the project. Coarse aggregates, consisting of angular fragments of uniform density and quality, shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3.

a. Crushed Gravel: Crushed gravel shall be manufactured from gravel particles 50 percent of which by weight are retained on the maximum size gradation sieve specified.

b. Crushed Stone: Crushed stone retained on each sieve specified shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are adjacent, the angle between the planes of the fractures must be at least 30 degrees to count as two fractured faces.

2.1.2 Binder Material

Binder material shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. The portion of any component or of the completed course passing the 0.075 mm sieve shall be either nonplastic or have a plasticity index as specified below:

Percentage by Weight Passing No. 200 Sieve	Plasticity Index Maximum
0.1 to 3.	15
3.1 to 4.	12
4.1 to 5.	9
5.1 to 8.	6
8.1 to 10.	4

2.1.3 Gradation

Requirements for gradation specified shall apply to the completed base course. The aggregates shall have a 25 millimeter (1 inch) maximum size and shall be continuously graded within the following limits:

Sieve Designation	Percentage by Weight Passing Square-mesh Sieve (a) (b)
25 mm	100
12.5 mm	40-70
4.75 mm	20-50
2 mm	15-40

Sieve Designation	Percentage by Weight Passing	
	Square-mesh Sieve	(a) (b)
0.425 mm	5-25	
0.075 mm	0-10	

(a) Particles having diameters less than 0.02 millimeter shall not be in excess of 3 percent by weight of the total sample tested.

(b) The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction in accordance with ASTM C 127 and ASTM C 128 when aggregates of varying specific gravities are used.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from off-site sources.

3.3 PREPARATION OF UNDERLYING COURSE

3.3.1 General Requirements

Before constructing aggregate base course, the previously constructed underlying course shall be cleaned of foreign substances. Surface of underlying course shall meet the specified compaction and surface tolerances. Subgrade shall conform to Section 02250 FILLS AND SUBGRADE PREPARATION. Ruts or soft, yielding spots that may appear in the underlying course, areas having inadequate compaction, and deviations of the surface from requirements specified shall be corrected. For cohesionless underlying materials containing sands, sand gravels, or any other cohesionless material in harmful quantities, the surface shall be mechanically stabilized with aggregate prior to placement of the aggregate course. Stabilization may be accomplished by mixing base course material into the underlying course and compacting by approved methods. Properly compacted material will be considered as part of the underlying course and shall meet all requirements for the underlying course. Finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until base course is placed.

3.3.2 Grade Control

Underlying material shall be excavated to sufficient depth for the required base course thickness so that the finished base course with the subsequent surface course will meet the fixed grade. Finished and completed area

shall conform to the lines, grades, cross section, and dimensions indicated.

### 3.4 INSTALLATION

#### 3.4.1 Mixing and Placing

Materials shall be mixed by the stationary plant, traveling plant, or road mix method and placed in such a manner as to obtain uniformity of the aggregate base course material and at a uniform optimum water content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to ensure a satisfactory base course.

#### 3.4.2 Edges of Base Course

Approved material shall be placed along edges of aggregate base course in such quantities as will compact to thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 300 mm width of the shoulder to be rolled and compacted simultaneously with rolling and compacting of each layer of base course.

#### 3.4.3 Compaction

Each layer of aggregate base course including shoulders shall be compacted.

Water content shall be maintained at optimum. Density of compacted mixture shall be at least 100 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths.

Speed of the roller shall be such that displacement of the aggregate does not occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.

#### 3.4.4 Layer Thickness

Compacted thickness of the aggregate course shall be as indicated. No layer shall be in excess of 200 mm nor less than 75 mm in compacted thickness.

#### 3.4.5 Finishing

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

##### 3.4.5.1 Smoothness

Surface of each layer shall show no deviations in excess of 9.5 mm when tested with the 3.05 meter straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

##### 3.4.5.2 Thickness Control

Compacted thickness of the base course shall be within 12.7 mm of the thickness indicated. Where the measured thickness is more than 12.7 mm deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 12.7 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 7 mm of the thickness indicated.

### 3.5 FIELD QUALITY CONTROL

#### 3.5.1 Field Density

Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167. Calibration curves and calibration test results shall be furnished within 24 hours of the conclusion of the tests. At least one field density test shall be performed for each 1000 square meters (yards) of each layer of base material.

#### 3.5.2 Smoothness

Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 3.05 meter straightedge. Measurements shall also be taken perpendicular to the road centerline at 15 meter intervals.

#### 3.5.3 Thickness

Thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

### 3.6 TRAFFIC

Completed portions of the area may be opened to traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

### 3.7 MAINTENANCE

The aggregate base course shall be maintained in a satisfactory condition until accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for the base course material that is removed for the required correction of defective areas, and waste material and debris shall be disposed of as directed.

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## SECTION 02250

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## SECTION 02250

## FILLS AND SUBGRADE PREPARATION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m)
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

## 1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

## SD-01 Data

Moisture-density relations; GA.

Moisture-density relations shall be determined by the Contractor, in accordance with the requirements in paragraph LABORATORY CONTROL.

Survey Data; FIO.

The settlement monument survey data shall be provided to the Contracting Officer for review to determine the need for further, in accordance with the requirements in paragraph SETTLEMENT MONITORING.

## SD-04 Drawings

Settlement Monument Plan; FIO.

The settlement monument plan along with the plan to protect the monument during construction shall be provided by the Contractor as required in paragraph SETTLEMENT MONITORING.

#### SD-09 Reports

Field Density Tests; FIO.

Field density tests shall be performed by the Contractor. The Contractor shall submit reports as required in paragraph CONTROL.

### PART 2 PRODUCTS (NOT APPLICABLE)

### PART 3 EXECUTION

#### 3.1 COMPACTION EQUIPMENT

Compaction shall be accomplished by tamping roller, rubber tired roller vibratory compactor or mechanical tampers. All equipment, tools, and machines shall be maintained in satisfactory working condition at all times. Compaction equipment shall be suitable for consistently producing uniform soil densities.

#### 3.2 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS

##### 3.2.1 Control

Moisture-density relations shall be established by the Contractor. The soil used for each maximum density test shall be classified in accordance with ASTM D 2487 and shall include a particle size analysis in accordance with ASTM D 422. At least one five point maximum density test shall be made for every 10 field density tests. Field density tests shall be performed by the Contractor at the frequency established in paragraph FIELD CONTROL, and in such locations to insure that the specified density is being obtained. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight determinations shall be provided on the day each test is taken. The completed test reports shall be provided with the Contractor Quality Control Report on the work day following the test.

##### 3.2.1.1 Laboratory Control

Moisture-density relations shall be established by the Contractor. One moisture-density relation shall be made for each classification, blend or change in classification of soil materials encountered. Approval of moisture-density relations shall be obtained prior to the compacting of any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557.

- a. The desired amount of mixing water will be added for each compaction test specimen, mixed well, and the mixture will be placed in a container with an airtight cover and allowed to cure for 24 hours. A shorter curing time may be allowed where tests show that shortening the curing time will not affect the results.

##### 3.2.1.2 Field Control

Field in-place density shall be determined in accordance with ASTM D 1556. The field moisture content shall be determined in accordance with ASTM D

2216. Determination of in-place densities using the nuclear method (ASTM D 2922) may be used to supplement the sand cone density tests (ASTM D 1556). When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. At least one adjacent sand cone test shall be performed for every five nuclear density tests performed. If field density tests determined by the nuclear method vary by more than 0.5 kilonewtons per cubic meter from comparison sand-cone tests, and are consistently high or low, adjustment of the calibration curve is necessary.

a. In-Place Densities

(1) One test per 750 cubic meters, for the first 7,500 cubic meters of material and one test for each 1,500 cubic meters thereafter, or fraction thereof, shall be made of each lift of fill or backfill areas compacted by other than hand-operated machines. At least one test shall be made in each 0.6 meter layer of compacted fill or backfill processed as a unit and not less than one test shall be made in each area.

(2) One test per 400 cubic meters, or fraction thereof, shall be made of each lift of fill or backfill areas compacted by hand-operated machines.

3.2.2 Settling of Fills or Backfills with Water

Settling of fills or backfills with water will not be permitted.

