

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02100

DIVERSION AND CONTROL OF WATER

PART 1 GENERAL

1.1 REQUIREMENT

1.1.1 General

1.1.2 Requirements

1.1.3 Drainage Ditches

1.2 SUBMITTALS

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section Table of Contents --

SECTION 02100

DIVERSION AND CONTROL OF WATER

PART 1 GENERAL

1.1 REQUIREMENT

1.1.1 General

All permanent construction shall be carried on in areas free from water. Storm runoff from watersheds can be rapid and, during periods of rain, flash flooding may be expected. The project consists of improvements to a natural drainage course.

Within 10 days after receipt of Notice to Proceed, the Contractor shall submit a control of water plan showing the method that he proposes to use to protect each working area. 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.

1.1.2 Requirements

The Contractor is responsible for control of all runoff entering the construction area. The runoff will include water originating from upstream 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 as described in his Storm Water Pollution Prevention Plan (SWPPP) as required per Section 01200 GENERAL REQUIREMENTS and shall be approved by the Contracting Officer.

1.1.3 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 02300 EARTHWORK by and at the expense of the Contractor.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Control of Water Plan.

The Contractor shall submit 2 copies of the plan.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02230

CLEAR SITE AND REMOVE OBSTRUCTIONS

PART 1 GENERAL

- 1.1 DEFINITIONS
 - 1.1.1 Clearing
 - 1.1.2 Grubbing
- 1.2 SUBMITTALS (NOT APPLICABLE)
- 1.3 ENVIRONMENTAL PROTECTION
- 1.4 BURNING

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

- 3.1 REQUIREMENTS
 - 3.1.1 General
 - 3.1.2 Existing Structures and Obstructions
- 3.2 CLEARING
- 3.3 GRUBBING
- 3.4 Trash and Construction Debris
- 3.5 Environmental Assessment Requirement
- 3.6 DISPOSAL OF GRUBBED AND REMOVED MATERIAL

-- End of Section Table of Contents --

SECTION 02230

CLEAR SITE AND REMOVE OBSTRUCTIONS

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS (NOT APPLICABLE)

1.3 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION and Section 02300 EARTHWORK.

1.4 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 areas of fill and excavation, and

remove and dispose of existing structures and obstructions necessary for project construction, except for those structures which are identified to be protected in place as shown on the drawings.

3.2 CLEARING

All rubbish, waste dumps, and debris areas shall be cleared. Vegetation including grasses, shrubs and weeds shall be removed by grading the existing ground surface to a depth of 0.15 meters, except such vegetation as may be indicated or directed to be left standing. Vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.3 GRUBBING

Grubbing shall consist of removing non-salvaged roots larger than 75 mm in diameter, matted roots, and other objectionable vegetable matter in the required fill areas, foundation areas, and all excavation areas. In grubbing roots, 610 mm diameter roots shall be removed to below the depth of the required excavation or existing ground level, whichever is lower. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.4 Trash and Construction Debris

Surface trash and construction debris may be present at the project site. Surface trash and construction debris shall be removed from within the limits of the right-of-way and temporary construction easements.

3.5 Environmental Assessment Requirement

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

3.6 DISPOSAL OF GRUBBED AND REMOVED MATERIAL

Trash, construction debris, and material from grubbing, that is designated as scrap, shall become the property of the Contractor, and shall be removed from the site. Scrap and unsatisfactory soils and materials and unstable soils and materials as described in Section 02300 EARTHWORK, paragraph DISPOSITION AND DISPOSAL OF EXCAVATED MATERIALS, shall become the property of the Contractor, and shall be removed from the site. Disposal shall be in accordance with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02300

EARTHWORK

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DEGREE OF COMPACTION

PART 2 PRODUCTS

- 2.1 PRE-EMERGENT HERBICIDE PRODUCT
- 2.2 PIGMENTED DUST PALLIATIVE/SOIL STABILIZER PRODUCT

PART 3 EXECUTION

- 3.1 STRIPPING
- 3.2 EXCAVATION, GENERAL
 - 3.2.1 Excavation Plan
- 3.3 EXCAVATION, BLASTING
 - 3.3.1 General Requirements
 - 3.3.2 Blasting
 - 3.3.2.1 BLASTING AND UTILITY LINES
 - 3.3.3 Overshooting
 - 3.3.4 Pre-excavation Survey
 - 3.3.4.1 Vibration Monitoring
 - 3.3.5 Notifications
 - 3.3.6 Qualifications
 - 3.3.7 Post-Blast Data Reports
 - 3.3.8 Explosives
 - 3.3.8.1 Safety
 - 3.3.8.2 Storage
- 3.4 PRESERVATION OF PROPERTY
- 3.5 EXCAVATION FOR STRUCTURES
- 3.6 EXCAVATION CHANNEL
- 3.7 EXCAVATION OF BASINS
- 3.8 FOUNDATION PREPARATION
 - 3.8.1 Excavation of Inspection Trench
 - 3.8.2 Excavation of Dam Foundation
 - 3.8.3 EXCAVATION OF OUTLET CONDUIT
- 3.9 REMOVAL OF UNSATISFACTORY SOILS
- 3.10 DISPOSITION AND DISPOSAL OF EXCAVATED MATERIALS
 - 3.10.1 Hauled Excavated Material
 - 3.10.2 DESIGNATED DISPOSAL SITE - LOT "P"
 - 3.10.2.1 General - Lot "P"
 - 3.10.2.2 Preparation for Placing in Lot "P"

- 3.10.2.3 FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR LOT "P"
- 3.10.2.4 PLACEMENT OF EXCESS EXCAVATED MATERIAL IN LOT "P"
- 3.10.2.5 COMPACTION OF EXCESS EXCAVATED MATERIALS IN LOT "P"
DISPOSAL SITE
- 3.10.3 DESIGNATED DISPOSAL SITE - A PORTION OF LOT "A" & "B"
 - 3.10.3.1 General - A Portion Of Lot "A" & "B"
 - 3.10.3.2 Preparation for Placing in A Portion Of Lot "A" & "B"
 - 3.10.3.3 FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR A PORTION
OF LOT "A" & "B" DISPOSAL SITE
 - 3.10.3.4 PLACEMENT OF EXCESS EXCAVATED MATERIAL FOR A PORTION OF
LOT "A" & "B" DISPOSAL SITE
- 3.11 OVERCUT
 - 3.11.1 OVERCUT FOR EXISTING BLASTED REACH F-1 CHANNEL STA. 37+47.674
THROUGH STA. 41+40.000
 - 3.11.1.1 Invert
 - 3.11.1.2 Sideslopes of Excavation
 - 3.11.1.3 Backfill with Compacted Fill
- 3.12 COMPACTION EQUIPMENT
- 3.13 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS
 - 3.13.1 Control
 - 3.13.1.1 Laboratory Control
 - 3.13.1.2 Field Control
 - 3.13.2 Settling of Fills or Backfills with Water
 - 3.13.3 Fill Material
 - 3.13.4 Placement
 - 3.13.5 Moisture Content
 - 3.13.6 Compaction
- 3.14 COMPACTED FILL, CHANNEL
 - 3.14.1 Invert
 - 3.14.1.1 Preparation for Placing
 - 3.14.1.2 Compaction
 - 3.14.2 Behind Channel Walls
 - 3.14.2.1 Limitations on Equipment
 - 3.14.2.2 Construction Balance
 - 3.14.2.3 Compaction
 - 3.14.2.4 Trimming
 - 3.14.2.5 Backfill Against Plywood at Ends of Pipe and Sewer Stubs
 - 3.14.3 Compacted Fill Over Covered Channel
 - 3.14.3.1 General
 - 3.14.3.2 Material
 - 3.14.3.3 Placement
 - 3.14.3.4 Contractors Option
 - 3.14.3.5 Compaction
 - 3.14.4 Compacted Fill, Roadway
 - 3.14.4.1 Compaction
 - 3.14.4.2 Trimming
- 3.15 COMPACTED FILL, DAM EMBANKMENT
 - 3.15.1 Foundation Preparation
 - 3.15.2 PLACEMENT AND COMPACTION, DAM EMBANKMENT
 - 3.15.3 Compacted Fill For RCB Outlet Conduit
 - 3.15.3.1 Compaction
 - 3.15.3.2 SUBGRADE FOR RCB OUTLET CONDUIT
 - 3.15.3.3 LIMITATIONS ON EQUIPMENT, RCB OUTLET CONDUIT
 - 3.15.4 Settlement

- 3.15.5 Settlement Monitoring
- 3.15.6 Settlement Monument Protection Plan
- 3.15.7 Regrading of Embankment Crest
- 3.15.8 Basin
 - 3.15.8.1 Location
 - 3.15.8.2 Preparation for Placing
 - 3.15.8.3 Compaction
- 3.15.9 Filter Material
 - 3.15.9.1 Preparation for Placing
 - 3.15.9.2 Material
 - 3.15.9.3 Placement and Compaction, Filter Material
- 3.15.10 Drain Material
 - 3.15.10.1 Material
 - 3.15.10.2 Placement and Compaction, Drain Material
- 3.16 BACKFILL
 - 3.16.1 Structural Backfill
 - 3.16.1.1 Location
 - 3.16.1.2 Material
 - 3.16.1.3 Placing
 - 3.16.1.4 Compaction
- 3.17 SUBGRADE PREPARATION
 - 3.17.1 Subgrade for Channel
- 3.18 TOPSOIL
- 3.19 FINISHING
 - 3.19.1 EARTHWORK FINISHING
 - 3.19.2 PRE-EMERGENT HERBICIDE
 - 3.19.3 PIGMENTED DUST PALLIATIVE/SOIL STABILIZER

-- End of Section Table of Contents --

SECTION 02300

EARTHWORK

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE EM 385-1-1 (1996) Safety and Health Requirements Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422 (1963; R 1998) Particle-Size Analysis of Soils

ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 2216 (1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock

ASTM D 2487 (2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (1996e1) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 4914 (1994) Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.

ASTM D 5030 (1994) Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation Plan; G, RE.

The Contractor shall submit his excavation plan to the Contracting Officer in conformance with paragraph EXCAVATION PLAN

Haul Route Plan; G, RE.

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

SD-02 Shop Drawings

Shop Drawings; G, RE.

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

Explosive Storage Locations; G, RE.

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.

Pre-construction topographic survey of the disposal sites

The contractor shall submit to the Contracting Officer pre-construction surveys of the disposal site shown on the drawings.

Post-construction topographic survey of the disposal sites

The contractor shall submit to the Contracting Officer post-construction surveys of the disposal site for each of the compacted fill work and the stockpiled filled work shown on the drawings.

SD-05 Design Data

Blast Data Reports.

The Contractor shall submit Pre- and Post-Blast Reports which shall contain all of the pertinent data on the location by station, ground surface elevation in the 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 to be used and actually used per hole and per blast; the sequence and pattern of delays, and

description and purpose of special methods.

SD-06 Test Reports

Field Density Tests; G, RE.

Treating of Compacted Fill Materials; G, RE.

Copies of all laboratory and field test reports shall be submitted to the Contracting Officer on approved forms within 24 hours of the completion of the tests.

1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

PART 2 PRODUCTS

2.1 PRE-EMERGENT HERBICIDE PRODUCT

Soil surfaces requiring treatment with pre-emergent herbicide shall be treated with a mixture of SURFLAN herbicide or approved equal applied at 0.16 liters per hectare and GALLERY herbicide or approved equal applied at 0.01 liters per hectare.

2.2 PIGMENTED DUST PALLIATIVE/SOIL STABILIZER PRODUCT

The dust palliative/soil stabilizer shall be a mixture of plaster and natural 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 naturally 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 crushed dry calcium sulfate hemihydrate having a purity of not less than 88 percent. The Contractor shall add a color pigment to the dust palliative/soil stabilizer slurry at the time of application. Apply color pigment to match existing soil color at the site, at the application rate recommended by the manufacturer. Color can be matched using the "Davis Colors" chart by Soil-Tech, Las, Vegas, Nevada, or equal. 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 that has become partially air set, lumpy, or caked shall not be used. The plaster/cellulose fiber mulch shall be applied at a rate of 6.75 tonnes of plaster mixed with 2.242 tonnes of fiber per hectare.

PART 3 EXECUTION

3.1 STRIPPING

Stripping consists of removing loose (not requiring blasting or ripping) surface soils approximately 300 millimeters deep from the areas of basin

excavation and embankment, after plant salvage operations in accordance with Section 02910 NATIVE PLANT EXTRACTION, SALVAGE AND STORAGE. Stripping operations shall include clearing of grasses, weeds, and non-salvaged shrubs. Surface soils shall be stockpiled for use as topsoil in areas of revegetation treatment or as miscellaneous fill on the downstream side of the dam embankment.

3.2 EXCAVATION, GENERAL

Excavation shall consist of the removal of every type of material encountered 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 cementation, caliche, asphalt, vegetation, trash, and other debris. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slopes to which the excavation must be made to safely perform the work. Unforeseen conditions may dictate that the temporary cut slope shall be made to the actual slope to which the work can be safely performed. Measurement and payment for excavation will be made in accordance with Section 01270. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation will likely require ripping or other rock-excavation techniques, which may include blasting, and shall be performed in a manner which will not impair the subgrade. Use of heavy tractors equipped with a ripper tooth, hoe-rams, and hydraulic or pneumatic rock breaker could be necessary to excavate highly cemented soils. Rock or cemented material from required excavation to be used in compacted fills and backfills shall be crushed or otherwise reduced in size to meet gradation requirements prior to placement or stockpiling. Except as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 25 mm from indicated grade, except at areas to receive concrete where finished surfaces of subgrade shall not vary more than 12.5 mm from indicated grade. Excess excavated materials shall be hauled and stockpiled in the disposal site per the lines and grades shown on the drawings. Excess excavated materials including rocks and cemented soils shall be processed/crashed or otherwise reduced in sizes not exceeding 75 mm, prior to hauling and placing in the primary disposal site.

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.

3.2.1 Excavation Plan

Prior to commencing excavation, the Contractor shall submit his plan for excavation to the Contracting Officer for acceptance. The plan must show all proposed locations of excavation operations utilizing methods involving blasting, headache balling, hoe ramming, or other techniques as may be applicable. In addition, the plan must include the results of a pre-excavation survey, a detailed blasting plan (if applicable) performed by a certified blasting consultant, and a seismic monitoring plan. The excavation plan shall be updated and resubmitted to the Contracting Officer any time the Contractor proposes altering his methods. The Contractor's methods for excavation are solely his responsibility. Approval of the excavation plan by the Contracting Officer will in no way limit the

Contractor's liability regarding property damaged by this operations, nor will it alter the Contractor's sole responsibility for the safety of his operations. The Contractor shall be responsible for all damage caused by his excavation operations and be responsible for answering all complaints. The Contractor shall provide the Contracting Officer with 30 days advance warning of the use of excavation techniques which may lead to property damage to allow for review of the proposed techniques, to confirm general compliance with these specifications, and to allow monitoring of the excavations methods.

3.3 EXCAVATION, BLASTING

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

3.3.1 General Requirements

The drilling and blasting program and methods shall be the minimum necessary to break up the rock and/or caliche/cemented alluvium 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 or caliche/cemented alluvium and reduce airblast (sonic impacts) and ground vibrations to minimal levels. In the design of the blasting pattern, no blastholes will be permitted within 60 meters of an active tortoise or Gila Monster 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 or Gila Monsters from the surface or burrows within the 60 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 as 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 meters of concrete that has been placed less than seven days. Blasting within 30 meters of concrete older than seven days will be permitted only if approved by the Contracting Officer.

3.3.2 Blasting

Prior to drilling for each blast, unless waived by the Contracting Officer, the Contractor shall submit a Pre-Blast data report plan on an approved form, which includes the pertinent data on the location by station, ground surface elevation in the 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 the Pre-Blast plan will not relieve the Contractor of his sole 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 rock and/or caliche/cemented alluvium surfaces or damage beyond the prescribed excavation limits. When a drilling and blasting program results in damage to the excavation, or to natural or man-made features, or is injurious to wildlife and habitat, 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.

3.3.2.1 BLASTING AND UTILITY LINES

Blasting will not be permitted close to existing utility lines. Contractor shall use other rock excavation techniques, and deploy all means necessary to break-out and remove layers of highly cemented soils nearby the utility lines. Contractor shall coordinate with utility owners prior to excavation and blasting in the vicinity of utility lines.

3.3.3 Overshooting

The Contractor shall use controlled blasting techniques so as not to overshoot. All possible care shall be exercised in drilling and blasting operations to prevent formation of discontinuities and to minimize over-break and blast damage of adjacent unexcavated ground and structures. Any material outside the authorized limits 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.

3.3.4 Pre-excavation Survey

The Contractor shall perform a pre-excavation survey which shall include as a minimum; detailed examination of adjacent structures, including video taping and installation of crack monitoring tape along existing structural cracks. Also included shall be a seismic survey performed by a certified seismic survey firm to determine limiting charge weights, distances to structures, ect. for all areas where blasting is proposed and limiting ball weights, height of drop, etc., for all areas where headache balls and/or hoe ram techniques are proposed.