3.2.3 Fill Material

Fill material shall be obtained from the basin excavation, foundation excavation or stockpiles. Materials considered unsatisfactory for use as compacted fill include but are not limited to those materials containing roots and other organic matter, trash, debris, oversize chunks or clumps of cemented material. Fill material shall contain no stone whose greatest dimension is more than 3/4 the lift thickness. The contractor shall be expected to break-down, crush, or otherwise process the excavated material for use as fill material due to the cementation of in-situ soil. Materials classified in ASTM D 2487 as MH, CH, Pt, OH, and OL are also considered unsuitable for use as compacted fill. Material for compacted fill behind concrete structures shall contain less than 30 percent by weight passing the 0.075 mm sieve and shall contain no stone larger than 75 mm.

3.2.4 Placement

Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 17.2 megapascals when tested in accordance with the Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE. Heavy equipment shall not be operated over pipes and buried structures until at least 1 meter of fill material has been placed and compacted over them. Material from the top of the pipe or buried structure to 1 meter above pipe or buried structure shall be compacted by mechanical tampers or other equipment approved by the Contracting Officer. Compacted fill and backfill shall be placed with suitable equipment in horizontal layers which before compaction, shall not exceed 0.3 meters in depth for rubber-tired or vibratory rollers, 0.2 meters in depth for tamping rollers, and 0.1 meters in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing

stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

### 3.2.5 Moisture Content

Material shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after time water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 2 percent above optimum and a minimum moisture content of not less than 2 percent below optimum.

### 3.2.6 Compaction

No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to operate within 0.3 meters of outlet conduit or structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of 0.6 meters. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures where rolling equipment is impracticable for use in compaction.

## 3.3 COMPACTED FILL

### 3.3.1 Dam Embankment

#### 3.3.1.1 Preparation for Placing

Before placing material for dam embankment, the foundation surface shall be cleared of all existing obstructions, vegetation and debris. Within the dam embankment footprint, the following shall be removed: (1) the upper 1.5 meters of foundation soil within the footprint of dam embankment within the main and tributary washes, (2) the upper 0.610 meters of foundation soil within the footprint of the dam embankment outside of the main and tributary washes', (3) material shall be removed in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS and Section 02200 EXCAVATION. The inspection trench and the banks of the existing wash shall be excavated as shown on the plans and in accordance with Section 02200 EXCAVATION.

Unsuitable or unstable (too wet) material not meeting the requirements for fill material shall be removed where directed. The existing surfaces, including the excavated inspection trench and bank, shall be scarified to a depth of 0.15 meters and proofrolled by four passes of the compaction equipment before placing the fill. Sloped ground surfaces steeper than one vertical to four horizontal, on which fill or compacted backfill is to be placed, shall be stepped in such a manner that the compaction equipment will bear on the full depth of the layer. Banks of the natural washes which have steep slopes shall be cleared of loose materials and benched to a minimum 2H: 1V slope before placement of the fill material.

#### 3.3.1.2 Compaction

Each layer of the materials shall be compacted to not less than 95 percent

of maximum density, per ASTM D 1557.

#### 3.3.1.3 Settlement

The Contractor shall delay RCC placement between STA 2+10.903 and STA 7+69.097 for a maximum settlement period of 60 days after embankment in that area reaches full height in order to monitor anticipated settlement of the embankment. The Contractor shall install three surface settlement monuments at STA 4+00.000, STA.5+00.000, and STA.7+00.000; the location with respect to the dam centerline will be determined by the Contracting Officer.

#### 3.3.1.4 Settlement Monitoring

The monuments shall be surveyed by the Contractor within 24 hours of installation and the elevation surveyed on a weekly basis. The survey data shall be provided to the Contracting Officer for review to determine the need for further monitoring. If the survey data indicates there is inconsequential settlement, the Contracting Officer may approve RCC placement between STA 2+10.903 and STA 7+69.097 before the 60 day settlement period expires. A settlement monument plan including typical details of the surface settlement monuments along with the plan to protect the monument during construction shall be provided by the Contractor for review not less than 14 calendar days prior to installation of the monument.

#### 3.3.1.5 Settlement Monument Protection Plan

The location of the settlement monument shall be clearly marked and readily visible (red flagged) to equipment operators. In the event of damage to settlement monument or extension resulting from equipment operating within the specified area, the Contractor shall immediately notify the Contracting Officer and shall be responsible for restoring the settlement monument to working order.

#### 3.3.1.6 Regrading of Embankment Crest

If the dam embankment crest settles as anticipated, the embankment shall be regraded to the lines and grades indicated after the settlement period is completed.

### 3.3.2 Compacted Fill, Basin

#### 3.3.2.1 Preparation for Placing

The foundation for the compacted fill to be placed in the basin, compacted fill for the outlet conduit and compacted fill for the basin bypass pipe shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS and Section 02200 EXCAVATION. Unsuitable or unstable (too wet) material not meeting the requirements for fill material shall be removed where directed. The existing surfaces for the compacted fill in the basin shall be proofrolled by four passes of the compaction equipment. The subgrade for the outlet conduit and basin bypass pipe shall be prepared in accordance with paragraph: Subgrade Preparation. Material for compacted fill behind the outlet conduit walls and trench cut slopes and up to 0.60 meters above the top of conduit shall contain less than 30 percent by weight passing the 0.075 mm sieve and shall contain no stone larger than 75 millimeters. Trench backfill material for basin bypass pipe and up to .61 meters above the top of pipe shall consist of well-graded

sand, crashed gravel or crushed stone, and shall contain not more than 10 percent by weight of material passing the 0.75 mm sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum backfill aggregate size shall not exceed 75 millimeter, or the maximum size recommended by manufacturer, whichever is smaller. Backfill material for basin bypass pipe shall be placed in layers not exceeding .1 meter and shall be compacted by hand operated mechanical tampers.

### 3.3.2.2 Limitations on Equipment

The gross weight of any piece of equipment, or the combined weight of any combinations of equipment coupled together, used to place, moisten and/or compact fill behind and within 1.2 meters of outlet conduit walls and basin bypass pipe shall not exceed 16 000 kilograms, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill behind the outlet conduit walls shall be of such size as to be capable of operating in the area between the cut slope and the wall.

### 3.3.2.3 Compaction

Each layer of fill behind outlet conduit walls and pipe backfill around the basin by-pass pipe through the dam embankment shall be compacted to not less than 95 percent of maximum density, per ASTM D 1557. Pipe backfill and trench backfill around the basin by-pass pipe outside the dam embankment and fill placed in the basin shall be compacted to not less than 90 percent of maximum density, per ASTM D 1557.

### 3.3.3 Filter Material

#### 3.3.3.1 Preparation for Placing

Foundation for the filter material shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS and Section 02200 EXCAVATION. Unsuitable or unstable (too wet) material not meeting the requirements for fill material shall be removed where directed.

The existing surfaces shall be scarified to a depth of 0.15 meters and proofrolled by four passes of the compaction equipment before placing the filter material. The subgrade for Filter Material shall be prepared in accordance with paragraph SUBGRADE PREPARATION.

#### 3.3.3.2 Material

Filter material shall be processed from materials obtained from the required excavations or may be obtained from commercial sources. Filter material gradation shall be in accordance with SECTION 02710 SUBDRAINAGE SYSTEM.

#### 3.3.3.3 Placement and Compaction

Filter material shall be spread by motor graders or other approved means in approximately horizontal layers to the lines and grades indicated on the plans, the thickness of the layers before compaction shall not be more than 0.3 meters, the entire surface of the layer shall be compacted by not less than four complete passes of the 9-ton vibratory roller. Each trip of the roller shall overlap the adjacent trip not less than 0.3 meters. The finished surface of the filter material shall not vary more than 12.5 millimeters above or below the indicated grades.

### 3.3.4 Drain Material

#### 3.3.4.1 Material

Drain material shall be processed from materials obtained from the required excavations or may be obtained from commercial sources. Filter material gradation shall be in accordance with SECTION 02710 SUBDRAINAGE SYSTEM.

#### 3.3.4.2 Placement and Compaction

Drain materials shall be spread over the filter material by motor graders or other approved means in approximately horizontal layers to the lines and grades indicated on the plans, the thickness of the layers before compaction shall not be more than 0.3 meters, the entire surface of the layer shall be compacted by not less than 4 complete passes of the 9-ton vibratory roller. Each trip of the roller shall overlap the adjacent trip not less than 0.3 meters. Mechanical tampers shall be used for compaction of Drain materials over and adjacent to the drainage pipes. The finished surface of the drain material layers shall not vary more than 12.5 millimeters above or below the indicated grades.

### 3.4 BACKFILL

#### 3.4.1 Structural Backfill

##### 3.4.1.1 Location

Structural backfill shall consist of all fill against and/or around concrete structures.

##### 3.4.1.2 Material

Structural backfill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, and silty sands. Organic material, silt, clay, broken concrete or pavement, boulders and other objectionable material shall not be used. Backfill for structures shall not contain any stones larger than 0.1 meters.

##### 3.4.1.3 Placing

Structural backfill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 17.2 megapascals when tested in accordance with Section 03301 CAST-IN PLACE STRUCTURAL CONCRETE. Backfill shall be placed in 0.1 meter layers.

##### 3.4.1.4 Compaction

Compaction shall be not less than 95 percent of maximum density, per ASTM D 1557.

### 3.5 BACKFILL, TOE

Backfill, Toe shall consist of suitable material from the required excavation. Stone with a maximum size of 0.2 meters may be used. Nesting of material shall be avoided. Broken concrete, asphalt, or chunks of cemented material shall not be permitted. Stones larger than 0.1 meters in

the backfill shall not be allowed within 0.3 meters of the roller compacted concrete surface. Compaction of backfill, toe will not be required other than that obtained by the controlled movement of construction equipment.

### 3.6 SUBGRADE PREPARATION

Subgrade preparation shall include subgrade preparation for the dam, outlet works conduit, basin bypass pipe, and for areas to receive aggregate base course paving for access roads, maintenance roads and turnarounds. All trash and debris shall be removed in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS and Section 02200 EXCAVATION. After the outlet conduit has been excavated to rough grade, the entire subgrade for the outlet conduit invert, bypass conduit invert and other area indicated above shall be moisture conditioned and proofrolled by 4 passes of the compaction equipment and trimmed to a uniform grade and smoothed with a steel-wheeled roller to make the subgrade ready to receive concrete. If the subgrade is disturbed by the Contractor's operations or is overexcavated, or is soft or yielding, the subgrade shall be restored to grade and compacted to a density of 95 percent of maximum density, per ASTM D 1557. The finished surface of the subgrade shall not be more than 12.5 millimeters from the indicated grade at any point when tested with a 3 meter straightedge.

### 3.7 SOIL STABILIZER

Soil Stabilizer shall be placed on all exposed excavation and fill surfaces after construction is completed. The soil stabilizer shall be a mixture of plaster and natural cellulose fiber mulch. The cellulose fiber mulch shall be produced from grinding clean, whole wood chips, or fiber produced from ground newsprint with a labeled ash content not to exceed 7 percent. The plaster shall consist of natural occurring high purity processed gypsum and additives. The gypsum shall be produced from a mined or quarried source. The gypsum shall be processed to be composed of a crushed, dry calcium sulfate hemihydrate having a purity of not less than 88 percent. The gypsum and additives shall be furnished either in bags or bulk and be accompanied by bills of lading and shipping invoices. The shipping invoices for the gypsum shall state the gypsum's purity content, dry weight, and source of manufacture. Processed gypsum which has become partially air set, lumpy or caked shall not be used. The plaster/cellulose fiber mulch shall be applied at a rate of 6.725 tonnes of plaster mixed with 2.242 tonnes of fiber per hectare. The plaster/cellulose fiber mulch stabilizer shall formulate a protective crust-like barrier within 4 to 8 hours after application. Application of the plaster/cellulose fiber mulch stabilizer will not be permitted when weather conditions are unsuitable for concrete placement in accordance with Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE.

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SECTION 02510

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## SECTION 02510

## BASIN BYPASS PIPE

## PART 1 GENERAL

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556 (1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C300 (1992) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids

AWWA M9 Manual of Water Supply Practices

## 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish and install all pipe and fittings for the Basin Bypass Pipe as shown on the contract drawings. In addition, the Contractor shall be responsible for the structural design of the pipe. The structural design of the pipe and pipe joints shall be done by a licensed Professional Engineer experienced in the design of reinforced concrete pressure pipe, steel-cylinder type.

## 1.3 DESIGN REQUIREMENTS

The reinforced concrete pressure pipe, steel-cylinder type shall be design in accordance with AWWA C300, AWWA M9 Manual, and the design criteria and parameters contained herein.

## 1.3.1 Design Parameters

The design of the reinforced concrete pressure pipe, steel-cylinder type shall be based on the following parameters and criteria and those shown on plans:

Inside Pipe Diameter	Di = 1500 mm
Working Pressure established by static head	Ps = 167 Kpa
Earth Cover	H = see plans
Width of Trench	Bd = O.D. + 1000 mm
Saturated Soil Density	Ws = 2323 kg/m <sup>3</sup>
Drained Soil Density	Ws = 2224 kg/m <sup>3</sup>
Live Load	LL = AASHTO HS20-44 (MS 18) or maximum of any piece equipment of 16000 Kg
Impact	If = 1.2
Maximum Water Elevation	Elev = 906.000 meters

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Design Analysis; GA.

Design analysis as one package with the detail drawings 14 days prior to beginning of manufacture. The design analysis signed by a Registered Professional Engineer shall include a list of the design loads, and complete calculations for the reinforced concrete pressure pipe, steel-cylinder type. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a Registered Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included in the submittal. The program input and output data file shall be annotated and supplemented with sketches to make it easier for an engineer unfamiliar with the program to review and verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer and checker who function as a point of contact to answer questions during the technical review.

SD-06 Instructions

Placing Pipe; FIO.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-09 Reports

Hydrostatic Tests; FIO.

SD-13 Certificates

Pipeline Testing; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

1.5 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be

kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

## PART 2 PRODUCTS

### 2.1 PIPE

Pipe and pipe fittings shall conform to the requirements of AWWA C300 and to the applicable sections of these contract documents and AWWA M9 Manual.

## PART 3 EXECUTION

### 3.1 EXCAVATION AND SUBGRADE PREPARATIONS

Excavation of trenches and backfilling for pipes shall be in accordance with the applicable portions of Section 02200 EXCAVATION and Section 02250 FILLS AND SUBGRADE PREPARATION and the requirements herein.

#### 3.1.1 Trench Excavation

Trenches shall be excavated to a depth sufficient to provide the required bedding for the pipe. The trench bottom shall be graded to the established line to provide uniform support for the full length of the pipe. The trench shall be deep enough to provide at least 1.000 m of cover over the pipe. The trench width shall be as shown on the drawings. Should the actual trench width at the top of the top of the pipe exceed the maximum allowed, the contractor, at his expense, shall provide approved bedding and backfill material and other measures to increase the pipe supporting strength to resist the resulting additional external loads. If the trench is inadvertently excavated deeper than necessary, it shall be back filled to the proper grade with approved compacted granular material at the Contractor's expense.

#### 3.1.2 Excavation in Rock

If the trench bottom is composed of rock or other unyielding material, the Contractor shall excavate to a depth of at least 150 mm below the bottom of the pipe. The excess excavation shall be filled with appropriate material up to the elevation of the bottom of the pipe bedding. The trench bottom shall be graded to the established line to provide uniform support for the full length of the pipe.

#### 3.1.3 Bedding

The type of bedding, if required, to be used for the basin bypass pipe shall be determined in conjunction with the structural design of the pipe. The contractor shall install the pipe using the recommended bedding and details specified with the pipe structural design.

### 3.2 INSTALLATION

#### 3.2.1 Placing and Laying

Two half lengths of pipe shall be used at each structure connection to provide flexibility. Pipe length should not exceed 3.7 meters. Concrete

cradles should be provided under the first length of pipe at the upstream and downstream ends of structures. Drainage blanket shall be placed on the landside end third of the pipe. Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Pipe shall not be dropped or dumped into the trench.

Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe shall be securely closed so that no trench water, earth, or other substance will enter the pipes. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner.

### 3.2.2 Reinforced Concrete Pressure Pipe Installation

Reinforced concrete pipe shall be installed in accordance with recommendations of the pipe manufacturer. Before laying reinforced concrete pressure pipe, the outside surface of the spigot and the inside surface of the bell shall be thoroughly cleaned and an acceptable vegetable-compound lubricant applied to the inside surface of the bell and to the rubber gasket. Where prescribed by the pipe manufacturer, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gauge in accordance with the pipe manufacturer's recommendations.

### 3.3 JOINT DEFLECTION

Minor deflection of the pipe alignment may be obtained at standard pipe joints; however, the maximum joint opening caused by such deflection shall not exceed the recommendations of the Pipe manufacturer. Where it becomes necessary to make larger deflections, sections of pipe with beveled ends or fabricated fittings shall be used.