3.3.4.1 Vibration Monitoring

During construction, the Contractor shall hire a certified seismic survey

firm to perform a seismic monitoring program to determine the effects of any blasting, headache ball or hoe ram use, or any other specialized excavation technique. Particle velocities measured at an existing structure or 300 meters from the blasting, whichever is closest, shall not exceed statutory limits or 12.5 millimeters per second (whether the result of blasting or other excavation technique). In addition to these requirements, the Contractor shall provide suitable vibration monitoring equipment to measure and record ground motions at the 60 meter distance.

3.3.5 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. Any blasting adjacent to or crossing existing utilities shall be fully coordinated with the owner of the effected utility to include hole spacing, loading and vibration.

3.3.6 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.

3.3.7 Post-Blast Data Reports

In addition to the reporting requirements required above, a separate Post-Blast Data 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, ground surface elevation, 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 all other blast information directed by the Contracting Officer. Original or legible copies of the report shall be provided to the Contracting Officer within 24 hours of the blast event.

3.3.8 Explosives

3.3.8.1 Safety

The contractor shall fully comply with Section 29, Blasting, COE EM 385-1-1 and any Local or State Laws and Regulations applicable to the proposed Blasting Plan.

3.3.8.2 Storage

The Contractor shall submit to the Contracting Officer, for approval, drawings showing the explosive storage locations, 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. The explosives storage magazine shall be securely locked when not in use.

3.4 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.

3.5 EXCAVATION FOR STRUCTURES

Excavation within the vicinity of existing structures, utilities, roads, 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. Potential for damage resulting from severe vibration may limit the Contractor's operations or choice of equipment. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with COE EM 385-1-1.

3.6 EXCAVATION CHANNEL

Channel excavation consists of the removal of all materials within the lines and grades indicated.

3.7 EXCAVATION OF BASINS

Basin excavation consists of the removal of all materials to the lines and grades indicated. The finished surface shall be reasonably smooth, free from irregular surface changes, and shall not vary more than 100 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.

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 area shall be regular in shape,

graded smoothly and graded to drain. Side slopes shall not be steeper than one vertical to three horizontal and shall be uniform for the entire length of any one side, unless otherwise directed. Final basin excavation quantity shall be coordinated with the material required for completion of the chosen upstream embankment slope protection option.

3.8 FOUNDATION PREPARATION

3.8.1 Excavation of Inspection Trench

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

3.8.2 Excavation of Dam Foundation

Excavation dam foundation consist of removal of all materials within footprint of the dam embankment to the lines and grades shown on the drawings after stripping. 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.

3.8.3 EXCAVATION OF OUTLET CONDUIT

Excavation of outlet conduit consists of the removal of all materials to the lines and grades indicated for outlet conduit construction.

3.9 REMOVAL OF UNSATISFACTORY SOILS

The removal of soils or materials which are unsatisfactory for the foundation of the channel, or structures may be required in certain areas. Unsatisfactory soils or 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 too wet to support construction equipment. Channel and Embankment subgrade materials that cannot be brought to 95% compaction after scarification, shall be removed. The Contractor will be required to excavate any such areas to the depth directed and backfill the removal areas with compacted fill conforming to the requirements of Paragraph GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS.

3.10 DISPOSITION AND DISPOSAL OF EXCAVATED MATERIALS

Excavated materials suitable for required fills shall be placed in temporary stockpiles or used directly in the work. Satisfactory excess excavated natural ground and surface material and soils not utilized as part of the construction shall be become the property of the Contractor, and may be hauled and processed and stockpiled or compacted in the designated disposal sites or disposed off project site at the Contractor's expense.

The Contractor at his discretion may dispose of satisfactory excess excavated material originating from the construction of the F-1 Channel from Station 57+50.000 through Station 37+47.674 and satisfactory excess excavated material originating from the construction of the F-2 Channel from Station 23+80.000 through Station 12+24.774 in the designated disposal site - Lot "P", and/or the designated disposal site a portion of Lot "A" & "B", and/or to dispose the satisfactory excess excavated material off site.

The designated disposal site - Lot "P" has capacity for a maximum of 17,610 cubic meters of satisfactory excess excavated material. The designated disposal site a portion of Lot "A" & "B" has capacity for 58,730 cubic meters of satisfactory excess excavated material.

Materials and soils that the Contractor elects to be placed in the designated disposal sites shall be satisfactory excess excavated material originating from the construction of the F-1 Channel from Station 57+50.000 through Station 37+47.674 and satisfactory excess excavated material originating from the construction of the F-2 Channel from Station 23+80.000 through Station 12+24.774 and shall be free from trash, dumped debris and demolition products, and shall consist of no materials and soils suspected of having characteristics of hazardous and/or toxic waste materials characterized as unsatisfactory soil and material including trash, dumped debris and demolition products, and shall meet the requirements of paragraph DESIGNATED DISPOSAL SITE - LOT "P" or the requirements of paragraph DESIGNATED DISPOSAL SITE - A PORTION OF LOT "A" & "B" of this section. Materials and soils suspected of having characteristics of hazardous and/or toxic waste materials characterized as unsatisfactory soil including trash, dumped debris and demolition products and unstable soils shall become the property of the Contractor and shall be removed from the project site in accordance with requirements Section 01355 ENVIRONMENTAL PROTECTION and Section 01200 GENERAL REQUIREMENTS. No excavated material or waste of any kind shall be removed beyond the project limits under this contract without the express written authority of the Contracting Officer, or as allowed under the contract. Prior to placing material, the approved stockpile area(s) and designated disposal sites shall be cleared of trash and vegetation. Vegetation shall be removed by grading the existing ground surface to a depth of 150 mm. Any stockpiles shall be placed in a manner to preclude ponding of water. The designated disposal sites shall be graded and filled as per plan(s) and in accordance with paragraph DESIGNATED DISPOSAL SITE - LOT "P", or with paragraph DESIGNATED DISPOSAL SITE - A PORTION OF LOT "A" & "B", of this section. Natural ground and surface soils and materials thus excavated and removed will then be designated as either:

- i. Materials to be salvaged, or
- ii. Scrap and unsatisfactory materials and soils and unstable materials and soils to be treated as specified above and in Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS.

3.10.1 Hauled Excavated Material

The Contractor shall have a routing plan for haul within the project limits, including removal of required excavated materials and placing fill materials, that utilizes the drawings provided. The haul route plan shall be submitted to the Contracting Officer for approval. Haul routes for

transport of the excess excavated material shown on the drawing sheets are approximate. See Section 01200 GENERAL REQUIREMENTS for additional requirements and information on excavated material haul routes. 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.

3.10.2 DESIGNATED DISPOSAL SITE - LOT "P"

The Contractor at his discretion may dispose of satisfactory excess excavated material originating from the construction of the F-1 Channel from Station 57+50.000 through Station 37+47.674 and satisfactory excess excavated material originating from the construction of the F-2 Channel from Station 23+80.000 through Station 12+24.774 in the designated disposal site - Lot "P", and/or the designated disposal site a portion of Lot "A" & "B", and/or to dispose the satisfactory excess excavated material off site.

The designated disposal site - Lot "P" has capacity for a maximum of 17,610 cubic meters of satisfactory excess excavated material. The designated disposal site a portion of Lot "A" & "B" has capacity for 58,730 cubic meters of satisfactory excess excavated material.

3.10.2.1 General - Lot "P"

Excess excavated satisfactory material from the channel excavation between Sta. 57+50.000 through Sta. 37+47.674 for the F-1 Channel and Sta. 23+80.000 through Sta. 12+24.774 for the F-2 Channel shall be stockpiled, processed as necessary, graded and compacted to the grade and lines as shown on the Lot "P" disposal site drawings. The material will be processed as necessary to meet the size requirements of paragraph: FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR LOT "P". Compacted fills in the Lot "P" disposal site shall be placed and compacted in accordance with paragraph: PLACEMENT OF EXCESS EXCAVATED MATERIAL IN LOT "P" and paragraph: COMPACTION OF EXCESS EXCAVATED MATERIALS IN LOT "P" DISPOSAL SITE. The material will be processed as necessary to meet the size requirements of paragraph: FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR LOT "P". Prior to hauling excess excavated material to the Lot "P" disposal site, the Contractor shall submit a pre-construction topographic survey of the disposal site with 0.5 meter contour intervals. Upon completion of the compacted fill earthwork within the Lot "P" disposal site, the Contractor shall submit a post-construction topographic survey of the disposal site with 0.5 meter contour intervals for the compacted fill work. All surveys shall be in accordance with the requirements of Section 01200 GENERAL REQUIREMENTS, paragraph : CONTRACTOR'S SURVEYS.

3.10.2.2 Preparation for Placing in Lot "P"

The foundation for the compacted fill to be placed shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. Unsatisfactory or unstable (too wet) material and soils not meeting the requirements for fill material shall be removed where directed.

The existing surfaces for the compacted fill at the disposal site shall be scarified to a depth of 150 mm, moisture conditioned and proofrolled by

four passes of the compaction equipment.

3.10.2.3 FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR LOT "P"

Excess excavation material including rocks and cemented soils shall be hauled to the disposal site, processed as necessary by breakdown, crushing or otherwise reduced in sizes with 85% of material to be less than 150 mm (6 inches) in maximum dimension and consisting of at least 40% (by weight of the 150 mm (6 inch) minus material) of material finer than 19 mm (3/4 inch) in size, and then utilized as compacted fill in accordance with grading and compaction requirements of the drawing LOT "P" FILL AREA GRADING PLAN and paragraph: PLACEMENT OF EXCESS EXCAVATED MATERIAL IN LOT "P", and with paragraph: COMPACTION OF EXCESS EXCAVATED MATERIALS IN LOT "P" DISPOSAL SITE.

3.10.2.4 PLACEMENT OF EXCESS EXCAVATED MATERIAL IN LOT "P"

Excess excavated material placed as compacted fill in the disposal site shall be placed with suitable equipment in horizontal layers which before compaction (loose material), shall not exceed 200 mm (8 inches) in depth for rubber-tired or vibratory rollers or tamping rollers. The Contractor may vary the layer thickness within this limit for the 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.

3.10.2.5 COMPACTION OF EXCESS EXCAVATED MATERIALS IN LOT "P" DISPOSAL SITE

Each layer of compacted fill in the Lot "P" disposal site shall be compacted to not less than 95 percent of minimum density, per ASTM D 1557. The Contractor shall perform additional compaction requirements such as control and moisture content of the excess excavated materials in accordance with the applicable portions of paragraph: GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS.

3.10.3 DESIGNATED DISPOSAL SITE - A PORTION OF LOT "A" & "B"

The Contractor at his discretion may dispose of satisfactory excess excavated material originating from the construction of the F-1 Channel from Station 57+50.000 through Station 37+47.674 and satisfactory excess excavated material originating from the construction of the F-2 Channel from Station 23+80.000 through Station 12+24.774 in the designated disposal site - Lot "P", and/or the designated disposal site a portion of Lot "A" & "B", and/or to dispose the satisfactory excess excavated material off site.

The designated disposal site - Lot "P" has capacity for a maximum of 17,610 cubic meters of satisfactory excess excavated material. The designated disposal site a portion of Lot "A" & "B" has capacity for 58,730 cubic meters of satisfactory excess excavated material.

3.10.3.1 General - A Portion Of Lot "A" & "B"

Excess excavated material from the channel excavation shall be stockpiled, processed as necessary, and graded to the grade and lines as shown on the drawing A PORTION OF LOT "A" & "B" FILL AREA GRADING PLAN. The material

will be processed as necessary to meet the size requirements of paragraph: FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR A PORTION OF LOT "A" & "B" DISPOSAL SITE. Stockpiled fills in the portion of Lot "A" & "B" disposal site shall be placed and graded in accordance with paragraph: PLACEMENT OF EXCESS EXCAVATED MATERIAL FOR A PORTION OF LOT "A" & "B" DISPOSAL SITE. Prior to hauling excess excavated material to the portion of Lot "A" & "B" disposal site, the Contractor shall submit a pre-construction topographic survey of the disposal site with 0.5 meter contour intervals. Upon completion of the stockpiled fill earthwork within the portion of Lot "A" & "B" disposal site, the Contractor shall submit a post-construction topographic survey of the disposal site with 0.5 meter contour intervals for the stockpiled fill work. All surveys shall be in accordance with the requirements of Section 01200 GENERAL REQUIREMENTS, paragraph : CONTRACTOR'S SURVEYS.

3.10.3.2 Preparation for Placing in A Portion Of Lot "A" & "B"

The foundation for the stockpiled fill in the portion of Lot "A" & "B" disposal site to be placed shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. Unsatisfactory or unstable (too wet) material and soils not meeting the requirements for fill material shall be removed where directed. The existing surfaces for the compacted fill at the disposal site shall be scarified to a depth of 150 mm, moisture conditioned and proofrolled by four passes of the compaction equipment.

3.10.3.3 FILL MATERIAL FROM EXCESS EXCAVATED MATERIAL FOR A PORTION OF LOT "A" & "B" DISPOSAL SITE

Excess excavation material including rocks and cemented soils shall be hauled to the portion of Lot "A" & "B" disposal site, processed as necessary by breakdown, crushing or otherwise reduced in sizes not exceeding 610 mm and then utilized as stockpiled fill in accordance with grading requirements of the drawing A PORTION OF LOT "A" & "B" FILL AREA GRADING PLAN and paragraph: PLACEMENT OF EXCESS EXCAVATED MATERIAL FOR A PORTION OF LOT "A" & "B" DISPOSAL SITE.

3.10.3.4 PLACEMENT OF EXCESS EXCAVATED MATERIAL FOR A PORTION OF LOT "A" & "B" DISPOSAL SITE

Excess excavated material placed as stockpiled fill in the disposal site shall be placed and graded with suitable equipment to the lines and grades shown on the drawing A PORTION OF LOT "A" & "B" FILL AREA GRADING PLAN.

3.11 OVERCUT

Except as otherwise specified or specifically ordered in writing, any overcut or excavation beyond the lines and grades indicated in the plans (or as directed) shall be backfilled with compacted fill conforming to the Paragraph GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS, and to Paragraph COMPACTED FILL, CHANNEL, or concrete conforming to the Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Subgrades shall be prepared in accordance with paragraph SUBGRADE PREPARATION. 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 existing or newly constructed channels and structures shall be backfilled with concrete.

3.11.1 OVERCUT FOR EXISTING BLASTED REACH F-1 CHANNEL STA. 37+47.674 THROUGH STA. 41+40.000

3.11.1.1 Invert

For the existing blasted reach of the F-1 Channel from Station 37+47.674 through Station 41+40.000, the Contractor shall overcut by excavation the invert of the channel to a depth of 300 mm below the bottom of the reinforced concrete channel invert, or until stable material is reached if the depth of the overcut is less than the 300 mm below the bottom of the reinforced concrete channel invert.

3.11.1.2 Sideslopes of Excavation

For the existing blasted reach of the F-1 Channel from Station 37+47.674 through Station 41+40, the Contractor shall also overcut the portions of excavation sideslopes that extends below the bottom of the reinforced concrete channel invert by upto 600 mm horizontal distance from the heel of the reinforced concrete channel invert or less if stable material is encountered, with the cut then being extended vertically plumb to intersect the excavation sideslope.

3.11.1.3 Backfill with Compacted Fill

Prior to placement of the reinforced concrete channel invert between Station 37+47.674 through Station 41+40.000, the Contractor shall backfill the excavation invert and excavation sideslope to the lines and grades indicated on the plans (or as directed) with compacted fill conforming to the Paragraph GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS, and to Paragraph COMPACTED FILL, CHANNEL, or concrete conforming to the Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.12 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.

3.13 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS

3.13.1 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 test 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 field density tests report shall be provided with the Contractor Quality Control Report on the work day following the test. All data related to the treating of compacted fill materials shall be submitted to the Contracting Officer on approved forms within 24 hours of the completion of the tests.

3.13.1.1 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.

3.13.1.2 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. When material contain considerable amount of rock or coarse gravel in-place density test method ASTM D 4914 or ASTM D 5030 shall be used. 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 0.1 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

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 600 mm layer of compacted fill or backfill processed as a unit and not less than one test shall be made in each area. One test per 300 cubic meters, or fraction thereof, shall be made of each lift of fill or backfill areas compacted by hand-operated machines. The contractor CQC shall maintain a log of all tests, which will, updated and submitted to the contracting officer on a weekly

basis. The test log shall include: Test number (if retest shall include retest number), date, feature of work, station and offset, weight of wet soil, weight of dry soil, percent of compaction, optimum moisture content, maximum dry unit weight, soil classification, in-place density test methods either sand-cone or nuclear densimeter.

(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. The Contractor QOC shall maintain a log of all tests which will updated and submitted to the Contracting Officer on a weekly basis. The test log shall include: Test number (if retest shall include retest number), date, feature of work, station and offset, weight of wet soil, weight of dry soil, percent of compaction, optimum moisture content, maximum dry unit weight, soil classification, in-place density test methods either sand-cone or nuclear densimeter.

3.13.2 Settling of Fills or Backfills with Water

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

3.13.3 Fill Material

Fill material shall be obtained from the required excavation. Materials considered unsatisfactory for use as compacted fill include but are not limited to those materials containing roots and other organic matter, trash, debris, chunks or clumps of cemented material, and shall contain no stone whose greatest dimension is more than 3/4 the lift thickness. The Contractor shall expect to break-down, crush or otherwise process required excavation for use as fill material due to the cementation of in-situ soils. Materials classified in ASTM D 2487 as MH, CH, Pt, OH, and OL are also considered unsatisfactory for use as compacted fill. The fill material shall have sufficient amount of fine material to fill the voids between coarser aggregate and shall conform to the following requirements:

Sieve Size (Millimeters)	Percent by Weight Passing
150	100
75	80 - 100
4.75	70 - 35

Material for compacted fill behind concrete structures shall contain less than 30 percent by weight passing the .075 mm sieve and shall contain no stone or particle larger than 75 mm.

3.13.4 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 FOR CIVIL WORKS. Fill shall not be placed over covered channels (roof decks) until the concrete has obtained 70% of the contract required design strength. Heavy equipment shall not be operated over pipes and buried structures until at least 600 mm of fill material have been placed and compacted over them. Material from the top of the pipe or buried structure to 600 mm above pipe or buried structure shall be compacted by mechanical tampers or other equipment approved by the Contracting Officer. Compacted fill shall be placed with suitable equipment in horizontal layers which before compaction, shall not exceed 300 mm in depth for rubber-tired or vibratory rollers, 200 mm in depth for tamping rollers, and 100 mm 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.

3.13.5 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.

3.13.6 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 300 mm of channel or structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of

600 mm. 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.

3.14 COMPACTED FILL, CHANNEL

3.14.1 Invert

3.14.1.1 Preparation for Placing

The foundation for the compacted fill to be placed and compacted fill at the channel shall be cleared of all existing obstructions, vegetation and debris. Any trash or debris shall be removed in accordance with Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. Unsatisfactory or unstable (too wet) material and soils not meeting the requirements for fill material shall be removed where directed. The existing surfaces for the compacted fill at the channel site shall be scarified to a depth of 150 mm and proofrolled by four passes of the compaction equipment. The subgrade for the channel shall be prepared in accordance with paragraph SUBGRADE PREPARATION.

3.14.1.2 Compaction

Each layer of the material shall be compacted to not less than 95 percent of maximum density, per ASTM D 1557.

3.14.2 Behind Channel Walls

3.14.2.1 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 channel walls and up to 600 mm above the top of covered sections shall not exceed 16,000 kilograms, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill behind the channel walls shall be of such size as to be capable of operating in the area between the cut slope and the channel wall. Compaction equipment will not be required to operate at elevations lower than 600 mm above the top of wall footings. This equipment shall be of such size as to be capable of operating in the area between the cut slope and the channel wall at any point 600 mm above the top of the heel of wall footings.

3.14.2.2 Construction Balance

Fills behind wall on one side of the channel shall not exceed by more than 1.5 meters the high of the fill behind the opposite channel wall at any time during construction.

3.14.2.3 Compaction

Each layer of fill behind channel walls, shall be compacted to not less than 90 percent of maximum density, per ASTM D 1557. The top 300 mm of the maintenance road fill adjacent to the channel wall shall be compacted to

not less than 95 percent of maximum density per ASTM D 1557.

3.14.2.4 Trimming

The top of fill adjacent to channel walls shall be trimmed to the lines indicated on the drawings with a tolerance of plus or minus 25 mm. Any material loosened by trimming shall be recompact and the area moistened and compacted with one pass of a smooth-wheeled roller. Tolerances shall apply after rolling. Fill slopes shall be trimmed to a uniform alignment at the top of the berm and reasonably uniform slope at or outside the lines shown on the drawings.

3.14.2.5 Backfill Against Plywood at Ends of Pipe and Sewer Stubs

Plywood shall be braced or otherwise held flush against the end of the pipe during backfilling. The Contractor shall make sure the plywood is of sufficient size to adequately cover the pipe or sewer stub opening. The Contractor shall attach blocks or shims to roughly fit the inside diameter of the pipe to assure that the plywood is not displaced during backfilling.

3.14.3 Compacted Fill Over Covered Channel

3.14.3.1 General

No fill material shall be placed over the top of the covered channel until all voids at the sides of the covered channel have been filled as described below, and until all caved material has been compacted to the specified density to the top of the roof slab.

3.14.3.2 Material

Materials for filling voids shall be clean sand, free of trash, organic materials, debris, and with 100 percent passing the 4.75 mm sieve and not more than 10 percent passing the 150 mm sieve.

3.14.3.3 Placement

The first layer of fill over the concrete box section shall be 300 mm in thickness and shall be compacted with a rubber-tired or vibratory roller having a maximum weight of 9,000 kilograms. The remainder of the fill shall be deposited in 150 mm layers and compacted with rubber-tired or vibratory rollers, or other approved equipment with a maximum weight of 9,000 kilograms until the structure has a cover of at least 600 mm. The remainder of the compacted fill shall be placed as specified in paragraph COMPACTED FILL, CHANNEL of this section.

3.14.3.4 Contractors Option

If the Contractor elects to leave the inside forms and shoring in place, permission will be granted to place fill material 48 hours after concrete has been placed.

3.14.3.5 Compaction

Each layer of fill on top of the covered channel shall be compacted to not less than 95 percent of maximum density, per ASTM D 1557. Compacted Fill under streets and maintenance roads shall be compacted per paragraph COMPACTED FILL, ROADWAY.

3.14.4 Compacted Fill, Roadway

3.14.4.1 Compaction

Fill shall be compacted to not less than 95 percent of maximum density per ASTM D 1557 for the width of all traveled ways plus 1 meter on each side thereof.

3.14.4.2 Trimming

All street and maintenance road shoulders and side slopes shall be trimmed to the lines indicated on the drawings with a tolerance of plus or minus 25 millimeters. Any material loosened by trimming shall be recompacted and the area moistened and compacted with one pass of a smooth-wheeled roller.

Tolerances shall apply after rolling. Fill slopes shall be trimmed to a reasonably uniform slope at or outside the lines shown on the drawings.

3.15 COMPACTED FILL, DAM EMBANKMENT

3.15.1 Foundation Preparation

Before placing material for compacted fill, the foundation surface shall be cleared of all existing obstructions, vegetation, debris, and stripped of surface soils in accordance with paragraph STRIPPING of this Section 02300 EARTHWORK, Section 02910 NATIVE PLANT EXTRACTION, SALVAGE AND STORAGE, and Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. Within the dam embankment footprint, excluding miscellaneous fill zone, the following shall be removed: (1) the upper 1.5 meters of foundation soil within an inspection trench, 4 meters wide, along the centerline of the embankment, (2) the upper 1.5 meters of foundation soil in designated wash areas, (3) the upper 0.610 meters of foundation soil within the footprint of the dam embankment outside of the inspection trench and designated wash areas, and (4) the material shall be removed in accordance with SECTION 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS and this SECTION 02300 EARTHWORK. The inspection trench and the banks of the existing washes shall be excavated as shown on the plans and in accordance with this SECTION 02300 EARTHWORK. Depths may be reduced if hard cemented materials or bed rock is encountered subject to the approval of the Contracting Officer. Unsatisfactory materials not meeting the requirements for fill material shall be removed where directed. The existing surfaces, including the excavated inspection trench and banks and the areas beneath the outlet structure and conduit within the footprint of the dam embankment, shall be scarified to a depth of 150 millimeters 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. All rock surfaces upon which or against which embankment materials are to be placed shall be broom cleaned.

Prior to the placement of embankment material upon or against a rock

surface, all open joints and cracks greater than 13 mm in width shall be filled with mortar to the depths cleaned. Those portions of such rock surfaces where there are holes greater than 100 mm deep and smaller than 610 mm across shall be filled with mortar or concrete. Rough areas that, in the opinion of the Contracting Officer, the compaction of the embankment materials cannot be accomplished satisfactorily with power tampers or other specified compaction equipment shall be filled with mortar or concrete, as directed to the extent necessary, to merit satisfactory use of the compaction equipment. In no case shall a thin coat of mortar be left on smooth, intact rock surfaces. Large rock overhangs and protrusions shall be removed by the use of pre-splitting or line drilling techniques in such a manner as to minimize damage to the underlying rock, or the spaces beneath overhangs and around protrusions shall be filled with tamped concrete so that satisfactory compaction of embankment materials can be accomplished. Vertical surfaces shall not be more than 1.5 meters in height, and benches of sufficient width shall be provided as necessary so that the average slope of any rock face is not steeper than 1 vertical on 4 horizontal. Mortar and concrete, including forming as necessary, shall conform with the applicable provisions of Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.15.2 PLACEMENT AND COMPACTION, DAM EMBANKMENT

Each layer of the material shall be compacted to not less than 95 percent of maximum density, per ASTM D 1557. The Contractor shall construct dam embankment by placing successive horizontal lifts over the entire plane of the work surface. All fill materials shall be placed parallel to axis of dam in compacted horizontal lifts less than 300 mm thickness. Placement of adjacent fills at different heights is prohibited. Where interim slopes are allowed by the Contracting Officer, the Contractor shall grade slopes flatter than 3H:1V. The Contractor must bench and moisture condition interim slopes immediately prior to placement of each lift of new fill against interim slopes. Whenever a compacted surface of any lift has been made too smooth to bond to successive layer by concentration of hauling equipment or other reasons, the Contractor shall loosen by scarifying or other equivalent methods and moisture condition surface prior to placement of the succeeding lift. The embankment lift surfaces shall be kept moist. If a lift surface dries out and cracks, the Contractor shall moisture condition to specified range and rework the lift prior to placement of the subsequent lift. Finished surfaces shall be overbuilt and cut to final grade.

3.15.3 Compacted Fill For RCB Outlet Conduit

3.15.3.1 Compaction

Each layer of the material shall be compacted to not less than 95 percent of maximum density, per ASTM D 1557, and shall be in accordance with paragraph PLACEMENT AND COMPACTION, DAM EMBANKMENT and in accordance with paragraph LIMITATIONS ON EQUIPMENT, RCB OUTLET CONDUIT. Contractor shall utilize paragraph SUBGRADE FOR RCB OUTLET CONDUIT prior to installation of the RCB outlet conduit.

3.15.3.2 SUBGRADE FOR RCB OUTLET CONDUIT

Subgrade preparation for RCB outlet conduit shall include subgrade preparation for areas to receive concrete for RCB outlet conduit. All trash and debris shall be removed in accordance with Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. After the RCB outlet conduit alignment has been excavated to rough grade, the entire RCB outlet conduit invert shall be scarified to a depth of 0.15 meters, 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 13 mm above the indicated grade at any point when tested with a 3 meters straightedge.

3.15.3.3 LIMITATIONS ON EQUIPMENT, RCB OUTLET CONDUIT

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 along the sides of the RCB outlet conduit and up to 600 mm above the top of the RCB outlet conduit shall not exceed 16,000 kilograms, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill along the sides and above the top of the RCB outlet conduit shall be of such size as to be capable of operating in the area between the cut slope and the RCB outlet conduit. Compaction equipment will be required to operate at elevations equivalent to the elevation of the bottom of the invert of the RCB outlet conduit. This equipment shall be of such size as to be capable of operating in the area between the cut slope and the RCB outlet conduit.

3.15.4 Settlement

The Contractor shall delay RCC placement 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 10+35.000, STA 11+00.000, and STA 12+25.000 for the F-1 Debris Basin Embankment, and the Contractor shall install one surface settlement monument at STA 10+40.000 for the F-2 Debris Basin Embankment; the locations with respect to the dam centerline will be determined by the Contracting Officer.

3.15.5 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 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.

3.15.6 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.

3.15.7 Regrading of Embankment Crest

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

3.15.8 Basin

3.15.8.1 Location

Compacted fill for the basin shall consist of small amount of fill associated with the detention basin grading and access roads to be placed outside of the dam embankment footprint. This quantity shall not be measured for payment but shall be considered incidental to basin excavation.

3.15.8.2 Preparation for Placing

The foundation for the compacted fill to be placed in the basin shall be cleared of all existing obstructions, vegetation and debris. Vegetation shall be salvaged in accordance with SECTION 02910 NATIVE PLANT EXTRACTION, SALVAGE AND STORAGE. Any trash or debris shall be removed in accordance with SECTION 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS and with this SECTION 02300 EARTHWORK. Unsuitable materials or unstable (too wet) not meeting the requirements for fill material shall be removed where directed. The existing surfaces for compacted fill in the basin shall be scarified to a depth of 0.15 meters and proofrolled by four passes of the compaction equipment.

3.15.8.3 Compaction

Each layer of the material shall be compacted to not less than 90 percent of maximum density, per ASTM D 1557.

3.15.9 Filter Material

3.15.9.1 Preparation for Placing

The 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 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS and with this SECTION 02300 EXCAVATION. Unsatisfactory materials not meeting the requirements for fill material shall be removed where directed. The existing surfaces for compacted fill in the basin shall be scarified to a depth of 0.15 meters and proofrolled by four passes of the compaction equipment. The subgrade for filter material shall be prepared in

accordance with paragraph: SUBGRADE PREPARATION.

3.15.9.2 Material

Filter material shall be obtained by commercial sources or processed materials from basin excavation. Filter material gradation shall be within the limits specified in SECTION 02710 SUBDRAINAGE SYSTEMS - WEEPHOLES.

3.15.9.3 Placement and Compaction, Filter Material

Filter materials 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 8,200 kilogram 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.

3.15.10 Drain Material

3.15.10.1 Material

Drain material shall be obtained by commercial sources or processed materials from basin excavation. Drain material gradation shall be within the limits specified in SECTION 02710 SUBDRAINAGE SYSTEMS - WEEPHOLES.

3.15.10.2 Placement and Compaction, Drain Material

Drain materials shall be spread over 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 four complete passes of the 8,200 kilogram 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 conduits. The finished surface of the filter material shall not vary more than 12.5 millimeters above or below the indicated grades.

3.16 BACKFILL

3.16.1 Structural Backfill

3.16.1.1 Location

Backfill shall consist of all fill against and/or around structures, except backfill for conduits and compacted fill, channel.

3.16.1.2 Material

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 unsatisfactory material shall not be used. Backfill for structures shall not contain any stones larger than 75 mm.

3.16.1.3 Placing

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 FOR CIVIL WORKS.

3.16.1.4 Compaction

Compaction shall be not less than 95 percent of maximum density, per ASTM D 1557 unless noted or shown otherwise.

3.17 SUBGRADE PREPARATION

3.17.1 Subgrade for Channel

Subgrade preparation for channel shall include subgrade preparation for areas to receive concrete, aggregate base course and/or bituminous paving for streets, access roads, maintenance roads, turnarounds, and invert access ramps. All trash and debris shall be removed in accordance with Section 02230 CLEAR SITE AND REMOVE OBSTRUCTIONS. After the channel has been excavated to rough grade, the entire channel invert, invert access ramp, and other area indicated above shall be scarified to a depth of 0.15 meters, 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 13 mm above the indicated grade at any point when tested with a 3 meters straightedge.

3.18 TOPSOIL

Topsoil shall consist of material stripped from the surface of excavation areas stockpiled for placement on the downstream side of the embankment in designated revegetation treatment areas. Topsoil shall be placed with a minimum thickness of 200 millimeters. Topsoil shall be processed with soil amendments for Section 02930 EXTERIOR PLANTING. Compaction other than that required by the controlled movement of the construction equipment will not be required.

3.19 FINISHING

3.19.1 EARTHWORK FINISHING

Prior to the application of the pre-emergent herbicide and dust palliative/soil stabilizer, all exposed earthen slopes and surfaces shall be finished to the grades shown on the drawings or as directed by the

Engineer, including the removal of all existing vegetation and the filling and smoothing of erosional features and surface irregularities. The exposed finished surfaces shall then be scarified to a depth of 150 mm, compacted, and groomed to produce a smooth surface with all particles greater than 75 mm in diameter removed.

3.19.2 PRE-EMERGENT HERBICIDE

All exposed and disturbed surface areas in the project area not covered by concrete or asphalt and prepared as described in paragraph EARTHWORK FINISHING shall be treated with a pre-emergent herbicide with the concentrations stated in paragraph PRE-EMERGENT HERBICIDE PRODUCT to discourage the growth of weeds and other vegetation. The pre-emergent herbicide shall be watered in per the manufacturer's recommendations and is to be applied prior to application of the pigmented dust palliative/soil stabilizer in paragraph PIGMENTED DUST PALLIATIVE/SOIL STABILIZER.