### 3.4 JOINTING

#### 3.4.1 Reinforced Concrete Pressure Pipe Requirements

The inside and outside annular spaces between abutting sections of concrete pipe shall be filled with rich cement mortar in accordance with the pipe manufacturer's recommendations. Excess mortar shall be removed from interior annular spaces, leaving a smooth and continuous surface between pipe sections. Exposed portions of steel joint rings shall be protected from corrosion by a metallic coating or by an approved nonmetallic coating.

Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the pipe manufacturer's recommendations.

### 3.5 HYDROSTATIC TESTS

#### 3.5.1 Pressure Test

Bypass pipe under the dam footprint shall be subjected to hydrostatic and leakage tests. After the pipe is laid, the joints completed, and the

trench partially backfilled leaving the joints exposed for examination, the newly laid piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 120 percent of the working pressure.

Exposed pipe, joints, fittings, shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of herein and in Section 02200 EXCAVATION and Section 02250 FILLS AND SUBGRADE PREPARATION.

### 3.5.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 120 percent of the working pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or approved section, necessary to maintain pressure within 34.5 kPa of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

### 3.5.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure

test and subsequent leakage test.

#### 3.5.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using the following procedure. Regardless of the sequence of tests employed, the results of pressure tests and leakage tests shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently.

#### 3.6 BACKFILLING

After the bedding and the pipe have been installed, selected material from the required excavation at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 1000 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 150 mm and compacted to the requirement specified in Section 02250 FILLS AND SUBGRADE PREPARATION. In place densities shall be determined using ASTM D 1556 where it is necessary in the opinion of the Contracting Officer, any sheeting and/or portions of bracing used shall be left in place, and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures.

#### 3.7 CLEANUP

Upon completion of the installation of the bypass pipe, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

#### 3.8 MOVEMENT OF CONSTRUCTION MACHINERY

Operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over the bypass pipe at any stage of the construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at the expense of the Contractor.

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## SECTION 02600

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## SECTION 02600

## STONE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## American Society for Testing and Materials (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 1141	(1980) Substitute Ocean Water
ASTM D 5519	(1994) Particle Size Analysis of Natural and Man-Made Riprap Materials
ASTM E 548	(1989) General Criteria Used for Evaluating Laboratory Competence

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

## SD-01 Data

Placing Method and Equipment; GA.

All placing methods and equipment shall be submitted for review by the Contracting Officer for conformance with paragraph PLACEMENT.

## SD-09 Reports

Gradation Sampling and Testing; GA.

Copies of field test results within 24 hours after the tests are performed. Certified copies of test results shall be submitted for approval in

accordance to paragraph GRADATION SAMPLING AND TESTING.

#### SD-14 Samples

Stone Quality; GA.

Stone quality samples shall be submitted at least 45 days prior to start of stone placement, in accordance with paragraph STONE QUALITY.

#### SD-18 Records

Waybills and Delivery Tickets; FIO.

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used as required in paragraph WAYBILLS AND DELIVERY TICKETS.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Definitions

##### 2.1.1.1 Rounded Stone.

Stone which is obtained from alluvial deposits and is well rounded to sub-rounded.

##### 2.1.1.2 Angular Stone.

Stone which is obtained from bedrock deposits and is angular in shape.

#### 2.1.2 General

The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The Contractor shall vary the quarrying, processing, loading and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications.

#### 2.1.3 Stone Sources

##### 2.1.3.1 Stone from Project Excavation

Stone conforming to these specifications will not be available from the required excavation due to variable stone quality and insufficient quantities of suitably large stone. Therefore, the required stone will need to be obtained from offsite sources. One offsite source is Sloan Quarry located about 7 miles to the southeast of the project site.

##### 2.1.3.2 Source Authorization

Before any stone is produced from a source for completion of the work under this contract, the source of stone must be authorized by the Contracting Officer's Representative. Authorization of a stone source shall not be construed as a waiver of the right of the Government to require the

Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, zones or strata will be rejected when such materials do not comply with the specifications.

2.1.3.3 Source Development

Before a proposed source or sources of stone will be considered for sampling and testing, the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements. If sufficient amounts of stone conforming to these specifications are not available from a source or sources used in the work, the Contractor shall submit stone from another source for authorization.

2.1.3.4 Source Documentation

Authorization of a proposed stone source will be based on test results and/or service records. In general, current Corps of Engineers test results shall be required as outlined in paragraph Quality Compliance Testing, below. In special cases, however, the Contracting Officer's Representative may elect to use either past Corps of Engineers test results, test results from other agencies or private laboratories, or service records. A service record is considered to be acceptable if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to the one to be constructed under these specifications.

2.1.4 Stone Quality

2.1.4.1 Quality Compliance Testing

Samples for Corps of Engineers testing as specified in paragraph 2.1.3.4 (Source Documentation) shall be submitted a minimum of 45 days in advance of the time when the stone will be required in the work. Stone from a proposed source will be tested by the Government for quality compliance. The first test shall be at Government expense, however, if the stone fails the tests, or if the Contractor desires to utilize more than one source, additional testing will be performed by the Government at the Contractor's expense. The cost of additional testing will be deducted from payment due the Contractor in the amount of \$4500 for each sample tested. All test samples (136 kg minimum) shall be representative of the stone source and shall be obtained by the Contractor under the supervision of the Contracting Officer's Representative and delivered at the Contractor's expense to a testing laboratory approved by the Contracting Officer's Representative.

2.1.4.2 Stone Quality Testing Requirements

Stone shall be subjected to such tests as are necessary to demonstrate to the satisfaction of the Contracting Officer's Representative that the materials are acceptable for use in the work. At a minimum the stone shall meet the following test requirements.

Test	Test Method	Requirement
Specific Gravity (Bulk SSD)	ASTM C 127	2.60 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting and Drying	SPD Test Procedure(1)	No fracturing(3)
Sulfate Soundness	ASTM C 88(2)	10% max. loss(4)

Test	Test Method	Requirement
Abrasion Loss	ASTM C 535	50% max. loss(4)

In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C 295 (5). The stone must not contain any expansive clays. Stone for grouted stone protection shall not contain excessive amounts of deleterious minerals associated with alkali-silica or alkali-carbonate reactions as described in ASTM C 33.

NOTE: (1): Test procedure for wetting and drying test. The entire sample is carefully examined and representative test specimens are selected. The sample should be large enough to produce two cut slabs, 25 mm thick (+/-6 mm) with a minimum surface area of 0.019 square meters on one side. Two chunks approximately seventy-six by one-hundred and two millimeters are also chosen. The slabs and chunks are carefully examined under a low-power microscope and all visible surface features are noted and recorded. The specimens are then oven dried at 60 degrees C., for eight hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 60 degrees C. After each cycle the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all particles broken off during the test are oven dried, weighed and photographed.

NOTE: (2): The test shall be made on 50 particles each weighing 100 grams, +/-25 grams, in lieu of the gradation given in ASTM C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.

NOTE: (4): Stone which has a loss greater than the specified limit will be accepted if the Contractor demonstrates that the stone has a satisfactory service record.

NOTE: (5): The test procedure for Petrographic and X-ray Diffraction is performed according to ASTM C 295, except for the following:

- a. A color, microscopic photograph shall be made of each stone type and the individual minerals within the stone shall be identified by labels and arrows upon the photograph.
- b. A very detailed macroscopic and microscopic description shall be made of the stone, to include the entire mineral constituents, individual sizes, their approximate percentages and mineralogical

histories. A description of stone hardness, texture, weathering, and durability factors shall also be discussed.

c. A written summary of the suitability of stone for use as riprap based on the Petrographic and X-ray tests and the results of ASTM C 535 shall be presented in the final laboratory report on stone quality.

#### 2.1.4.3 Stone Acceptance Criteria

Prior to placement, all stone shall be subject to acceptance by the Contracting Officer's Representative. Acceptance of any stone shall not constitute acceptance of all stone from a source. All accepted stone shall be:

- a. of the same lithology as the original stone from which test results or service records were taken as a basis for authorization of the source;
- b. sound, durable and hard, and free from laminations, weak cleavages, undesirable weathering, or blasting or handling-induced fractures (or fracture zones which subtend more than 1/3 of the total circumference of the stone along the plane of fracturing);
- c. of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing; and,
- d. clean and free from earth, clay, refuse, or adherent coatings.