3.19.3 PIGMENTED DUST PALLIATIVE/SOIL STABILIZER

All exposed excavation and fill surfaces and disturbed surface areas in the project area not covered by concrete or asphalt and treated as per paragraph PRE-EMERGENT HERBICIDE shall be treated with a pigmented dust palliative/soil stabilizer for soil stabilization and dust control with the concentrations stated in paragraph PIGMENTED DUST PALLIATIVE/SOIL STABILIZER PRODUCT after construction is completed. The pigmented dust palliative/soil stabilizer shall be watered in per the manufacturer's recommendations.

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 FOR CIVIL WORKS.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEGREE OF COMPACTION
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Satisfactory Materials
 - 2.1.2 Unsatisfactory Materials
 - 2.1.3 Unstable Material
 - 2.1.4 Select Granular Material
 - 2.1.5 Initial Backfill Material

PART 3 EXECUTION

- 3.1 EXCAVATION
 - 3.1.1 Trench Excavation Requirements
 - 3.1.1.1 Bottom Preparation
 - 3.1.1.2 Removal of Unyielding Material
 - 3.1.1.3 Removal of Unstable Material
 - 3.1.1.4 Excavation for Appurtenances
 - 3.1.2 Stockpiles
- 3.2 BACKFILLING AND COMPACTION
 - 3.2.1 Trench Backfill
 - 3.2.1.1 Replacement of Unyielding Material
 - 3.2.1.2 Replacement of Unstable Material
 - 3.2.1.3 Bedding and Initial Backfill
 - 3.2.1.4 Final Backfill
 - 3.2.2 Backfill for Appurtenances
- 3.3 TESTING
 - 3.3.1 Testing Facilities
 - 3.3.2 Testing of Backfill Materials
 - 3.3.3 Field Density Tests

-- End of Section Table of Contents --

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES 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 D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests; G, RE.

Testing of Backfill Materials; G, RE.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as CL, GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SC, SM, SW, SP.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75 mm,. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.4 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum allowable aggregate size shall be 25 mm, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.5 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 25 mm, or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the

depth of the excavation, but in no instance closer than 600 mm. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.5 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm plus pipe outside diameter (O.D.) for pipes of less than 600 mm inside diameter and shall not exceed 900 mm plus pipe outside diameter for sizes larger than 600 mm inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 25 mm or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 100 mm below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without

additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete is to be placed.

3.1.2 Stockpiles

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density.

3.2.1 Trench Backfill

Trenches shall be backfilled to existing grade.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.2.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted to 95 percent maximum density. Water flooding or jetting methods of compaction will not be permitted.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.3.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.3.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.3.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 50 meters of installation shall be performed. One moisture density relationship shall be determined for every 1,500 cubic meters of material used. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2922. When ASTM D 2922 is used, the

calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02317

UTILITY SYSTEMS - GENERAL

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 UTILITY SYSTEM SLEEVES AND DUCT BANKS
 - 1.2.1 Sleeves sized 150 mm (6 Inches) or Larger
 - 1.2.2 Duct Banks
 - 1.2.3 Excavation, Trenching, and Backfilling
- 1.3 SUBMITTALS
- 1.4 HANDLING

PART 2 PRODUCTS

- 2.1 PIPE
 - 2.1.1 Pipe, Steel
 - 2.1.1.1 Pipe, Steel, Fittings
 - 2.1.2 Pipe, PVC
 - 2.1.2.1 Pipe, PVC, Fittings
- 2.2 DUCT BANK MATERIALS
 - 2.2.1 Duct Bank Pipe/Tube Material
 - 2.2.2 Duct Bank Encasement Material

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Excavation, Trenching for Pipe Sleeves and Duct Banks
 - 3.1.1.1 Excavation, Trenching for Pipe Sleeves
 - 3.1.1.2 Excavation, Trenching for Duct Banks
 - 3.1.2 Cutting of Pipe Sleeve Material
 - 3.1.3 Joints
 - 3.1.3.1 Joints for Steel Pipe Sleeves
 - 3.1.3.2 Joints for PVC Pipe/Tube
 - 3.1.4 Placing and Laying Pipe Sleeves
 - 3.1.4.1 Piping Sleeve Connections
 - 3.1.5 Placing Duct Banks
 - 3.1.5.1 Duct Bank Pipes/Tubes
 - 3.1.5.2 Duct Bank Encasement Material
- 3.2 Backfilling of Pipe Sleeves and Duct Banks
- 3.3 CLEANUP
- 3.4 Satisfactory Installation

-- End of Section Table of Contents --

SECTION 02317

UTILITY SYSTEMS - GENERAL

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.11 (1996) Forged Steel Fittings, Socket Welded and Threaded

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 865 (1997) Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints

ASTM D 1785 (1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D 2466 (1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D 2855 (1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105 (1993) Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA C600 (1999) Instalation of Ductile-Iron Water Mains and Their Appurtenances

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 3 (1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing

NEMA TC 9 (1990) Fittings for ABX and PVC Plastic

Utilities Duct for Underground Installation

1.2 UTILITY SYSTEM SLEEVES AND DUCT BANKS

This section covers utility system sleeves and duct banks crossing under flood control channels. All work shall conform to the specifications and drawings (including VTN drawings) provided herein. All work shall also conform to the Las Vegas Valley Water District Standard Plates, Drawings, Specifications and the "Uniform Design and Construction Standards for Water Distribution Systems," UDACS, latest edition, and to Nevada Power Company and Southwest Gas standards as applicable. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Sleeves sized 150 mm (6 Inches) or Larger

Sleeves shall be of the materials and dimensions as shown on the drawings.

1.2.2 Duct Banks

Piping and components of duct bank systems shall be of the materials and dimensions as shown on the drawings.

1.2.3 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Satisfactory Installation.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.4 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. 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 shall conform to the respective specifications and other requirements specified below.

2.1.1 Pipe, Steel

Pipe, steel, for future utilities shall be steel pipe conforming to ASTM A 53/A 53M, Class B, and to the dimensions and diameters shown on the drawings. Unless specified otherwise, the minimum thickness shall be 6 mm.

When installed underground, steel pipe shall be encased with 0.15 mm thick polyethylene in accordance with AWWA C105.

2.1.1.1 Pipe, Steel, Fittings

Pipe, steel, fittings, shall conform to ASTM A 865 or ANSI B16.11 as necessary.

2.1.2 Pipe, PVC

Pipe, PVC, for future utilities shall conform to ASTM D 1785, and to the dimensions and diameters shown on the drawings. Unless specified otherwise, schedule 80 shall be utilized.

2.1.2.1 Pipe, PVC, Fittings

Pipe, PVC, fittings, shall conform to ASTM D 2466.

2.2 DUCT BANK MATERIALS

Duct bank materials shall conform to the respective specifications and other requirements specified below.

2.2.1 Duct Bank Pipe/Tube Material

Duct bank pipe/tube material and fittings shall be of PVC and shall conform to ASTM D 1785 for pipe/tubes and ASTM D 2466, or to NEMA TC 3 or to NEMA TC 9 as required for fittings, and to the dimensions shown on the drawings.

Unless specified otherwise, schedule 40 shall be utilized.

2.2.2 Duct Bank Encasement Material

Duct bank encasement material shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Nominal maximum-size coarse aggregate for the concrete used to encase the duct bank shall be 13 mm.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Excavation, Trenching for Pipe Sleeves and Duct Banks

3.1.1.1 Excavation, Trenching for Pipe Sleeves

Excavation, trenching for pipe sleeves shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.1.1.2 Excavation, Trenching for Duct Banks

Excavation, trenching for duct banks shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except that subgrade of duct bank will be undisturbed material, and bedding is not required.

3.1.2 Cutting of Pipe Sleeve Material

Cutting of pipe sleeve material shall be done in a neat and workmanlike manner without damage to the pipe sleeve. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable.

3.1.3 Joints

3.1.3.1 Joints for Steel Pipe Sleeves

The maximum allowable deflection for the steel pipe sleeve joints shall be as given in AWWA C600 as it is anticipated that ductile-iron water mains will be installed in some of these pipe sleeves. Deflection in excess of the above limitations will not be allowed, nor will allowance be provided for special bends or angular deflections.

3.1.3.2 Joints for PVC Pipe/Tube

Joints for PVC Pipe/Tube Sleeves and/or Ducts shall be in accordance with ASTM D 2855.

3.1.4 Placing and Laying Pipe Sleeves

Pipe sleeve and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Steel or PVC pipe sleeve materials shall not be dropped or dumped into the trench. Abrasion of the pipe sleeve coating when present shall be avoided. Except where necessary in making connections with other lines or as

authorized by the Contracting Officer, pipe sleeves with bells shall be laid with the bells facing in the direction of laying. The full length of each section of pipe sleeve shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe sleeves that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe sleeves 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 and ends plugged as necessary. When work is not in progress, open ends of pipe sleeve, and fittings shall be securely closed so that no trench water, earth, or other substance will enter the pipe sleeves or fittings. 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. Pipe sleeve ends left for future connections and/or work shall be plugged, or capped, and anchored, as shown.

3.1.4.1 Piping Sleeve Connections

The connections shall be made by using specials and fittings to suit the actual conditions.

3.1.5 Placing Duct Banks

3.1.5.1 Duct Bank Pipes/Tubes

Duct bank pipes/tubes shall be aligned per drawings. Steel rods and clamps shall be used to anchor and support the duct bank pipe/tube runs as necessary to prevent misalignment during duct bank encasement material placement.

3.1.5.2 Duct Bank Encasement Material

Duct bank encasement material shall be placed between solid ground and the duct banks pipe/tube and shall encase the duct banks pipe/tube as shown on the drawings. Unless otherwise indicated or directed, the duct bank encasement material shall be poured directly against undisturbed earth. The sides of duct bank encasement material may be poured against forms. Blocking shall be placed and used so that the duct bank encasement material does not restrict access for work related to the duct banks. The duct bank encasement material will require a red imbedded pigment as per Nevada Power Company and Sprint Company specifications.

3.2 Backfilling of Pipe Sleeves and Duct Banks

Backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

3.3 CLEANUP

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

3.4 Satisfactory Installation

The contractor shall submit a Satisfactory Installation statement signed by the principal officer of the contracting firm stating that the installation of the pipe sleeves is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02531

SANITARY SEWERS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 PIPE
 - 2.1.1 Plastic Pipe
 - 2.1.1.1 PVC Pipe
- 2.2 REQUIREMENTS FOR FITTINGS
 - 2.2.1 Fittings for PVC Pipe
- 2.3 JOINTS
 - 2.3.1 Plastic Pipe Jointing
- 2.4 BRANCH CONNECTIONS
- 2.5 FRAMES AND COVERS
- 2.6 CEMENT MORTAR
 - 2.6.1 Portland Cement
 - 2.6.2 Portland Cement Concrete
 - 2.6.3 Concrete Aggregate for Cement Mortar
- 2.7 STRUCTURES
 - 2.7.1 Precast Reinforced Concrete Manhole Sections

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Adjacent Facilities
 - 3.1.1.1 Water Lines
 - 3.1.2 Pipe Laying
 - 3.1.2.1 Trenches
 - 3.1.2.2 Backfill
 - 3.1.2.3 Width of Trench
 - 3.1.2.4 Jointing
 - 3.1.2.5 Handling and Storage
 - 3.1.3 Leakage Tests
 - 3.1.4 Test for Deflection
- 3.2 CONCRETE CRADLE AND ENCASEMENT
- 3.3 INSTALLATION OF WYE BRANCHES
- 3.4 MANHOLE DETAILS
 - 3.4.1 General Requirements
 - 3.4.2 Jointing, Plastering and Sealing
 - 3.4.3 Setting of Frames and Covers

- 3.4.4 External Preformed Rubber Joint Seals
- 3.5 CONNECTING TO EXISTING MANHOLES
- 3.6 CLEANOUTS AND OTHER APPURTENANCES

-- End of Section Table of Contents --

SECTION 02531

SANITARY SEWERS

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	(1999a) Concrete Aggregates
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 270	(1999b) Mortar for Unit Masonry
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F 402 (1993; R 1999) Safe Handling of Solvent
Cements, Primers, and Cleaners Used for
Joining Thermoplastic Pipe and Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49 (1994) Hazardous Chemicals Data

NFPA 325-1 (1994) Fire Hazard Properties of Flammable
Liquids, Gases, and Volatile Solids

NFPA 704 (1996) Identification of the Fire Hazards
of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6 (1990) Recommended Practice for the
Low-Pressure Air Testing of Installed
Sewer Pipe

1.2 GENERAL REQUIREMENTS

All construction and materials shall be in accordance with the latest edition of the Design and Construction Standards for Wastewater Collection Systems and the Uniform Standard Specifications for Public Works Construction Off-Site Improvements, Clark County Area, Nevada. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-06 Test Reports

Test Report.

The Contractor shall submit copies of all test reports for Leakage and Deflection tests within 24 hours after completion of tests.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 380 mm (15 inch) or less in diameter. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to $735/D$ for cohesionless material pipe trench backfills.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.

2.3.1 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg. Reinforced

concrete frames and covers shall be as indicated or shall conform to ASTM C 478 and/or ASTM C 478M. The words "Clark County Sanitation District" shall be stamped or cast into covers so that it is plainly visible.

2.6 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.6.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type V for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement.

2.6.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.6.3 Concrete Aggregate for Cement Mortar

Concrete aggregates may be furnished from any source capable of meeting the quality requirements of ASTM C 33. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size shall be as listed in Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, paragraph NOMINAL MAXIMUM-SIZE COARSE AGGREGATE.

2.7 STRUCTURES

2.7.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478 and/or ASTM C 478M, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 3 m to a water-supply main or service line, except that where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, the

horizontal spacing may be a minimum of 2 m. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 3 m on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 1 m to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 100 mm.

3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
- c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
- d. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.5 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Leakage test reports shall be submitted for each test documenting the test results within 24 hours after the completion of the test. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 610 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 610 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 50 mL per 5 mm diameter per 100 m of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. A deflection test report shall be submitted documenting the test within 24 hours after the completion of the test. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as

applicable, of 92.5 percent of the inside diameter of the pipe. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4.0 degrees C (39.2 degrees F), and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 6 mm (1/4 inch) minimum diameter steel shaft having a yield strength of 480 MPa (70,000 psi) or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run.

When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the

inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 100 mm per meter nor more than 200 mm per meter.

3.4.2 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.3 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 50 mm higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.4 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 50 mm adjusting rings. The bottom section shall be 305 mm in height. A 152 mm high top section will cover up to two, 50 mm adjusting rings. A 305 mm high bottom section will cover up to six, 50 mm adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 50 mm and shall be overlapped by the top section by 50 mm.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02630

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - 1.3.1 Delivery and Storage
 - 1.3.2 Handling

PART 2 PRODUCTS

- 2.1 PIPE FOR CULVERTS AND STORM DRAINS
 - 2.1.1 Reinforced Concrete Pipe Laterals
- 2.2 HYDROSTATIC TEST ON WATERTIGHT JOINTS
 - 2.2.1 Concrete

PART 3 EXECUTION

- 3.1 EXCAVATION FOR PIPE AND DRAINAGE STRUCTURES
 - 3.1.1 Trenching
 - 3.1.2 Removal of Rock
 - 3.1.3 Removal of Unstable Material
- 3.2 BEDDING
- 3.3 BACKFILLING
 - 3.3.1 Backfilling Pipe in Trenches
 - 3.3.2 Backfilling Pipe in Fill Sections
- 3.4 PLACING PIPE - REINFORCED CONCRETE PIPE
- 3.5 TESTING REQUIREMENTS (BACKFILLING)
- 3.6 MOVEMENT OF CONSTRUCTION MACHINERY

-- End of Section Table of Contents --

SECTION 02630

STORM-DRAINAGE SYSTEM

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 198 (1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76 (2000) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 76M (2000) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)

ASTM C 443 (1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

ASTM C 655 (1995a) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-07 Certificates

Pipe for Culverts and Storm Drains; G, RE.

Hydrostatic Test on Watertight Joints; G, RE.

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

SD-08 Manufacturer's Instructions

Placing Pipe; G, RE.

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

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Reinforced Concrete Pipe Laterals

ASTM C 76, ASTM C 76M, Class III, or ASTM C 655 with D-Load of 1,350 pounds per linear foot of pipe diameter to produce a 0.01 inch crack.

2.2 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.2.1 Concrete

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than required to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 150 mm.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

Bedding for all RCP pipe shall be a Type II aggregate base, meeting the requirements of Section 02722 AGGREGATE BASE COURSE. The bedding gradation shall be in accordance with Section 02722. The bedding surface for the pipe shall be placed with a thickness of 150 mm below the pipe and extend up to the springline of the pipe.

The bedding shall be brought up evenly on both sides of pipe for the full length of pipe. The bedding shall be thoroughly compacted with mechanical tampers or rammers.

3.3 BACKFILLING

3.3.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, backfill shall be placed, including selected granular material, or initial backfill material in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.3.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 610 mm above

the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 610 mm above the top of the pipe, the remainder of the compacted fill shall be placed and thoroughly compacted in layers not exceeding 300 mm.

3.4 PLACING PIPE - REINFORCED CONCRETE PIPE

Each pipe section shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversions of drainage or dewatering of trenches during construction shall be provided as necessary.

The Contractor shall determine his source of supply of sand for use in mortar a sufficient time in advance of pipe laying operations to permit sampling and testing before use, and no mortar shall be used until the sand has been approved by the Engineer. Pipe sections shall be checked for alignment and grade at the time of joining the sections. If an adjustment in alignment or grade is necessary after making the joint, additional mortar shall be firmly pressed into the joint.

The interior of the pipe shall be kept free of dirt, excess mortar, and other foreign material as the pipe laying progresses, and left clean at the completion of the work. Any pipe which is not in true alignment or which shows any undue settlement after laying, or is damaged, shall be taken up and relaid at the Contractor's expense. The first section of pipe to be laid shall be firmly placed to the designated line and grade with the groove upstream. Laying shall proceed upgrade with tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Abutting ends of the sections of pipe to be jointed shall then be cleared and wetted, after which joining mortar shall be firmly placed into the lower half of the groove end of the previously laid section. Joining mortar shall be firmly placed on the top half of the tongue end of the section to be jointed which shall then be inserted truly and snugly into the groove end of the section previously laid so as to completely fill the joint. The interior joint shall then be either brushed or pointed and all surplus mortar removed from the pipe. The external space between the ends of the jointed pipe shall be firmly filled from the outside with laying mortar. When pipe with self-centering joints and without an inside pointing recess is furnished, the inside shoulder of the groove end of section shall first be lightly plastered or buttered with joining mortar after which the pipe ends shall be firmly fitted together in such a way that the tongue end of each section fits snugly into the groove end of the preceding section in order to center the joint and form a true flow line. The inside joints shall be troweled or brushed smooth and excess mortar removed from the pipe. The outside joint recesses shall then be filled with mortar, after which backfilling shall be performed as specified. When pipe is furnished with self-centering joints with both inside and outside pointing recesses, the pipe shall be firmly fitted together in such a way that the tongue end of each section fits snugly into the groove end of each preceding section in order to center the joint and to form a true flow line, after which the

inside joint recess shall be firmly filled with pointing mortar and then troweled or brushed smooth and excess mortar removed from the pipe, after which backfilling shall be performed as specified. Backfill of the pipe trench may be completed while the joint mortar is still plastic. Should the joint mortar become set before the backfill is placed, backfilling of the trench shall be commenced within sixteen (16) hours of joining the pipe sections. When the pipe is not backfilled while the mortar is plastic, the mortar shall be cured in accordance with the water, curing compound, form, or waterproof membrane method. Free water shall not be allowed to come in contact with the pipeline until the mortar in the joints has set at least twenty-four (24) hours.

Storm drain stubouts shall be capped and location identified with a marker post as shown on the plans.

3.5 TESTING REQUIREMENTS (BACKFILLING)

All testing requirements shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.6 MOVEMENT OF CONSTRUCTION MACHINERY

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02710

SUBDRAINAGE SYSTEMS - WEEPHOLE SYSTEMS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS

PART 2 PRODUCTS

- 2.1 DRAIN MATERIAL
- 2.2 FILTER FABRIC

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Drain Material
 - 3.1.2 Filter Fabric
- 3.2 TESTS
 - 3.2.1 Drain Material
 - 3.2.1.1 Points
 - 3.2.1.2 Sampling and Testing

-- End of Section Table of Contents --

SECTION 02710

SUBDRAINAGE SYSTEMS - WEEPHOLE 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	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 4632	(1991; R 1997) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, "SUBMITTAL PROCEDURES":

SD-04 Samples

Filter Fabric.

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.

Drain material sampling.

Filter material sampling.

Samples of Drain and Filter Material.

SD-06 Test Reports

Drain material testing.

Filter material testing.

The Contractor shall submit copies of all test reports for drain material and filter material tests within 24 hours after completion of tests.

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
25	100
19	90 - 100
9.5	20 - 55
4.75	0 - 10
0.15	0 - 4
0.075	0 - 2

2.2 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 700 newtons 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 250 newtons 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 as shown on the drawings.

3.1.2 Filter Fabric

Filter fabric shall be installed per manufacturer's recommendations. The Contractor shall use all means necessary to protect the fabric before, during and after installation. Many fabrics are subject to degradation from ultra-violet rays. Materials which, in the judgment of the Contracting Officer, are not being handled in accordance with the manufacturer's recommendation shall be rejected. Rejected materials shall be removed from the job site. Filter fabric shall be applied on a prepared surface as shown on the plans. End and longitudinal joint overlapping widths shall be a minimum of 610 millimeters.

3.2 TESTS

3.2.1 Drain Material

3.2.1.1 Points

Points on the individual grading curves obtained from representative samples of the drain 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

Drain material sampling and drain material testing 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. Filter material sampling and filter material testing 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 the drain materials. The location of after placement tests shall be as directed.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02722

AGGREGATE BASE COURSE

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Aggregate Base Course
 - 1.2.2 Degree of Compaction
- 1.3 SUBMITTALS
- 1.4 SAMPLING AND TESTING
 - 1.4.1 Sampling
 - 1.4.2 Tests
 - 1.4.2.1 Sieve Analysis
 - 1.4.2.2 Liquid Limit and Plasticity Index
 - 1.4.2.3 Moisture-Density Determinations
 - 1.4.2.4 Field Density Tests
 - 1.4.2.5 Wear Test
 - 1.4.2.6 Fractured Faces
 - 1.4.3 Testing Frequency
 - 1.4.3.1 Initial Tests
 - 1.4.3.2 In Place Tests
 - 1.4.4 Approval of Material
- 1.5 WEATHER LIMITATIONS
- 1.6 PLANT, EQUIPMENT, AND TOOLS

PART 2 PRODUCTS

- 2.1 AGGREGATES
 - 2.1.1 Coarse Aggregate
 - 2.1.2 Fine Aggregate
 - 2.1.3 Gradation Requirements
 - 2.1.4 Liquid Limit and Plasticity Index

PART 3 EXECUTION

- 3.1 GENERAL REQUIREMENTS
- 3.2 OPERATION OF AGGREGATE SOURCES
- 3.3 STOCKPILING MATERIAL
- 3.4 PREPARATION OF UNDERLYING COURSE
- 3.5 INSTALLATION
 - 3.5.1 Mixing the Materials
 - 3.5.2 Placing
 - 3.5.3 Grade Control
 - 3.5.4 Edges of Base Course
 - 3.5.5 Compaction

- 3.5.6 Thickness
- 3.5.7 Finishing
- 3.5.8 Smoothness
- 3.6 TRAFFIC
- 3.7 MAINTENANCE
- 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

-- End of Section Table of Contents --

SECTION 02722

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 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993e1) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing
Purposes

STATE OF NEVADA DEPARTMENT OF TRANSPORTATION (NDOT) MATERIALS
TESTING DIVISION

NDOT T230C (Rev C) Method of Test For Determining the
Percent of Fractured Faces

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools.

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

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

SD-06 Test Reports

Sampling and testing; G, RE.

Field Density Tests; G, RE.

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.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used.

1.4.2.5 Wear Test

Wear tests shall be made on ABC coarse material in conformance with ASTM C 131.

1.4.2.6 Fractured Faces

The percentage fractured faces will be determined in accordance with NDOT T230C.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Abrasion Loss (ASTM C 131).
- e. Fractured Faces.

1.4.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 500 square meters, or portion thereof, of completed area.
- b. Sieve Analysis shall be performed for every 1000 metric tons, or portion thereof, of material placed.
- c. Liquid limit and plasticity index, abrasion loss and fractured faces tests shall be performed at the same frequency as the sieve analysis.

1.4.4 Approval of Material

The source of the material shall be selected 15 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 2 degrees C. When the temperature falls below 2 degrees C, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or

other weather conditions shall be corrected to meet specified requirements.

1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of stone, crushed stone, gravel, crushed gravel, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that portion passing the 4.75 mm sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Only one type of coarse aggregate shall be used on the project. Coarse aggregate shall not show more than 45 percent loss when subjected to the Los Angeles abrasion test 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; an elongated particle is one having a ratio of length to width greater than 3.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 25 mm and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
50.0 mm	100	----	----
37.5 mm	70-100	100	----

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
25.0 mm	45-80	60-100	100
12.5 mm	30-60	30-65	40-70
4.75 mm	20-50	20-50	20-50
2.00 mm	15-40	15-40	15-40
0.425 mm	5-25	5-25	5-25
0.075 mm	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 35 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC 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

Aggregate sources shall be cleared, stripped and excavated to working depths producing excavation faces that are as nearly vertical as practicable for the materials being excavated. Strata of unsuitable materials overlying or occurring in the deposit shall be wasted. Methods of operating aggregate sources, and the processing and blending of the

materials, shall be changed or modified if necessary to obtain material conforming to the specified requirements. Upon completion of the work, aggregate sources shall be conditioned to drain readily and be left in a satisfactory condition.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately. Waybills and Delivery tickets are required for each load.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC.

Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 150 mm is required, the material shall be placed in layers of equal thickness. No layer shall

exceed 150 mm or less than 75 mm when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

Approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the 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 600 mm width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. 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. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No

individual layer shall exceed 150 mm nor be less than 75 mm compacted thickness. The total compacted thickness of the ABC course shall be within 13 mm of the thickness indicated. Where the measured thickness is more than 13 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 13 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 6 mm of the thickness indicated. The total thickness of the ABC 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.

3.5.7 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 13 mm or more below grade, then the top layer should be scarified to a depth of at least 75 mm and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.8 Smoothness

The surface of the top layer shall show no deviations in excess of 10 mm when tested with a 3.05 meter straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 20 meter intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Completed portions of the ABC course may be opened to limited 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 ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to

the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02741

HOT-MIX ASPHALT (HMA) FOR ROADS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DESCRIPTION OF WORK
- 1.3 SUBMITTALS
- 1.4 ASPHALT MIXING PLANT
- 1.5 HAULING EQUIPMENT
- 1.6 ASPHALT PAVERS
- 1.7 ROLLERS
- 1.8 STRAIGHTEDGE
- 1.9 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS
 - 1.9.1 Plan Grade
 - 1.9.2 Surface Smoothness
- 1.10 GRADE CONTROL
- 1.11 WEATHER LIMITATIONS

PART 2 PRODUCTS

- 2.1 AGGREGATES
 - 2.1.1 Coarse Aggregate
 - 2.1.2 Fine Aggregate
 - 2.1.3 Mineral Filler
 - 2.1.4 Aggregate Gradation
- 2.2 ASPHALT CEMENT BINDER
- 2.3 MIX DESIGN
 - 2.3.1 JMF Requirements
 - 2.3.2 Adjustments to Field JMF

PART 3 EXECUTION

- 3.1 PREPARATION OF ASPHALT BINDER MATERIAL
- 3.2 PREPARATION OF MINERAL AGGREGATE
- 3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE
- 3.4 PREPARATION OF THE UNDERLYING SURFACE
- 3.5 TESTING LABORATORY
- 3.6 TRANSPORTING AND PLACING
 - 3.6.1 Transporting
 - 3.6.2 Placing
- 3.7 COMPACTION OF MIXTURE
- 3.8 JOINTS
 - 3.8.1 Transverse Joints
 - 3.8.2 Longitudinal Joints
- 3.9 CONTRACTOR QUALITY CONTROL

- 3.9.1 General Quality Control Requirements
- 3.9.2 Testing Laboratory
- 3.9.3 Quality Control Testing
 - 3.9.3.1 Asphalt Content
 - 3.9.3.2 Aggregate Gradation
 - 3.9.3.3 Aggregate Moisture
 - 3.9.3.4 Temperatures
 - 3.9.3.5 Moisture Content of Mixture
 - 3.9.3.6 Laboratory Air Voids, Marshall Stability and Flow
 - 3.9.3.7 In-Place Density
 - 3.9.3.8 Thickness
 - 3.9.3.9 Grade Conformance and Surface Smoothness
 - 3.9.3.10 Additional Testing
 - 3.9.3.11 QC Monitoring
- 3.9.4 Action Required
 - 3.9.4.1 Asphalt Content
 - 3.9.4.2 Aggregate Gradation
 - 3.9.4.3 Aggregate Moisture Content
 - 3.9.4.4 Temperature
 - 3.9.4.5 Asphalt Properties
 - 3.9.4.6 Density
 - 3.9.4.7 Thickness
- 3.9.5 Sampling
- 3.9.6 Reports

-- End of Section Table of Contents --

SECTION 02741

HOT-MIX ASPHALT (HMA) FOR ROADS

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 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(1999a) Portland Cement
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM D 140	(2000) Sampling Bituminous Materials
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985; R 1994) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2489	(2000) Degree of Particle Coating of Bituminous-Aggregate Mixtures

ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3381	(1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3666	(2000) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4867/D 4867M	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(1998) Asphalt Content of Hot Mix Asphalt by Ignition Method
ASPHALT INSTITUTE (AI)	
AI MS-2	(1997) Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types
STATE OF NEVADA DEPARTMENT OF TRANSPORTATION (NDOT) MATERIALS TESTING DIVISION	
NDOT T230C	(Rev C) Method of Test For Determining the Percent of Fractured Faces

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G, RE.

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved.

SD-03 Product Data

Waybills and Delivery Tickets.

Waybills and delivery tickets submitted during progress of the work.

SD-04 Samples

Asphalt Cement Binder.

Samples of the asphalt cement binder specified shall be submitted for approval not less than 14 days before start of the test section.

SD-05 Design Data

Bituminous Pavement Mix Design; G, RE.

Copy of Mix Design selected. Report to be submitted and signed by a Civil Engineer Licensed to Practice in the State of Nevada.

Job Mix Formula; G, RE.

Properties of Bituminous Pavement Mixture; G, RE.

The job mix formula and properties of bituminous pavement mixture shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of paving operations.

SD-06 Test Reports

Asphalt Content.

Aggregate Gradation.

Aggregate Moisture.

Temperatures.

Moisture Content of Mixture.

Laboratory Air Voids, Marshall Stability and Flow.

In-place Density.

Thickness.

Grade Conformance and Surface Smoothness.

Copies of test results. Reports to be submitted and signed by a Civil

Engineer Licensed to Practice in the State of Nevada.

Asphalt Cement Binder.

Copies of test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer.

Aggregates; G, RE.

All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

QC Monitoring; G, RE.

QC test results.

SD-07 Certificates

Testing Laboratory; G, RE.

Certification of compliance.

Plant Scale Calibration Certification.

Certificate of the testing laboratory, certification of compliance, and plant scale calibration certification.

1.4 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory. The plant scale shall have a valid plant scale calibration certification.

b. Testing Facilities. The Contractor shall provide all necessary laboratory facilities for the Contractor's quality control testing and use of the Government for acceptance testing, as necessary.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

- (1) The asphalt mixture may be stored in non-insulated storage bins for

a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.5 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.6 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.7 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.8 STRAIGHTEDGE

The Contractor shall furnish and maintain at the site, in good condition, one 3.66 m straightedge for each bituminous paver. 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 insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.9 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses shall conform to gradeline and elevations shown and to surface smoothness requirements specified.

1.9.1 Plan Grade

The grade of the completed surface shall not deviate more than 15.2 mm from the plan grade.

1.9.2 Surface Smoothness

When a 3.66 m straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 6.4 mm from the straightedge.

1.10 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

1.11 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, mm	Degrees C
75 or greater	4
Less than 75	7

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of stone, crushed stone, gravel, crushed gravel, screenings, natural sand and mineral filler, as required. The portion of material retained on the 4.75 mm sieve is coarse aggregate. The portion of material passing the 4.75 mm sieve and retained on the 0.075 mm sieve is fine aggregate. The portion passing the 0.075 mm sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free

from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

a. The percentage of loss shall not be greater than 45 percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The portion of the material larger than the 10 mm screen shall contain at least 75 percent particles having fractured faces when tested in accordance with NDOT T230C.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. Fine aggregate shall have a plasticity index of 6 percent or less and a liquid limit of 35 percent or less when tested in accordance with ASTM D 4318.

2.1.3 Mineral Filler

Mineral filler shall consist of Portland cement conforming to ASTM C 150 or shall be mechanically reduced rock with the following gradation.

<u>Grain size in mm</u>	<u>Percent Finer</u>
0.075	75-100
0.05	65-100
0.02	35-65
0.01	26-35
0.005	10-22

Grain size shall be determined in accordance with ASTM D 422.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to the gradation specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradation

<u>Sieve Size, mm</u>	<u>Percent Passing by Mass</u>
12.5	100
9.5	90-100
4.75	55-85
2.36	32-67
0.30	7-27
0.075	2-10

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade AC-40. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement binder specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the bituminous pavement mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 90 kg of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to the start of construction.

2.3.1 JMF Requirements

The job mix formula and properties of bituminous pavement mixture shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of paving operations and shall include as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade.
- e. Number of blows of hammer per side of molded specimen.
- f. Laboratory mixing temperature.

- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.
- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.
- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.
- m. Percent particles with 2 or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.
- o. Tensile Strength Ratio (TSR).
- p. Antistrip agent (if required) and amount.
- q. List of all modifiers and amount used.

Table 3. Marshall Design Criteria

<u>Test Property</u>	<u>50 Blow Mix</u>
Stability, newtons minimum	*4450
Flow, 0.25 mm	8-18
Air voids, percent	3-5
TSR, minimum percent	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits

specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix.

Table 4. Field (Plant) Established JMF Tolerances
Sieves Adjustments (plus or minus), percent

12.5 mm	3
4.75 mm	3
2.36 mm	3
0.075 mm	1
Binder Content	0.4

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; while not desirable, this is acceptable.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C when added to the aggregates. Modified asphalts shall be no more than 174 degrees C when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 175 degrees C when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated

particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

The underlying surface shall be maintained in suitable condition for the placement of asphaltic pavement. Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. The surface of the base course will be inspected for adequate compaction and surface tolerances specified in paragraph: GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS. Unsatisfactory areas shall be corrected, prior to commencement of asphaltic pavement lay down operations.

3.5 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction.

The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.6 TRANSPORTING AND PLACING

3.6.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 60 degrees C. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver. Waybills and delivery tickets are to be submitted with each load.

3.6.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to

the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 3 m. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 300 mm; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 3 m from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 3 m. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.7 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. After the Contractor is assured of meeting grade and smoothness requirements, rolling shall be continued until all roller marks are eliminated and at least 95 percent of the laboratory maximum density has been achieved. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.8 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.8.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to

placing material at the joint. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.8.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 50 mm from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.9 CONTRACTOR QUALITY CONTROL

3.9.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness

3.9.2 Testing Laboratory

The Contractor shall have access to a fully equipped asphalt laboratory. The laboratory shall meet the requirements as required in ASTM D 3666.

Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When, in the opinion of the Contracting Officer, the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.9.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, aggregate moisture, temperatures, moisture content of mixture, laboratory air voids, Marshall stability and flow, in-place density, thickness, grade conformance and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.9.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per 1000 metric tons of asphaltic concrete produced by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the ASTM D 6307. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.9.3.2 Aggregate Gradation

Aggregate gradations shall be determined for each 1000 metric tons of asphaltic concrete produced from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.9.3.3 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per shift in accordance with ASTM C 566.

3.9.3.4 Temperatures

At least one measurement of asphaltic concrete temperature shall be taken in each hour, in which paving operations are being conducted. Additional tests at additional locations, to determine the temperature at the dryer,

the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site, may be required as directed by the Contracting Officer.

3.9.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per shift in accordance with ASTM D 1461 or an approved alternate procedure.

3.9.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least once per 1000 metric tons and compacted into specimens, using 50 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.9.3.7 In-Place Density

At least three cores will be recovered and tested for every 1000 square meters of pavement, or one day's production, whichever is smaller. Additional tests may be taken as required by the Contracting Officer. The Contractor may conduct any additional necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950. Record sampling will be by use of cores as indicated above.

3.9.3.8 Thickness

At least three cores will be recovered and tested for every 1000 square meters of pavement, or one day's production, whichever is smaller. Additional tests may be taken as required by the Contracting Officer.

3.9.3.9 Grade Conformance and Surface Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph GRADE AND SURFACE SMOOTHNESS REQUIREMENTS.

3.9.3.10 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.9.3.11 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing. At the completion of asphalt work the Contractor shall submit a certification of compliance indicating that the work is in compliance with this section.

3.9.4 Action Required

3.9.4.1 Asphalt Content

If there is a failure to meet the specified asphalt content production will cease and the Contracting Officer will be immediately notified. No additional paving will occur until adjustments to the plant and test results confirm that the specified asphalt is being supplied.

3.9.4.2 Aggregate Gradation

When the amount passing any sieve is outside the specification limits, the aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation.

3.9.4.3 Aggregate Moisture Content

When the moisture content of the aggregates is outside specification requirements the aggregates shall be immediately resampled and retested. If there is another failure, the fact shall immediately be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation.

3.9.4.4 Temperature

When the temperature of the bituminous mixture is outside specification requirements the mixture shall be immediately resampled and retested. If there is another failure, the fact shall immediately be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation. In no case will overheated or carbonized mixtures be allowed.

3.9.4.5 Asphalt Properties

If there is a failure in any of the asphalt properties production will cease and the Contracting Officer will be immediately notified. No additional paving will occur until adjustments to the plant and test results confirm that the specified properties are being achieved.

3.9.4.6 Density

When test results indicate lack of compaction additional specimens will be obtained as directed by the Contracting Officer. Based on the test results the Contractor will remove and replace the affected areas of pavement.

3.9.4.7 Thickness

When test results indicate that the finished pavement is 6 mm less than the thickness shown on the drawings, additional samples will be taken to determine the extent of defective thickness. The area determined will be removed and replaced or may be overlaid. The overlay will be a minimum of 25 mm thick and will be placed to duplicate slopes and drainages of the original pavement. No skin patching will be allowed.

3.9.5 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.9.6 Reports

All results of tests conducted shall be reported as required. During periods requiring protection from weather, reports of pertinent temperatures or other relevant values shall be made daily. These requirements do not relieve the contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor Quality Control records.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02748

BITUMINOUS TACK AND PRIME COATS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS
 - 1.3.1 General Requirements
 - 1.3.2 Bituminous Distributor
 - 1.3.3 Power Brooms and Power Blowers
- 1.4 WEATHER LIMITATIONS

PART 2 PRODUCTS

- 2.1 TACK COAT
- 2.2 PRIME COAT

PART 3 EXECUTION

- 3.1 PREPARATION OF SURFACE
- 3.2 APPLICATION RATE
 - 3.2.1 Tack Coat
 - 3.2.2 Prime Coat
- 3.3 APPLICATION TEMPERATURE
 - 3.3.1 Viscosity Relationship
 - 3.3.2 Temperature Ranges
- 3.4 APPLICATION
 - 3.4.1 General
 - 3.4.2 Prime Coat
 - 3.4.3 Tack Coat
- 3.5 CURING PERIOD
- 3.6 FIELD QUALITY CONTROL
- 3.7 SAMPLING AND TESTING
 - 3.7.1 Sampling
 - 3.7.2 Calibration Test
 - 3.7.3 Trial Applications
 - 3.7.3.1 Tack Coat Trial Application Rate
 - 3.7.3.2 Prime Coat Trial Application Rate
 - 3.7.4 Sampling and Testing During Construction

-- End of Section Table of Contents --

SECTION 02748

BITUMINOUS TACK AND PRIME COATS

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 140	(2000) Sampling Bituminous Materials
ASTM D 977	(1998) Emulsified Asphalt
ASTM D 2027	(1976; R 1997) Cutback Asphalt (Medium-Curing Type)
ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

SD-06 Test Reports

Sampling and Testing.

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 15 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 WEATHER LIMITATIONS

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.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 977, SS-1h.

2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2027, Grade MC-70.

PART 3 EXECUTION

3.1 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.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contractor and approved by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.20 liter nor more than 0.70 liter per square meter of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.70 liter nor more than 1.80 liters per square meter of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts	

MC-70	50-107 degrees C
Emulsions	

SS-1h	20-70 degrees C

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be

spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 8 meters of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein. Waybills and delivery tickets are to be submitted during progress of the work.

3.4.2 Prime Coat

The type of liquid asphalt and application rate will be as specified herein. The Contractor shall protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Damage to the underlying material caused by lack of, or inadequate, protection shall be repaired (recompacted or replaced) by approved methods at no additional cost to the Government. If the Contractor options to use the prime coat, it shall be applied as soon as possible after consolidation of the underlying material. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.4.3 Tack Coat

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to paragraph TACK COAT.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

A sample shall be obtained and tested by the Contractor for every 100 metric tons of bituminous material used.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 30 meters for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.20 liters per square meter. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 1.10 liters per square meter. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

<&

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02821

FENCING AND RAILING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS

PART 2 PRODUCTS

- 2.1 FENCE FABRIC
 - 2.1.1 Chain Link Fence Fabric
 - 2.1.2 TORTOISE FENCING
- 2.2 GATES
- 2.3 METAL POSTS FOR CHAIN LINK FENCE AND POST AND CABLE RAILING
 - 2.3.1 METAL POSTS FOR CHAIN LINK FENCE
 - 2.3.2 Metal Posts for Post and Cable Railing
- 2.4 BRACES AND RAILS
- 2.5 WIRE
 - 2.5.1 Tension Wire
- 2.6 CABLES FOR POST AND CABLE RAILING
- 2.7 ACCESSORIES
- 2.8 CONCRETE
- 2.9 PADLOCKS

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 EXCAVATION
- 3.3 POST INSTALLATION, CHAIN LINK FENCE
 - 3.3.1 Posts for Chain Link Fence
- 3.4 RAILS
 - 3.4.1 Top Rail
 - 3.4.2 Bottom Rail
- 3.5 BRACES AND TRUSS RODS
- 3.6 TENSION WIRES
- 3.7 CHAIN LINK FABRIC
- 3.8 GATE INSTALLATION
- 3.9 GROUNDING
- 3.10 POST AND CABLE RAILING INSTALLATION
 - 3.10.1 Posts for Post and Cable Railing
 - 3.10.2 Cables for Post and Cable Railing
 - 3.10.3 After Installation
- 3.11 TORTOISE FENCING INSTALLATION

-- End of Section Table of Contents --

SECTION 02821

FENCING AND RAILING

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 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 780	(2000) 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 B 32	(1996) Solder Metal
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 270	(2000) Mortar for Masonry
ASTM C 476	(1999) Grout for Masonry
ASTM F 626	(1996a) Fence Fittings
ASTM F 883	(1997) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates

ASTM F 1043	(2000) 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 "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence; G, RE.

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 1, zinc-coated steel wire with minimum coating weight of 610 grams of zinc per square meter of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh. Fabric height shall be 1.83 meters. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.1.2 TORTOISE FENCING

Tortoise fencing shall be temporary, shall be orange in color, shall consist of a 1.219 meter high, high-density polyethylene fencing, or equivalent, with set posts in mortar and grout, installed where shown on the drawings or required by the Contracting Officer. Mortar and grout to set posts in holes shall conform to ASTM C 270 Type M and ASTM C 476. Posts shall be similar to that found in paragraph METAL POSTS FOR CHAIN LINK FENCE, adjusted to the height of the tortoise fence fabric.

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) 1-1/2. 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) 1-1/2. 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 METAL POSTS FOR CHAIN LINK FENCE AND POST AND CABLE RAILING

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 and Group II, formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. 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.

2.3.2 Metal Posts for Post and Cable Railing

Posts for Post and Cable Railing shall be per ASTM A 501 and shall be hot-dip galvanized after drilling holes and other fabrication as shown on the drawings. Galvanizing shall be in accordance with ASTM A 123/A 123M, as applicable. Welded, cut, damaged, and deformed areas of galvanizing metal shall be neatly coated with Grade 50B solder conforming to ASTM B 32.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 42 mm, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

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 CABLES FOR POST AND CABLE RAILING

Cables shall be prestretched, galvanized wire rope of the size indicated, ungreased. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Fittings and accessories shall be hot-dip galvanized.

2.7 ACCESSORIES

Fence fittings and accessories shall be per ASTM F 626 and as shown on the drawings. 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. 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 153/A 153M unless modified. For the Post and Cable Railing system the turnbuckles, eyebolts, anchors, u-bolt clips, nuts and washers shall be galvanized or zinc plated.

2.8 CONCRETE

ASTM C 94/C 94M, 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.

2.9 PADLOCKS

Padlocks shall conform to ASTM F 883, Type P01 Grade 2. Padlocks shall be a combination commercial type Padlock Master #175 or equivalent

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 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 50 mm clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION, CHAIN LINK FENCE

3.3.1 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 greater 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. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm and shall be protected with drive caps when being set.

3.4 RAILS

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail.

3.4.2 Bottom Rail

The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.5 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 in height. 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.

3.6 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.

3.7 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.

3.8 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.

3.9 GROUNDING

Fences crossed by power lines 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.

3.10 POST AND CABLE RAILING INSTALLATION

3.10.1 Posts for Post and Cable Railing

Posts for Post and Cable Railing shall be installed as shown on the drawings. All posts for the post and cable railing installation shall be true vertical or plumb and not normal to the top of the channel walls.

3.10.2 Cables for Post and Cable Railing

Cables for the post and cable railing shall be installed as shown in the drawings. Cables shall be pulled taut and shall be free of sag. Cables shall be parallel to the top of the channel wall.

3.10.3 After Installation

The Contractor shall examine and certify the operation of all post and cable railing not sooner than 30 days after installation.

3.11 TORTOISE FENCING INSTALLATION

Installation of the tortoise fence, temporary, shall be in accordance with the manufacturer recommendations. Shop drawings submittal (including post selection) of the tortoise fence is required and shall be approved by the Contracting Officer prior to installation. Posts for the tortoise fencing shall be set plumb in holes formed in the ground and grouted into place. The grout shall be thoroughly consolidated around each post so as to be free of voids and finished to form a dome. The Contractor shall maintain the tortoise fence throughout the life of the project. The tortoise fencing shall be removed in its entirety at the end of the contract, and the post holes backfilled to surrounding ground height.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02910

NATIVE PLANT EXTRACTION, SALVAGE AND STORAGE

PART 1 GENERAL

- 1.1 PROFESSIONAL OVERSIGHT
- 1.2 SUBMITTALS
- 1.3 FREE USE PERMIT
- 1.4 INSPECTION
- 1.5 REPLACEMENT OF DAMAGED, DEAD, VANDALIZED OR MISSING PLANT MATERIAL

PART 2 PRODUCTS

- 2.1 NATIVE PLANT MATERIALS
 - 2.1.1 Cacti and Yucca
 - 2.1.2 Creosote Bush and White Bursage
 - 2.1.2.1 Additional Plant Materials
- 2.2 WATER
- 2.3 FENCING

PART 3 EXECUTION

- 3.1 EXTRACTION OF NATIVE PLANT MATERIALS
 - 3.1.1 Extraction Time
 - 3.1.2 Salvage Conditions
 - 3.1.3 Plant Orientation
 - 3.1.4 Yucca Extraction, Salvage, and Storage
 - 3.1.5 Cactus Extraction, Salvage and Storage
 - 3.1.6 Creosote Bush and White Bursage Extraction, Salvage and Storage
- 3.2 TEMPORARY ON-SITE PLANT STORAGE
 - 3.2.1 Plant Protection During Storage Period
 - 3.2.2 Watering Stored Plant Materials
- 3.3 CLEAN UP
 - 3.3.1 Clean Up

-- End of Section Table of Contents --

SECTION 02910

NATIVE PLANT EXTRACTION, SALVAGE AND STORAGE

PART 1 GENERAL

The Contractor shall furnish qualified personnel, equipment, labor, and materials, and perform all work for native plant material extraction, salvage, and temporary plant storage as specified herein, shown on the Contract Drawings, and as directed by the Contracting Officer. Plants shall be salvaged prior to clearing and grubbing operations.

1.1 PROFESSIONAL OVERSIGHT

The CONTRACTOR shall provide a landscape professional with previous, successful native plant salvage experience to oversee the extraction and salvage operations for the duration of this work type at the F-1 and F-2 projects. To be considered qualified, the professional's experience must include at least 3 successful projects involving the extraction, salvage, and maintenance of cactus, yucca, white bursage and creosote bush species. See the landscape Contractor's qualification sheet in the bid documents. The Contractor shall use the landscape subcontractor they were successful low bidder with and who meets the required qualifications. No landscape subcontractor substitutions shall be allowed.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The "A/E" designates that the Architect/Engineer will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Credentials and Past Project Experience; G, A/E.

The credentials and past project experience of the proposed landscape professional. Past projects and current references that can verify the projects must be listed on the applicable form.

Equipment; G, A/E.

A listing of equipment to be used for the plant extraction and salvage operation.

Fencing Materials; G, A/E.

Manufacturers' printed information for all fencing materials to be used to fence the temporary plant storage nursery.

Temporary Irrigation Plan; G, A/E.

The Contractor shall submit an irrigation plan outlining the operation of a temporary irrigation system to water plant materials stored in the temporary nursery from the time of salvage to the time of transplanting. The irrigation plan shall include water source, water quality report from a water quality laboratory, irrigation equipment, and the specifics of operation. The irrigation plan shall include the proposed watering schedule and quantity of water to be applied per each application. Methods to prevent run-off, puddling and plant wilting or water stress shall be described.

1.3 FREE USE PERMIT

Prior to the Contractor beginning any plant salvage activities at either the F-1 or F-2 sites, Clark County must obtain a "Free Use Permit" from the Bureau of Land Management (BLM) for use of yucca and cactus plant materials. The permit is good for a 3-year period and may be obtained through Gail Marrs-Smith at the BLM Las Vegas District Office, 4765 Vegas Drive, Las Vegas, NV (702) 647-5156. A copy of the permit shall be on-site at the Contractor's office before the salvage operations begin.