In addition, to be accepted, the greatest dimension of any stone piece shall not be greater than 3 times its least dimension.

##### 2.1.4.3.1 Stone for Riprap

Stone for riprap protection of the embankment slopes shall be angular quarried material.

#### 2.2 Stone for Spillway Toe Stone

Stone for spillway toe stone immediately downstream of the spillway stilling apron shall be angular quarried material.

#### 2.3 Stone for Grouted Riprap

Stone for grouted riprap in the collector channel upstream of the bypass inlet structure shall be angular quarried material. Grouting shall be conform to specifications SECTION 02650 GROUTING STONE PROTECTION.

#### 2.4 Gradation

##### 2.4.1 General

All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading due to segregation or degradation during

placement shall be rejected. If test results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor. For the size-weight relationships used during gradation tests, within-specification weights will be determined based on a stone specific gravity of 2.58 and stone sizes (diameters) that result for stone shapes midway between that of a sphere and a cube.

2.4.1.1 Stone Riprap

Riprap for embankment slope protection and for grouted riprap of collector channel structures shall be reasonably well-graded within the limits specified below, when tested in accordance with ASTM D 5519, Test Method A.

2.4.1.2 Stone Riprap

Stone Riprap for embankment slope protection and spillway toe stone shall be reasonably well-graded within the limits specified below, when tested in accordance with ASTM D 5519, Test Method A.

0.460 Stone Riprap, upstream slope of dam embankment and for grouted stone

Approximate Average Diameter (mm)	Percent Smaller
460-340	100
300-270	50
240-180	15

0.300 Stone Riprap, downstream slope of dam embankment

Approximate Average Diameter (mm)	Percent Smaller
300-220	100
200-180	50
160-120	15

Spillway Toe Stone

Approximate Average Diameter (mm)	Percent Smaller
300-220	100
200-180	50
160-120	15

2.4.1.3 Grouted Riprap

Stone for grouted riprap shall be reasonably well-graded between 150 and

380 millimeters with not less than 25 nor more than 50 percent passing 230 millimeters in size, when tested in accordance with ASTM D 5519, Test Method A.

#### 2.4.2 Gradation Sampling and Testing

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Tests shall be performed by an approved testing laboratory on samples selected by the Contracting Officer's Representative. Testing may be done by the Contractor, subject to approval by the Contracting Officer's Representative. If the Contractor elects to establish testing facilities, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted, until the Contractor's facilities have been inspected and approved by the Contracting Officer's Representative. Testing shall be supervised by a registered Civil Engineer, experienced in rock-testing. The Government reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. One gradation test each shall be required for the 460 mm riprap and the 300 mm riprap/toe stone at the beginning of production prior to delivery of stone from the source to the project site. A minimum of one additional test each for the 460 mm riprap and the 300 mm riprap/toe stone shall be required for each 4535 metric tons of stone placed, respectively. All sampling and gradation tests performed by the Contractor shall be under the supervision of the Contracting Officer's Representative. Each sample shall consist of not less than 4.5 metric tons of stone, selected at random from the production run for the first test or from stone placed on grade or stockpiled on-site for required additional tests.

#### 2.5 Rejected Stone

Stone of unsuitable quality and/or size distribution as required by these specifications shall be rejected. Any rejected stone shall be promptly removed from the project at no expense to the Government. Any portions of the work covered by these specifications containing rejected stone will be considered incomplete.

### PART 3 EXECUTION

#### 3.1 FOUNDATION PREPARATION

##### 3.1.1 General

Subgrade preparation for material placement shall conform to the provisions of SECTION 02250 FILLS AND SUBGRADE PREPARATION. Areas on which stone is to be placed shall be trimmed and dressed to conform to cross sections indicated or directed, within an allowable tolerance of plus or minus 25.4 mm from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth similar to the adjacent material and well compacted, or by filling with approved material, and no additional payment will be made for any material thus required. Immediately prior to placing the stone, the prepared base shall be inspected by the Contracting Officer's Representative and no material shall be placed thereon until that area has been approved.

##### 3.2 PLACEMENT

### 3.2.1 General

Except as otherwise specified, the limits of stone in place shall follow, with reasonable variation, the indicated lines and slopes, without continuous under- or overbuilding. Templates shall be placed at adequate intervals, as determined by the Contracting Officer's Representative, to accurately delineate the surface of the work being placed. For all stonework, the Contractor shall submit the placing method to the Contracting Officer's Representative for approval, before placement begins.

### 3.2.2 Stone Riprap

Stone Riprap shall be placed in a manner to produce a reasonably well-graded mass with the minimum practicable percentage of voids, and shall be constructed to the lines and grades indicated or directed. Stone shall be placed to its full course thickness in one operation and in a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 460 mm. The placing method shall be submitted to Contracting Officer's Representative for approval prior to commencement of placement operations. The Contractor shall maintain the stone protection until accepted and any material displaced by any cause shall be replaced at the Contractor's expense to the lines and grades shown on the drawings. Self propelled equipment shall not be used on the slopes.

Hand placing, barring, or placing by crane will be required only to the extent necessary to secure the results specified. Placing stone by dumping into chutes or by similar methods likely to cause segregation will not be permitted. A tolerance of minus 25 mm to plus 50 mm from the indicated slope lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 20 square meters.

### 3.2.3 Spillway Toe Stone

Spillway Toe stone shall be placed in a reasonably well-graded mass to the lines indicated or directed. Material shall not be dropped from a height of more than 460 mm. Barring of stone will be required only to the extent necessary to secure the results specified above. Hand placing will not be required. A tolerance of minus 25 mm to plus 51 mm from the indicated lines and grades will be allowed in the finished surface, except either extreme such tolerance shall not be continuous over an area greater than 18.6 square meters.

## 3.3 DEMONSTRATION SECTIONS

### 3.3.1 General

Prior to placement of stonework, the Contractor shall construct sections of embankment protection, spillway toe stone and channel protection consisting of riprap, toe stone and grouted riprap, respectively, to demonstrate the proposed operations for production placement. The sections shall demonstrate procedure and capability of grading and placing riprap, grouted riprap, and toe stone within the tolerances specified. Unless the approved construction method precludes it, the demonstration section for riprap shall extend for the full height of the embankment. The demonstration section for riprap and toe stone shall be 30 meters in length and shall conform to all applicable specifications. The demonstration section for grouted riprap shall be 10 meters in length. Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of riprap, grouted riprap, and toe stone and shall conform to the requirements

specified herein. The quantities of all materials placed within the sections shall be accurately tabulated and provided immediately to the Contracting Officer's Representative for comparison with the computed quantities.

### 3.3.2 Demonstration Sections Evaluation

The Contractor shall not proceed placing stonework prior to the approval of the demonstration sections. Within a period of 7 days after completion of the sections, the Contracting Officer's Representative shall determine the adequacy of the sections to function as part of the permanent construction.

The Contractor shall be notified as to the acceptability of the sections and may be directed to modify methods of construction, and remove the sections if necessary.

### 3.3.3 Removal of Demonstration Sections

If removal of the demonstration sections is required, it shall be conducted in such a manner as to maintain the integrity of the underlying subgrade. The Contractor shall make arrangements for removal and disposal, at the Contractor's expense, in areas not located on the site.

## 3.4 DELIVERY

All stone delivered by rail or truck shall be weighed and the scale tickets certified by authorized weighers. All railroad cars and trucks used for delivering stone shall be plainly numbered.

### 3.4.1 Scales

Scales used for measurement shall, at the option of the Contractor, be either public scales or approved scales provided by the Contractor. Weighing shall be at the point nearest the work at which the public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling the material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau charged with scales inspection within the state in which the project is located. Scales shall be calibrated and resealed as often as the Contracting Officer's Representative considers necessary to insure continuous accuracy. The necessary number of standard weights for testing the scales shall be on hand at all times and, if an official inspection bureau of the state is not available, the scales will be tested by the Contracting Officer's Representative.

### 3.4.2 Waybills and Delivery Tickets

Copies of waybills or delivery tickets shall be submitted to the Contracting Officer's Representative during the progress of the work. The Contractor shall furnish the Contracting Officer's Representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, date, time, and location of the loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicle loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer's Representative the master log of loadings, certified waybills and/or certified tickets within 24 hours of material delivery. Prior to the final payment, the Contractor shall furnish written

certification that the material recorded on the submitted waybills and/or certified tickets was actually used in the construction covered by the contract.

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## SECTION 02650

## GROUTING STONE PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 143	(1990a) Slump of Portland Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 172	(1990a) Sampling freshly Mixed Concrete
ASTM C 309	(1994) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

## SD-09 Reports

Grout Mix Design; GA.

Fifteen days prior to placement of concrete, the contractor shall submit to the Contracting Officer the detailed mixture proportions for the specified grout.

## SD-13 Certificates

Portland Cement; GA.

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause, CERTIFICATE OF COMPLIANCE. Cement will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material meets the requirements of the specifications under which it is furnished.

Curing Compound; GA.

Certificates of compliance attesting that the curing compound meets the requirements of the specifications shall be submitted in accordance with the Special Clause, CERTIFICATE OF COMPLIANCE. The curing compound will be accepted on the basis of a manufacturer's certificate of compliance.

### 1.3 PROTECTION OF COMPLETED WORK

After completion of any panel, no workman or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun; shall be protected from rain, flowing water, and mechanical injury and shall be moist cured or membrane cured at the Contractor's option.

### 1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.4.1 Aggregates

Aggregates shall be delivered to the site of the grout batching and mixing plant and stockpiled in such manner as to preclude intermingling of different materials or the inclusion of foreign materials in the stockpiles or batching operations. Sufficient aggregates shall be maintained at the site at all times to permit continuous placement and completion of any lift or section of grout started.

#### 1.4.2 Portland Cement

Cement shall be supplied in bulk. Carriers and systems for distribution of the cement will be accomplished in adequately designed weather-tight trucks, conveyors, or other means that will protect the material from exposure to moisture. All storage facilities shall permit easy access for inspection and identification. Sufficient materials shall be in storage to complete any lift or placement of grout started.

### 1.5 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the placing operation and grout production plant for checking the adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and installation of the grout and application of curing materials.

### 1.6 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all cement and grout actually used in the construction.

## PART 2 PRODUCTS

### 2.1 GROUT

#### 2.1.1 Aggregates

Fine aggregates shall conform to the requirements specified for fine aggregate in SECTION 03301 CAST-IN-PLACE STRUCTURAL CONCRETE and coarse aggregate shall meet the grading requirements of ASTM C 33, size No. 8.

#### 2.1.2 Portland Cement

Portland cement shall conform to the requirements of ASTM C 150, Type II, low alkali.

#### 2.1.3 Water

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali.

#### 2.1.4 Curing Compound

Membrane curing compound shall conform to ASTM C 309, Type 2.

### 2.2 PROPORTIONING OF MIXTURE

Grout shall be composed of cement, sand, and water mixed in the proportions as directed. The estimated cement content requirement per cubic meter of grout shall be 10 sacks. The water content of the mix shall not exceed 32 liters per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included.

## PART 3 EXECUTION

### 3.1 CONDITIONING OF UNDERLYING MATERIALS

Prior to grouting, the stone shall be thoroughly washed with water to wash down the fines and to prevent absorption of water from the grout. The stone shall be kept wet just ahead for the actual placing of grout. Existing stone protection to be grouted shall be cleaned of all soil, vegetation, and debris to a minimum depth of 300 millimeters prior to washing.

### 3.2 PREPARATION OF GROUT

Slump of grout mix shall be between 225 and 250 millimeters for the first course and between 175 and 200 millimeters for the second course or where one course is placed. The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming. Grout batches in the same course shall be uniform in mix, size, and consistency.

### 3.3 PLACING

#### 3.3.1 Mixing Time

The grout shall be mixed in a concrete mixer in the manner specified for concrete, except that time of mixing shall be as long as is required to produce a satisfactory mixture, and the grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted.

#### 3.3.2 Weather Limitations

##### 3.3.2.1 Hot Weather Placing

The temperature of the grout when deposited in the proper location shall not exceed 29 degrees C except as directed by the Contracting Officer.

##### 3.3.2.2 Cold Weather Placing

No grout shall be prepared except when the air temperature is at least 4 degrees C. in the shade and rising. Materials entering the mixer shall be free from ice, snow, and frozen lumps. A non-chloride based accelerating

admixture, conforming to the requirements of ASTM C 494, may be used when approved in advance, by the Contracting Officer.

### 3.3.3 Deposition of Grout

The grout shall be placed in one course on the invert and two courses on side slopes. Each course shall be placed fully, extending from toe to top of side slopes. In conditions where the stone is not placed on the slope in a continuous operation due to slope length; the grout shall be placed in two operations. The first operation shall begin at the toe and continue to approximately two feet above the dumped stone section. The second operation shall continue from the end of the first to the top of the side slope. Grout placing at each operation shall be a continuous process. The grout shall be brought to the place of final deposit by approved means and discharged directly on the stone. The use of a concrete shoot in placing grout will not be allowed. A splash plate of metal or wood shall be used where necessary to prevent displacement of stone directly under discharge. The flow of grout shall be directed with brooms or other approved baffles to cover the entire area and to assure that all crevices are filled. Sufficient barring shall be done to loosen tight pockets of stone and otherwise aid the penetration of grout. The first course shall fully penetrate the stone blanket. The second course shall be placed as soon as the first course has sufficiently stiffened so that it will not flow when additional grout is added. On side slopes, all brooming shall be uphill.

## 3.4 FINISHING

Placement and brooming of the grouted surface shall be such that the outer layer of rock projects  $1/3$  to  $1/4$  their diameter above the grouted surface except on the access ramps where grout is to be finished flush with the tops of the stones to create a smooth surface suitable for vehicular traffic. After the top course has stiffened the entire surface shall be re-broomed to eliminate runs in the top course and to fill voids caused by sloughing of the layers of grout.

## 3.5 CURING AND PROTECTION

Curing of the grouted surface shall be accomplished by one of the following methods.

### 3.5.1 Moist Curing

Moist curing shall consist of covering the grout with a uniform thickness of at least 150 millimeter of sand which shall be kept continuously saturated for a period of 14 days.

### 3.5.2 Curing Compound

Curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate not to exceed 5 square meter per liter for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angle to the direction of the first application.

## 3.6 CONTRACTOR QUALITY CONTROL

### 3.6.1 General

The individuals who sample and test grout as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

### 3.6.2 Inspection Details and Frequency of Testing

#### 3.6.2.1 Preparations for Placing

Stone, foundation, forms, and embedded items shall be inspected in sufficient time prior to each grout placement by the Contractor to certify to the Contracting Officer that is ready to receive grout.

#### 3.6.2.2 Slump

Slump shall be checked twice during each shift that grout is produced. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143.

#### 3.6.2.3 Consolidation and Protection

The Contractor shall ensure that the grout is properly installed, finished, protected, and cured.

### 3.6.3 Action Required

#### 3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that there is an adequate number of men with appropriate bars and other such tools are available for the necessary barring and adjustment of stone as required above.

#### 3.6.3.2 Slump

Whenever a test is outside the specification limits, the results of the test shall be reported to the Contracting Officer and another test shall be immediately taken. If the results of the subsequent test indicates that the slump is not being met, the placement will cease and the contractor will readjust the mix design to achieve the proper slump. The adjusted mix will continue to meet the requirements specified above.

### 3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the Contracting Officer within 3 days after the end of each weekly reporting period. See Section 01440: CONTRACTOR QUALITY CONTROL.

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## SECTION 02710

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## SECTION 02710

## SUBDRAINAGE SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 2751	(1993) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1994) Type PSM (Polyvinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4833	(1988) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Pipe Laying Plan; GA.

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample of subdrain pipe, both non-perforated and perforated, shall be a piece not less than 0.3 m in length.

SD-14 Samples

Filter Fabric; FIO.

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample of filter fabric shall be a piece not less than 0.15 m X 0.15 m.

Subdrain Pipe; FIO.

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample of subdrain pipe, both non-perforated and perforated, shall be a piece not less than 0.3 m in length.