1.4 INSPECTION

All extracted and salvaged native plant materials shall be inspected for plant condition and damage prior to being taken to the temporary storage facility. Plant materials that have been exposed to heat, excessive root drying, and damaged or mutilated stock shall be rejected and the Contractor will be charged for replacement fees at fair market value. All cacti and yucca plants shall be inspected to insure that the north orientation is clearly marked on each plant in such a manner that the marking will be protected during transport, storage, and transplanting. Any cacti or yucca plant materials that are salvaged without the north orientation being marked prior to extraction will be rejected by the Contracting Officer and the Contractor will be responsible for supplying replacement plants at no additional cost. Rejected plants shall not be stored in the temporary nursery.

1.5 REPLACEMENT OF DAMAGED, DEAD, VANDALIZED OR MISSING PLANT MATERIAL

The Contractor shall replace any damaged, dead, vandalized, rejected or missing plant materials at no additional cost. Replacement plants shall be of the same species, and size as original stock, and shall be subject to inspection and approval by the Contracting Officer.

PART 2 PRODUCTS

2.1 NATIVE PLANT MATERIALS

2.1.1 Cacti and Yucca

The following cacti and yucca species shall be extracted, and salvaged from all areas within the construction disturbance zone as shown on the Contract Drawings and as directed by the Contracting Officer.

- a. All barrel cactus (*Ferocactus cylindraceus*)
- b. All hedgehog cactus (*Echinocereus trigochidiatus*)
- c. All cottontop cactus (*Echinocactus polycephalus*)
- d. All other cactus over 305 mm (1-foot) tall, or over 305 mm wide (1-foot) including prickly pear (*Opuntia erinacea*), etc., must be salvaged.
- e. All yucca over 305 mm (1-foot) tall including Mohave yucca (*Yucca schidigeri*), Joshua tree (*Yucca brevifolia*).

2.1.2 Creosote Bush and White Bursage

The following creosote bush and white bursage shall be extracted and salvaged from the project basin and embankment areas first. If additional plants are required they shall be salvaged from remaining disturbance areas. Plants in non-disturbed areas shall be protected. Creosote bush and white bursage shall be treated with mycorrhizae, placed in grow-bags and stored in the on-site temporary nursery.

- a. 638 white bursage from the F-1 project site
- b. 638 creosote bushes from the F-1 project site
- c. 320 white bursage from F-2 project site
- d. 320 creosote bush from F-2 project site

2.1.2.1 Additional Plant Materials

If there are not enough creosote bush and/or white bursage plant materials at the F-2 site, additional plants may be salvaged from the F-1 Debris Basin site. The F-1 site is approximately one to 1.5 miles north of the F-2 site.

2.2 WATER

Unless otherwise noted, irrigation water for plant irrigation shall be the responsibility of the Contractor. Irrigation water shall not contain elements or metals toxic to plant life.

The temporary irrigation plan must be approved by the Contracting Officer prior to the Contractor beginning plant salvage operations. The Contractor shall submit a monthly report to the Contracting Officer documenting watering dates, application rates, person who can verify the watering schedule or answer questions pertaining to the required watering.

2.3 FENCING

Fencing materials for security fencing of the temporary plant nursery shall conform to the specifications in Section 02821 FENCING AND RAILING.

PART 3 EXECUTION

The Contractor shall submit a listing of equipment to be used for the plant extraction and salvage operation. The Contractor shall also submit the credentials and past project experience of the proposed landscape professional. Past projects and current references that can verify the projects must be listed on the applicable form.

3.1 EXTRACTION OF NATIVE PLANT MATERIALS

3.1.1 Extraction Time

Native plant materials shall be extracted and salvaged from January 1 to May 15 for spring work; and from September 15 to December 15 for fall work.

3.1.2 Salvage Conditions

Salvage operations shall be performed only during periods when beneficial results can be obtained. When drought, high temperatures, or other unsatisfactory conditions prevail, the work shall be stopped when directed.

When special conditions warrant a variance to the extraction and salvage operations, the Contractor shall propose alternate times for approval by the Contracting officer.

3.1.3 Plant Orientation

The north orientation of each individual cactus and yucca plant shall be marked prior to extraction from the growing site. The marking must be clearly visible and must stay on the plant throughout the extraction, salvage, storage and planting phases. If necessary a compass shall be used to determine the north orientation at the time of marking. Marking shall not result in any damage to the plant such as cuts, bruises, or insertion of any foreign objects into plant tissues. If the north orientation marking does not last through the planting process, the subject plant material shall be rejected and the Contractor shall be responsible for replacement of the same species and size at no additional cost.

3.1.4 Yucca Extraction, Salvage, and Storage

Clonal yucca plants may be salvaged as a clump or as individual plants. Individual plants shall be a minimum of 305 mm (12 inch) in height and/or width to be considered for payment. If salvaged individually each yucca plant must have the north orientation permanently marked prior to extraction from the growing site. If salvaged as a clump each stem also must be marked to provide for the situation that a stem may become detached from the clump during extraction, transport, storage or transplanting.

As much of the root ball as possible shall be dug and protected. Yucca and cacti shall be stored either bare root, healed-in with the root-ball wrapped and protected or in containers with the root-ball wrapped and protected.

3.1.5 Cactus Extraction, Salvage and Storage

Cacti and yucca must have the north orientation marked on each individual plant prior to extraction. The north marking shall be performed to last

through extraction, salvage, storage and transplanting. If the north orientation marking does not last through the planting process, the subject plant material shall be rejected and the Contractor shall be responsible for replacement at no additional cost. Roots shall be protected at all times from drying and physical damage. Cactus shall be watered as necessary during storage to maintain the health of each plant.

3.1.6 Creosote Bush and White Bursage Extraction, Salvage and Storage

Native creosote bush and white bursage shall be removed with the root ball intact unless otherwise approved. After extraction the plant root ball shall be dipped in mycorrhizae root stimulator, put in 12 gallon or larger grow bags and stored in the temporary nursery. Other storage containers may be used with the approval of the Contracting Officer.

3.2 TEMPORARY ON-SITE PLANT STORAGE

The Contractor shall establish an on-site, temporary plant nursery in the location shown on the Contract Drawings and as directed by the Contracting Officer. The temporary nursery shall include trenches to store the plant materials. The topography of the nursery shall be slightly sloped to drain so that no ponding will occur from irrigation of stored plant materials. The perimeter of the nursery shall be fenced with 1.83 meter high chain link fencing with 4 stands of barbed wire on the top and a double-swing gate that can be locked. The gate shall be large enough for a truck to pass through to load, unload, maintain and irrigate the plant materials. The access gate(s) shall be positioned where it will not be affected by project construction activities.

3.2.1 Plant Protection During Storage Period

All native plant materials salvaged from the construction site shall be stored in the designated temporary nursery. Plants shall be protected from exposure to wind and direct sunlight, predators and vandals during the storage period. Plants shall be delivered to the temporary nursery as soon as possible after extraction to avoid drying of plant roots. Yuccas and Joshua trees shall be supported and protected from tipping over or breaking off from winds or other forces such as watering. The CONTRACTOR shall replace unprotected plants that break from strong winds or watering blasts at no additional cost to the OWNER. Replacement plants shall be equal in size and structure to plants being replaced.

3.2.2 Watering Stored Plant Materials

The native plant materials shall be watered 2 to 3 times per week during the hottest summer months and once per month in cool months (or as required to maintain healthy plant materials) for the duration of the time they are held in the temporary nursery or as directed by the Contracting Officer. Water shall be applied at a rate sufficient to ensure moist soil conditions at a depth that reaches the bottom of the root zone of each plant. Run-off, puddling, and wilting shall be prevented. Plants shall be protected from damage from equipment used to perform the watering. Plants damaged by watering activities shall be replaced by the Contractor at no additional cost.

3.2.3 Soil and Plant Damage Caused by Irrigation

Any damage to stored plants that result from the Contractor's excessive or irregular irrigation practices shall be the responsibility of the Contractor and such plants shall be replaced at no additional cost.

3.3 CLEAN UP

3.3.1 Clean Up

Excess plant materials that are not salvaged, broken plant roots, and other organic waste material generated from the plant extraction and salvage operation or clearing and grubbing activities shall be disposed of off-site in a landfill or buried on-site in a location approved by the Contracting Officer. Inorganic waste materials must be hauled off-site to a landfill.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02921

SEEDING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PROFESSIONAL OVERSIGHT
- 1.3 SUBMITTALS
- 1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING
 - 1.4.1 Delivery
 - 1.4.2 Storage
 - 1.4.3 Handling
 - 1.4.4 Time Limitation

PART 2 PRODUCTS

- 2.1 SEED
 - 2.1.1 Seed Classification
 - 2.1.2 Permanent Seed Species and Mixtures
 - 2.1.3 Quality
 - 2.1.4 Seed Mixing
 - 2.1.5 Substitutions
- 2.2 TOPSOIL
 - 2.2.1 SOIL TEST
 - 2.2.1.1 Soil Samples
 - 2.2.1.2 Soil Sample Analysis
- 2.3 SOIL AMENDMENTS
 - 2.3.1 Fertilizer
 - 2.3.1.1 Nitrogen Carrier Fertilizer
 - 2.3.1.2 Super Absorbent Polymers
- 2.4 SOIL STABILIZER
 - 2.4.1 Soil Stabilizer Properties
 - 2.4.2 Wood Cellulose Fiber
- 2.5 IRRIGATION WATER
- 2.6 CHEMICAL TREATMENT MATERIAL

PART 3 EXECUTION

- 3.1 INSTALLING SEED TIME AND CONDITIONS
 - 3.1.1 Seeding Time
 - 3.1.2 Seeding Conditions
 - 3.1.3 Seeding Equipment Calibration
- 3.2 SITE PREPARATION
 - 3.2.1 Finished Grade and Topsoil
 - 3.2.2 Application of Soil Amendments
 - 3.2.2.1 Applying Fertilizer

- 3.2.2.2 Applying Super Absorbent Polymers
- 3.2.3 Tillage
- 3.2.4 Prepared Surface
 - 3.2.4.1 Preparation
 - 3.2.4.2 Protection
- 3.3 INSTALLATION
 - 3.3.1 Installing Seed
 - 3.3.1.1 Broadcast Seeding
 - 3.3.1.2 Drill Seeding
 - 3.3.1.3 Rolling
 - 3.3.2 Hydroseeding
 - 3.3.3 Application of Soil Stabilizer
 - 3.3.4 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper
 - 3.3.5 Irrigation System Approval
 - 3.3.5.1 Temporary Irrigation Plan
 - 3.3.6 Watering Requirements
 - 3.3.7 Soil and Plant Damage Caused by Irrigation
- 3.4 QUANTITY CHECK
- 3.5 APPLICATION OF PESTICIDE
 - 3.5.1 Technical Representative
 - 3.5.2 Application
- 3.6 RESTORATION AND CLEAN UP
 - 3.6.1 Restoration
 - 3.6.2 Clean Up
- 3.7 PROTECTION OF INSTALLED AREAS
- 3.8 SEED ESTABLISHMENT PERIOD
 - 3.8.1 Commencement
 - 3.8.2 Satisfactory Stand of Plants
 - 3.8.2.1 Seeded Areas
 - 3.8.3 Maintenance During Establishment Period
 - 3.8.3.1 Post-Fertilization
 - 3.8.3.2 Pesticide Treatment
 - 3.8.3.3 Repair or Reinstall
 - 3.8.3.4 Bi-Monthly Plant Maintenance Record

-- End of Section Table of Contents --

SECTION 02921

SEEDING

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.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Aug 95) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 PROFESSIONAL OVERSIGHT

The CONTRACTOR shall provide a licensed landscape professional with previous drill seeding and hydroseeding experience to oversee the seeding operations for the duration of this work type at the F-1 and F-2 projects. To be considered qualified, the professional's experience must include at least 3 successful projects involving drill seeding and hydroseeding. See the landscape Contractor's qualification form in the bid documents. The Contractor shall use the landscape subcontractor they were successful low bidder with and who meets the required qualifications. No landscape subcontractor substitutions shall be allowed.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The "A/E" designates that the Architect/Engineer will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment.

Soil Stabilizer; G, RE.

Chemical Treatment Material; G, A/E.

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, soil stabilizer material and chemical treatment material.

Seeding Equipment; G, A/E.

A listing of seeding equipment to be used for the seeding operation.

Temporary Irrigation Plan; G, A/E.

Temporary irrigation plan showing irrigation layout with list and descriptions of equipment, operation and proposed watering schedule.

SD-07 Certificates

Availability of topsoil from the stripping and stock piling operations; G, A/E.

Finished Grade and Topsoil Status; G, A/E.

Availability of topsoil from the stripping and stock piling operations and the finished grade status.

Seed; G, RE.

Fertilizer; G, RE.

Pesticide; G, A/E.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Fertilizer. Chemical analysis and composition percent.
- c. Pesticide. EPA registration number and registered uses.
- d. Soil Stabilizer. Manufacturer, contents, recommended application rate, application method.

SD-06 Test Reports

Soil Sample Fertility Analyses Report; G, A/E.

Seeding Equipment Calibration; G, A/E.

Certification of calibration tests conducted on the equipment used in the seeding operation.

SD-11 Closeout Submittals

Bi-Monthly Plant Maintenance Record; G, A/E.

Record of maintenance activities including, watering, reseeding, weeding, fertilizing and application of soil amendments and the specific areas where maintenance activities were conducted. The Contractor shall submit the information on the required Bi-Monthly Maintenance Record form included in the specifications.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.2 Storage

Materials shall be stored in designated areas. Seed, and fertilizer shall be stored in cool, dry locations away from contaminants.

1.4.3 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.4 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 12 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Scientific Name	Common Name	Kilograms	% of
-----------------	-------------	-----------	------

		per Hectare	Mixture By Weight
Hilaria rigida	Galleta grass	4.6	16
Oryzopsis hymenoides	Indian ricegrass	4.6	16
Sphaeralcea ambigua	Desert globemallow	1.7	6
Encelia virginensis	Virgin Mountains encelia	1.7	6
Baileya multiradiata	Desert Marigold	1.7	6
Eriogonum inflatum	Desert trumpet	1.7	6
Ambrosia dumosa	White bursage	4.2	14
Larrea tridentata	Creosote bush	2.5	8
Ephedra nevadensis	Nevada ephedra	3.5	12
Atriplex canescens	Four-wing saltbush	2.8	10
Total Application Rate		50	100

(kilograms/hectare)

(50 kilograms per hectare is equivalent to 44.5 pounds per acre)

2.1.3 Quality

Weed seed shall be a maximum one percent by weight of the total mixture.

2.1.4 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as verified by the Contracting Officer.

2.1.5 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

The topsoil shall be the existing 203 mm (8-inches) surface soil stripped and stockpiled onsite in accordance with Section 02300, EARTHWORK. Unless otherwise notified by the Government, the topsoil shall conform to ASTM D 5268. The Contractor shall submit the availability of topsoil from the stripping and stock piling operations and the finished grade and topsoil status. Topsoil shall be free from, large lumps of soil, large root wads, trash, spent ammunition, broken glass, or other material over a minimum 75 mm (3-inches) diameter. Topsoil shall not contain viable plants or plant parts.

2.2.1 SOIL TEST

2.2.1.1 Soil Samples

The Contractor shall collect a minimum of six composite soil samples from locations on the site where revegetation activities will take place. Each of the three composite samples shall contain 725 grams (1.6 pounds) of soil for fertility testing.

2.2.1.2 Soil Sample Analysis

The Contractor shall have the soil samples analyzed and results reported for texture, pH, percent organic material, nitrates, phosphorus, potassium, calcium, sodium, soluble salts, aluminum, magnesium, manganese, zinc, iron, copper, sulfate, lead, and boron. The pH of the soil shall be determined in accordance with ASTM D 4972. The Contractor shall submit the Soil Sample Fertility Analyses Report.

2.3 SOIL AMENDMENTS

Soil amendments shall meet the following requirements.

2.3.1 Fertilizer

Fertilizer composition shall be formulated as recommended by the required soil fertility test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients as recommended by the soil test. Fertilizer shall be applied at a rate of 160 kilograms per hectare (350 pounds per acre) or as recommended by the required soil fertility test.

2.3.1.1 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.1.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrite, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.4 SOIL STABILIZER

Soil stabilizer shall be a mixture of plaster and natural cellulose fiber mulch. The plaster cellulose fiber mulch stabilizer shall be Plas-Tex(tm) Soil Stabilizer as formulated by Soil-Tech Co., 5375 Cameron Dr., Las Vegas, NV 89118 (702) 873-2023) or approved equal. Proposed substitutions must be submitted to the Contracting Officer for review and approval.

2.4.1 Soil Stabilizer Properties

The plaster shall consist of naturally occurring high purity gypsum and necessary additives, such as retarders and accelerators and water to formulate a binder that will produce a protective crust-like barrier within 4 to 8 hours after application.