PART 2 PRODUCTS

2.1 DRAIN MATERIAL

Drain material shall be durable, hard, tough, and free from adherent coatings. The material shall not contain corrosive agents, organic matter, or soft, friable, thin or elongated particles in quantities considered deleterious by the Contracting Officer. Drain material shall consist of gravel, crushed stone, or processed crushed concrete, and shall show a loss in weight of not more than 50 percent when tested in accordance with ASTM C 131, and shall be reasonably well graded within the following limits:

Sieve Size (millimeters)	Percent by Weight Passing
63 mm	100
50 mm	95-100
37.5 mm	35-70
25 mm	0-15
12.5 mm	0-5

2.2 FILTER MATERIAL

Filter material shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands, and shall be reasonably well graded within the following limits:

Sieve Size (millimeters)	Percent by Weight Passing
9.5 mm	100
4.75 mm	85-95
1.18 mm	35-45
0.15 mm	0-20
0.075 mm	0-15

2.3 SUBDRAIN PIPE

Subdrain pipe may be polyvinyl chloride (PVC) or acrylonitrile-butadiene-styrene (ABS), except that only one type shall be used for the entire project.

2.3.1 Non-Perforated Pipe

2.3.1.1 Non-Perforated Acrylonitrile-Butadiene-Styrene (ABS) Pipe

Non-perforated acrylonitrile-butadiene-styrene (ABS) pipe shall conform to ASTM D 2751, with a maximum SDR of 35.

#### 2.3.1.2 Non-Perforated PolyVinyl Chloride (PVC) Pipe and Fittings

Non-perforated polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Type PSM with a maximum SDR of 35, with flexible elastomeric joints.

#### 2.3.2 Perforated Pipe

Perforations for pipe 0.15 meters in diameter shall have a combined area of at least 600 square millimeters per linear meter of pipe and shall be located within an arc of 120 degrees along the top of the pipe. Perforations may be either holes or slots with at least one perforation located in each linear 0.3 meters of pipe excluding joint areas. The diameter of holes shall be not less than 4.75 millimeters nor more than 6.35 millimeters. The slots shall be not less than 4.75 millimeters nor more than 6.35 millimeters wide and not more than 0.1 meters long. Perforations shall be made by the pipe fabricator using methods which will eliminate spalling insofar as practicable. Pipes having spalls extending more than 12.5 millimeters outside the perforations or more than 1/2 the wall thickness into the perforation shall be rejected.

##### 2.3.2.1 Perforated Acrylonitrile-Butadiene-Styrene (ABS) Pipe

Perforated acrylonitrile-butadiene-styrene (ABS) pipe shall conform to ASTM D 2751, with a maximum SDR of 35, perforations shall be as specified hereinbefore.

##### 2.3.2.2 Perforated PolyVinyl Chloride (PVC) Pipe and Fittings

Perforated polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Type PSM with a maximum SDR of 35, with flexible elastomeric seal joints, perforations shall be as specified hereinbefore.

#### 2.4 PIPE FITTINGS

Pipe fittings shall be acrylonitrile-butadiene-styrene or polyvinyl chloride and shall be suitable for use with the pipe furnished. Fittings shall be furnished with such adapters as are recommended by the manufacturers of the pipe.

#### 2.5 PIPE PLUGS

Pipe plugs shall be suitable for use with the pipe furnished and shall be installed as recommended by the manufacturer's of the pipe.

#### 2.6 FILTER FABRIC

Filter fabric shall be a nonwoven needle punch pervious sheet of plastic yarn. The filter fabric shall provide an apparent opening size no finer than the No. 100 sieve and no coarser than the No. 50 sieve. The filter fabric shall have a minimum tensile strength of 45 kilograms in any principal direction when tested in accordance with ASTM D 4632 grab test method using 25.4 millimeter square jaws and a 0.3 meter per minute constant rate of traverse. The filter fabric shall have a 15 percent minimum breaking elongation in any principal direction when tested in

accordance with ASTM D 4632. The filter fabric shall have a 22.5 kilogram minimum puncture strength when tested in accordance with ASTM D 4833. The filter fabric shall have no seams.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Drain Material

Drain material shall be placed, moistened, and spread to a uniform grade to the lines and grades indicated. Placing and spreading equipment shall be operated in such manner as to not disturb the underlying material. Water shall be added and the material manipulated with spreading equipment until a uniform density is achieved. After installation of the drain material, equipment shall not be operated over the blanket except for placement of the roller compacted concrete or downstream embankment, whichever applies. Any drain material contaminated or rutted by equipment shall be removed and replaced with fresh drain material. At pipe drains, drain material shall be placed to pipe bed elevation. Any pipe displaced or damaged during placement of the drain material shall be replaced and realigned by the Contractor at no additional cost to the Government.

##### 3.1.2 Filter Material

Filter material shall be placed, moistened, and spread to a uniform grade to the lines and grades indicated. Placing and spreading equipment shall be operated in such manner as to not disturb the underlying material. Water shall be added and the material manipulated with spreading equipment until a uniform density is achieved. After installation of the filter material, equipment shall not be operated over the blanket except for placement of the drain material. Any filter material contaminated or rutted by equipment shall be removed and replaced with fresh filter material.

##### 3.1.3 Pipe Laying

Installation of drainage pipe at drainage material and Roller Compacted Concrete (RCC) shall be in lines and graded shown on drawings. Drainage pipes shall be protected during placing and compacting operations of the RCC material by placing concrete surrounding the pipe as shown on the drawings. Each pipe shall be carefully inspected immediately before it is laid, and any damaged or defective pipe shall not be used. The perforated pipe shall be wrapped in filter fabric. The filter fabric shall be secured and have a minimum overlap of 0.15 meters. The pipe shall be placed in the bedding surface that is accurately shaped to conform to the lower 1/4 of the outside portion of the pipe. Perforated pipe shall be laid with the perforated side uppermost. Pipe shall be laid to the grades and alignment indicated or as directed. The laying shall proceed upgrade from the lower end of the pipe line. Pipe grade shall be maintained within 30 millimeters in 3 meters of that indicated. The Contractor shall submit his pipe laying plan (including the filter fabric wrap) to the Contracting Officer for approval.

##### 3.1.3.1 Joints

The joints between sections of perforated pipe shall be of a type that will hold the pipe securely in alignment and maintain the inner surfaces of abutting pipes flush and even. Solvent cement or elastomeric joints for

Acrylonitrile-Butadiene-Styrene pipe shall be in accordance with ASTM D 2751. Dimensions and tolerances shall be in accordance with ASTM D 2751. Joints for PolyVinyl Chloride pipe shall be in accordance with ASTM D 3212.

### 3.2 TESTS

#### 3.2.1 Drain Material and Filter Material

##### 3.2.1.1 Points

Points on the individual grading curves obtained from representative samples of the drain material and filter material not only shall lie between the boundary limits as defined by smooth curves drawn through the tabulated grading limits plotted on a mechanical-analysis diagram but also shall exhibit no abrupt changes in slope denoting skip grading, scalping of certain sizes, or other irregularities which would be detrimental to the proper functioning of the drain and filter.

##### 3.2.1.2 Sampling and Testing

Sampling and testing of the drain material shall be performed by the Contractor to determine compliance of the installed materials with specified requirements in conformance with ASTM C 131, ASTM C 136, and ASTM D 75. Sampling and testing of the filter material shall be performed by the Contractor to determine compliance of the installed materials with specified requirements in conformance with ASTM C 136. Sampling and testing shall be performed at regular intervals with at least three tests being made for both the drain and filter materials. The location of after placement tests shall be as directed.

##### 3.2.1.3 Smoothness Test

The finished surface of both the drain material and filter material layers shall not vary more than 12.5 millimeters from the established grade and in addition every area shall show no deviation greater than 12.5 millimeters when tested with a 3 meter straightedge.

### 3.3 PROTECTION

The Contractor shall take all necessary precautions to avoid damage to the completed subdrainage system and drainage pipes from the movement of equipment during placing and compacting operations of the RCC material. Protection shall consist of 1.00 meter wide and 0.60 meters high concrete surrounding the drainage pipe and neatly finished at the finish grade of RCC protection. Drain material surrounding the drainage pipes shall be compacted with mechanical tampers during placement and compaction operations.

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#### 1.4 WEATHER LIMITATIONS

##### 1.4.1 Asphaltic Concrete Pavement

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 5 degrees C.

##### 1.4.2 Bituminous Coat

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 10 degrees C or above and when the temperature has not been below 2 degrees C for the 12 hours prior to application.

#### 1.5 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 60 degrees C.

#### PART 2 PRODUCTS (NOT APPLICABLE)

#### PART 3 EXECUTION

##### 3.1 BASE COURSE CONDITIONING

The surface of the base course will be inspected for adequate compaction and surface tolerance specified in Section 02241 AGGREGATE BASE COURSE. Unsatisfactory areas shall be corrected.

##### 3.2 SURFACE PREPARATION OF UNDERLYING COURSE

Surface preparation shall be in accordance with Section 02250, FILLS AND SUBGRADE PREPARATION.

##### 3.3 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

##### 3.4 BITUMINOUS COATING

Surfaces of previously constructed base course shall be sprayed with a coat of bituminous material conforming to Federal or State Highway Specifications.

##### 3.4.1 Preparation of Surface

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

After the cleaning operation, and prior to application of the tack coat, an inspection of the area to be treated will be made by the Contracting Officer to determine fitness of the area to receive the bituminous coating.

### 3.5 COMPACTION

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of grade and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Grade and smoothness will be checked in each section of completed pavement by the Contracting Officer for compliance. After the Contractor is assured of meeting grade and smoothness requirements, rolling shall be continued until all roller marks are eliminated and at least 97 percent of the density of a laboratory-compacted specimen of the same mixture has been obtained. Density shall be determined by nuclear gauge. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

### 3.6 JOINTS

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 80 degrees C) shall be made to ensure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces or edges of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back to expose an even vertical surface for full thickness of the course or as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to paragraph BITUMINOUS COATING. Material shall be applied far enough in advance of placement of a fresh mixture to ensure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

### 3.7 SMOOTHNESS AND GRADE REQUIREMENTS

The surface course, upon completion of final rolling, shall be smooth, free of roller marks, and true to grade and cross section as shown. When tested with a 3-meter straightedge, the surface shall not vary more than 6 millimeters in a longitudinal and transverse direction. No tolerances will be allowed which will pond water. Defective areas are surface deviations in excess of 6 millimeters in 3 meters between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

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## SECTION 02831

## CHAIN LINK FENCE

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 121	(1992a) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153M	(1995) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1992) Aluminum-Coated Steel Barbed Wire
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM F 626	(1996) Fence Fittings
ASTM F 883	(1990) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM G 23	(1996) Operating Light-Exposure Apparatus

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; GA.

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

## PART 2 PRODUCTS

### 2.1 FENCE FABRIC

Fence fabric shall conform to the following:

#### 2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 610 grams ounces of zinc per square meter foot of coated surface. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh or Type I, aluminum-coated fabric. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

### 2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F1083 for Group IA, steel pipe, with external coating Type A, size shall be as shown on the drawings. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, size shall be as shown on the drawings. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

### 2.3 POSTS

#### 2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B shall meet the strength and coating requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

### 2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size shall be as shown on the drawings. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043.

## 2.5 WIRE

### 2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

## 2.6 ACCESSORIES

ASTM F 626, ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153M unless modified.

## 2.7 CONCRETE

ASTM C 94, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## 2.8 PADLOCKS

ASTM F 883, Type PO1, Grade 2, Size 44 mm. Padlocks shall be keyed alike and each lock shall be furnished with two keys.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3 m. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

### 3.2 POST INSTALLATION

#### 3.2.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from

the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25 mm than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts.

### 3.3 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m. A center brace or 2 diagonal truss rods shall be installed on 3.66 m fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

### 3.4 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 102 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.5 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 610 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the ground.

### 3.6 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

### 3.7 GROUNDING

Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 15 m of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 198 m. Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 45 m on each side of crossing. Ground conductor

shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 19 mm by 3.05 m long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 152 mm below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 305 mm deep and radially from the fence. The top of the electrode shall be not less than 0.6 m or more than 2.4 m from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

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## SECTION 02832

## TEMPORARY TORTOISE FENCING

## PART 1 GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 702	(1989; R1994) Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 740	(1986) Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric)
ASTM A 824	(1995) Metallic- coated Steel Marcellled Tension Wire for Use with Chain Link Fence
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM F 626	(1996) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

## 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

## SD-01 Data

Steel mesh hardware cloth, post, and accessories; GA.

Submit descriptions and product data on steel mesh hardware cloth, post, accessories, fittings, and hardware.

## SD-04 Drawings

Tortoise fencing and layout; GA.

Submit shop drawings showing details of tortoise fencing and gate layout, post foundation dimensions, bracing, hardware, and schedule of components for fence and gates.

## SD-14 Samples

Steel mesh hardware cloth; GA.

Submit two samples of steel mesh hardware cloth 150 mm x 150 mm in size.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Materials shall conform to the following requirements.

## 2.1.1 Steel Mesh Hardware Cloth

Steel mesh hardware cloth shall be 12.7 mm mesh, galvanized steel and fabricated in accordance with ASTM A 740.

## 2.1.2 Line Posts

Line Posts for temporary tortoise fence shall be T-post fabricated in accordance with ASTM A 702.

## 2.1.3 Tension Wire

Tension wire shall be 11-gauge galvanized steel wire fabricated in accordance with ASTM A 824.

## 2.2 GATES

ASTM F 900. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 50 mm. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 50 mm. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. The Steel mesh hardware cloth shall be attached to the gate frame as shown on the drawings. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for operation of the gate.

## 2.3 ACCESSORIES

ASTM F 626, ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. TENSION rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

## 2.4 CONCRETE

ASTM C 94, using 19-mm maximum-size aggregate, and having minimum compressive strength of 14 MPa at 28 days. Grout shall consist of one part

portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

### PART 3 EXECUTION

#### 3.1 GENERAL

The temporary tortoise Fencing shall be installed after the Biologist survey of the construction site in accordance with Section 01130 ENVIRONMENTAL PROTECTION and prior to initial clearing, grubbing, trash removal, grading or other construction activities in accordance with Section 02150 CLEAR SITE AND REMOVE OBSTRUCTIONS. The Contractor shall maintain the fencing in good condition during the construction period and shall remove the fencing after completion of all construction activities. Install fencing in accordance with manufacturer's instructions and details shown. Fencing shall be adequately braced to support normal usage. Temporary tortoise fencing shall be installed along the portion of the project right-of-way AND construction site as shown on the drawings or as directed by the Contracting Officer. If required, ground surface irregularities shall be graded to maintain the top and bottom of the steel mesh fabric within a 50 mm tolerance of the dimensions shown on the drawings. Tortoise proof gates shall be installed across haul roads or access roads that cross the right-of-way at the indicated areas of fencing.

Unless indicated otherwise on the drawings, all temporary tortoise fencing shall be of the same type and design. The temporary tortoise fencing shall be in place before construction and movement of heavy equipment is started and shall remain in place and maintained until all construction work is complete. Temporary tortoise fencing shall become the property of the contractor and shall be removed by the contractor upon completion of the project.

#### 3.2 POSTS

Posts shall be set plumb and in alignment. Except where solid rock is encountered, line posts shall be installed a minimum of 915 mm below existing ground level at a maximum 3.05 m center to center spacing. Gate posts shall be set in concrete to depth of 915 mm. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to a minimum depth of 915 mm unless a penetration of 457 mm in solid rock is achieved before reaching the 915 mm depth in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Line posts set in concrete shall be set in holes not less than 152 mm in diameter and gate post set in concrete shall be set in holes 305 mm in diameter.

#### 3.3 TENSION WIRES

Stretch tension wire approximately 406 mm above ground and attach securely to line post and gate post as applicable. Tension wire shall be pulled taut and shall be free of sag.

#### 3.4 STEEL MESH HARDWARE CLOTH

Installation of steel mesh hardware cloth shall be in accordance with one of the following options:

Option 1: Bottom of steel mesh hardware cloth shall be buried at least

305 mm below existing ground level.

Option 2: Bend steel mesh hardware cloth at ground level and extend bottom edge at least 457 mm towards the habitat side of fence. Cover flattened steel mesh hardware cloth with cobbles 152 mm in depth.

Steel mesh hardware cloth shall be installed on the habitat side of the post (side away from project area) with the top of the hardware cloth approximately 457 mm above the ground surface. The steel mesh hardware cloth shall be securely attached to the tension wire, with hog ties spaced at 305 mm and to the fence post with 11 gauge tie wires. The steel mesh hardware cloth shall be pulled taut to provide a smooth uniform appearance free from sag.

### 3.5 GATES

Gates shall be installed at haul road or access road crossings of the indicated temporary tortoise fencing locations. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required.

### 3.6 MAINTENANCE AND REPAIR

The Contractor shall maintain the temporary tortoise fencing in good condition during construction and shall promptly make repairs to any damaged sections that occur. The temporary tortoise fencing shall be removed after the completion of construction.

-- End of Section --