The gypsum shall be produced from a quarried or mined source. In addition, the processed gypsum shall be composed of a crushed dry calcium sulfate hemihydrate (CA S04 1/2H2O) having a purity of not less than 88 percent. The processed gypsum plus necessary additives shall be furnished either in bags or bulk and be accompanied by certificates stating 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 cellulose fiber mulch shall be produced from grinding clean, whole wood chips. The wood chips shall be thermally dehydrated to produce a high quality blend of fibers, dyed with a non-toxic vegetable based dye to aid in visual metering during application. The moisture content shall average 12 percent.

A color pigment shall be added to the slurry at the time of application. The pigment color shall be selected to blend with the existing site colors. Sample test plots of the proposed pigment color(s) shall be tested at the project site and approved by the Contracting Officer prior to application on the specified areas.

2.4.2 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.5 IRRIGATION WATER

Irrigation water shall be the responsibility of the Contractor. Irrigation water shall not contain elements toxic to plant life.

2.6 CHEMICAL TREATMENT MATERIAL

If necessary, the Contractor shall submit any additional chemical treatment material information.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed from March 1 to April 30 for spring establishment; and from September 1 to October 30 for fall establishment. If the Contractor elects to seed outside of the specified seeding periods, the Contractor shall notify the Contracting Officer in writing of the reason for the variance and describe the dates the seeding is actually performed.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other

unsatisfactory conditions prevail, the work shall be stopped when directed by the Contracting Officer. When special conditions warrant a variance to the seeding operations, the Contractor shall submit proposed alternate times to the Contracting Officer for approval.

3.1.3 Seeding Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the seeding equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing. Information on other equipment planned for utilization in the operation shall be submitted.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300, EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying Fertilizer

Fertilizer shall be applied at a rate of 160 kilograms per hectare (350 pounds per acre) or as recommended by the required soil fertility test. The application rate recommended by the fertility test shall be the actual application rate if different from the 160 kilogram application rate. Fertilizer shall be incorporated into the soil to a maximum 205 mm (8-inches) depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.2 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 100 mm (4 inch) depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 152 mm (6 inch) depth. Rototillers shall be used where soil conditions and length of slope permit. Areas compacted by construction operations shall be completely pulverized by tillage. Fertilizer may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 50 mm (2 inch) below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Broadcast Seeding, Drill Seeding or Hydroseeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.1.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 50 kilograms per hectare (44.5 pounds per acre) using broadcast seeders. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 6 mm depth by disk harrow, steel mat drag, cultipacker, or other approved device. Broadcast seeding shall be used in all areas not reachable by hydroseeding, or areas behind boulders.

3.3.1.2 Drill Seeding

Seed shall be uniformly drilled to a maximum 13 mm depth and at the rate of 50 kilograms per hectare (44.5 pounds per acre), using equipment having drills a maximum 175 mm distance apart. Row markers shall be used with the drill seeder. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations. Drill seeding shall be used on all areas flatter than 8H:1V.

3.3.1.3 Rolling

The entire area shall be firmed with a roller not exceeding 130 kilograms per meter roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.2 Hydroseeding

Seed shall be mixed to ensure broadcast at the rate of 50 kilograms per hectare (44.5 pounds per acre). Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Wood cellulose fiber mulch and tackifier shall be added at the rates recommended by the manufacturer after the seed, fertilizer, and water are thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled. Hydroseeding shall be used on slopes steeper than 8H:1V.

3.3.3 Application of Soil Stabilizer

The plaster/cellulose fiber mulch stabilizer shall be applied at a rate of 2,240 kilograms of plaster per hectare and 1,685 kilograms of wood fiber mulch per hectare. The specified seed mixture shall be added to the stabilizer mulch slurry. The slurry shall be such that when applied, the material shall form a protective coating that reduces water and wind induced erosion. Application shall not be permitted during high winds or when other weather conditions are unsuitable.

A minimum of three 3.0 meter x 3.0 meter on-site test plots shall be sprayed to determine the pigment color for the slurry. The Contracting Officer shall approve the pigment color prior to the Contractor beginning application on the project areas.

3.3.4 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.3.5 Irrigation System Approval

The Contractor shall review all short-term and long-term irrigation system proposals with the Engineer to ensure that said systems are adequate. No irrigation systems shall be installed or implemented without review and approval by the Engineer. Approvals from the Engineer shall be obtained 2 weeks prior to the time to begin required irrigation.

3.3.5.1 Temporary Irrigation Plan

The Contractor shall submit the temporary irrigation plan.

3.3.6 Watering Requirements

Watering shall be started immediately after completing the seeding of an area. Water shall be applied twice every week during the hottest summer months (or as required to germinate the seed) and twice per month during the remainder of the first year or as directed by the Contracting Officer. Run-off and puddling shall be prevented. Watering trucks shall not be driven over seeded areas, unless otherwise directed. Watering of other

adjacent areas or plant material shall be prevented.

3.3.7 Soil and Plant Damage Caused by Irrigation

Any damage to soils or plants that result from the Contractor's excessive or irregular irrigation practices shall be repaired within 1 week by the Contractor at no additional cost.

3.4 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the pest management program.

3.5.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.5.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Seeded areas, plant materials, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.6.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.7 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.8 SEED ESTABLISHMENT PERIOD

3.8.1 Commencement

The seed establishment period to obtain a healthy stand of plants shall begin after the last day of the seeding operation and shall end 12 months later or at the end of the end of the plant establishment period defined in Section 02930 EXTERIOR PLANTING, whichever is longer. Written calendar time period shall be furnished for the seed establishment period. The seed establishment period shall be coordinated with Section 02930 EXTERIOR PLANTING. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.8.2 Satisfactory Stand of Plants

Shrubs shall be evaluated for species and health when the plants are 15 to 30 cm high. Herbaceous plants shall be evaluated for health at a height of 80 mm.

3.8.2.1 Seeded Areas

A satisfactory stand of plants from the seeding operation for seeded areas shall be a minimum of 55 percent cover. The total bare area shall not exceed 45 percent of the total seeded area. If specified coverage is not met at the end of the establishment period the Contractor shall reseed bare areas when conditions are favorable for seeding success. Reseeding times must be approved by the Contracting Officer.

3.8.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; watering; and post-fertilization.

3.8.3.1 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the hydroseeded area.

3.8.3.2 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph

APPLICATION OF PESTICIDE.

3.8.3.3 Repair or Reinstall

Unsatisfactory stand of plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.8.3.4 Bi-Monthly Plant Maintenance Record

A Bi-Monthly Plant Maintenance Record of each site shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of plants. The attached form shall be used to record maintenance activities and shall be submitted to the Contracting Officer every 2 weeks.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02930

EXTERIOR PLANTING

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PROFESSIONAL OVERSIGHT
- 1.3 SUBMITTALS
- 1.4 SOURCE INSPECTIONS
- 1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING
 - 1.5.1 Delivery
 - 1.5.1.1 Plant Material Identification
 - 1.5.1.2 Protection During Delivery
 - 1.5.1.3 Protection of Salvaged Plant Material
 - 1.5.1.4 Soil Amendments
 - 1.5.2 Inspection
 - 1.5.3 Storage
 - 1.5.3.1 Plant Material Storage
 - 1.5.3.2 Other Material Storage
 - 1.5.4 Handling
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 PLANT MATERIAL
 - 2.1.1 Plant Material Classification
 - 2.1.2 Substitutions
 - 2.1.3 Quality
 - 2.1.4 Growing Conditions
 - 2.1.5 Method of Shipment to Maintain Health of Root System
 - 2.1.5.1 Balled and Potted Plant Material
 - 2.1.5.2 Bare-Root (BR) Plant Material
 - 2.1.5.3 Container-Grown (C) Plant Material
 - 2.1.6 Shrubs
 - 2.1.7 Plant Material Size
 - 2.1.8 Plant Material Measurement
- 2.2 TOPSOIL
- 2.3 SOIL AMENDMENTS
 - 2.3.1 Fertilizer
- 2.4 SOIL STABILIZER
 - 2.4.1 Soil Stabilizer Properties
- 2.5 MYCORRHIZAL FUNGI INOCULUM
- 2.6 IRRIGATION WATER
- 2.7 IRRIGATION EQUIPMENT
- 2.8 BROWSE CONTROL DEVICES
- 2.9 PESTICIDES

PART 3 EXECUTION

- 3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS
 - 3.1.1 Planting Time
 - 3.1.2 Plant Material Conditions
 - 3.1.3 Tests
 - 3.1.3.1 Soil Fertility Test
 - 3.1.3.2 Soil Percolation Test
 - 3.1.3.3 Temporary Irrigation Plan
- 3.2 SITE PREPARATION
 - 3.2.1 Finished Grade, Final Slope Configuration, and Topsoil
 - 3.2.2 Layout
- 3.3 EXCAVATION
 - 3.3.1 Obstructions Below Ground
 - 3.3.2 Plant Pits
- 3.4 INSTALLATION
 - 3.4.1 Setting Plant Material
 - 3.4.1.1 Bare-Root Plant Material
 - 3.4.2 Cactus and Yucca Plant Orientation
 - 3.4.3 Backfill Soil Mixture
 - 3.4.4 Adding Mycorrhizal Fungi Inoculum
 - 3.4.5 Backfill Procedure
 - 3.4.5.1 Bare-Root Plant Material
 - 3.4.5.2 Container-Grown and Potted Plant Material
 - 3.4.5.3 Earth Berm
 - 3.4.6 Watering
 - 3.4.7 Browse Control
 - 3.4.8 APPLICATION OF PESTICIDE
 - 3.4.8.1 Technical Representative
 - 3.4.8.2 Application
- 3.5 FINISHING
 - 3.5.1 Pruning
- 3.6 MAINTENANCE DURING PLANTING OPERATION
- 3.7 RESTORATION AND CLEAN UP
 - 3.7.1 Restoration
 - 3.7.2 Clean Up
- 3.8 PLANT ESTABLISHMENT PERIOD
 - 3.8.1 Commencement
 - 3.8.2 Maintenance During Establishment Period
 - 3.8.3 Irrigation System Approval
 - 3.8.4 Watering Requirements
 - 3.8.5 Soil and Plant Damage Caused by Irrigation
 - 3.8.6 Weeding
 - 3.8.7 Post-Fertilization
 - 3.8.8 Plant Pit Settling
 - 3.8.9 Maintenance Record
 - 3.8.10 Unhealthy Plant Material
 - 3.8.11 Replacement Plant Material
 - 3.8.12 Maintenance
 - 3.8.12.1 Maintenance Instructions
 - 3.8.12.2 Maintenance Activities

-- End of Section Table of Contents --

SECTION 02930

EXTERIOR PLANTING

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A 300 (1995) Tree Care Operations - Trees, Shrubs and other Woody Plant Maintenance

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA Z60.1 (1996) Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 PROFESSIONAL OVERSIGHT

The CONTRACTOR shall provide a licensed landscape professional with previous, successful native plant transplanting experience to oversee the native plant transplanting operations for the duration of this work type at the F-1 and F-2 projects. To be considered qualified, the professional's experience must include at least 3 successful projects involving native plant transplanting, and maintenance of cactus, yucca, white bursage and creosote bush. See the landscape Contractor's qualification sheet in the bid documents. The Contractor shall use the landscape subcontractor they were successful low bidder with, and who meets the required qualifications.

No landscape contractor substitutions shall be allowed unless approved in writing by the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. The "A/E" designates that the Architect/Engineer will review the submittal for

the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Soil Stabilizer; G, A/E.

Manufacturer's literature including physical characteristics, application and installation instructions.

Browse Control; G, A/E.

Manufacturer's literature including expected life expectancy of device, material and installation specification.

Soil Amendments; G, A/E.

The chemical composition of all soil amendments shall be provided including fertilizer, lime, pesticides, organic material, per-emergents.

SD-02 Shop Drawings

Temporary Irrigation Plan; G, A/E.

Temporary irrigation plan showing irrigation layout with list and descriptions of equipment, operation and proposed watering schedule.

SD-06 Test Reports

Soil Tests; G, A/E

Laboratory Analysis; G, A/E.

The laboratory analysis and results of the soil fertility tests shall be provided.

Three On-site Percolation Tests; G, A/E.

The results from the three on-site percolation tests shall be provided.

SD-07 Certificates

Plant Material; G, RE.

Fertilizer; G, RE.

Soil Stabilizer Properties; G, RE.

Mycorrhizal Fungi Inoculum; G, RE.

Pesticides; G, RE.

Irrigation Water; G, A/E.

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

- a. Plant Material: Classification, botanical name, common name, size, quantity by species, number of each native plant species salvaged, and location and elevation where any nursery stock is grown.
- b. Topsoil: Fertility analyses, percolation test.
- c. Fertilizer: Chemical analysis and composition percent.
- d. Soil Stabilizer Properties.
- e. Mycorrhizal Fungi Inoculum.
- f. Pesticide.
- g. Irrigation Water: Source, purity and chemical analysis to ensure water is not toxic to plant life.

SD-11 Closeout Submittals

Bi-Monthly Plant Maintenance Record; G, RE.

Maintenance work performed, quantity of plant losses, and replacements; and diagnosis of unhealthy plant material. The maintenance record shall be submitted on the required form that is part of this section of contract documents.

Maintenance Instructions; G

Instruction for year-round care of installed plant material. Schedule for irrigation and maintenance activities of stored and installed plant materials.

1.4 SOURCE INSPECTIONS

The nursery or source of any nursery-grown plant materials and the source of any delivered topsoil shall be subject to inspection and approval by the Contracting Officer.

1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.5.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery of any products to the project site.

1.5.1.1 Plant Material Identification

Nursery grown plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical plant name and size. In addition the north orientation of all salvaged

cactus and yucca plants shall be clearly marked with a permanent marking that will last through the salvage, storage and transplanting phase.

1.5.1.2 Protection During Delivery

Plant material obtained from a nursery shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport. Damaged plant materials must be replaced by the Contractor at no additional cost.

Salvaged plant material shall be protected from damage during transport from the temporary nursery to the planting site. Bare root plants shall not be left exposed to air more than 1-hour maximum between the time the plant is lifted from the nursery and transplanted on the Project. Plants damaged during transport shall be replaced by the Contractor at no additional cost.

1.5.1.3 Protection of Salvaged Plant Material

All salvaged plant materials shall be stored in the temporary plant nursery identified on the drawings. The plants shall be protected during transport to storage, during the storage period, and during transport to the final installation location from desiccation and damage to branches, trunk, root system or earth ball. Any dead, damaged, vandalized or missing plants shall be replaced at the Contractor's expense. Damaged plants include broken limbs, cuts into cactus and yucca tissue, bruises, or any other defect that will affect the plant's long-term survival. Dead, missing, vandalized, or damaged cactus and yucca will be rejected and shall be replaced with plants of the same species and size as the rejected plants.

1.5.1.4 Soil Amendments

Required soil amendments shall be delivered to the site(s) in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for all bulk deliveries. The analysis shall be provided to the Contracting Officer for approval prior to applying bulk amendments to the site.

1.5.2 Inspection

Nursery grown plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. Plant material showing desiccation, abrasion, sun-scald injury, disfigurement, or unauthorized substitution shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container. Plant material with broken or cracked balls; or broken containers shall be rejected. Bare-root plant material that is not dormant or is showing roots were pulled from the ground shall be rejected. Other materials shall be inspected for compliance with paragraph PRODUCTS. Open

soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other materials larger than 76 mm (3 inch) diameter shall be rejected. Unacceptable material shall be removed from the job site.

1.5.3 Storage

1.5.3.1 Plant Material Storage

Non-salvaged plant material not installed on the day of arrival at the site shall be stored and protected in designated areas. Plant material shall not be stored longer than 3 days. Plant material shall be protected from direct exposure to wind and sun. Bare-root plant material shall be heeled-in. All plant material shall be kept in a moist condition by watering until installed. Salvaged plant materials shall be stored in the temporary plant storage area identified on the drawings. The salvaged plant materials shall be protected, maintained and irrigated throughout the storage period.

1.5.3.2 Other Material Storage

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with planting operation material.

1.5.4 Handling

Plant material shall not be injured in handling. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles. The roots of all salvaged plant materials shall be protected from breakage or other damage and shall not be allowed to dry out.

1.6 WARRANTY

Furnished plant material shall have a warranty for plant growth to be in a vigorous growing condition for a minimum 12-month period. A minimum 12 month calendar time period for the warranty of plant growth shall be provided regardless of the contract time period. When plant material is determined to be unhealthy in accordance with paragraph PLANT ESTABLISHMENT PERIOD, it shall be replaced once by the Contractor, at the Contractor's expense, under this warranty. After 12 months, dead plants shall be replaced at no additional cost to the Contractor. All replacement plants shall be equal or better in quality, size and shape.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

2.1.1 Plant Material Classification

The plant material shall be nursery grown or salvaged native stock and shall be the species specified. Salvaged plant materials shall be those species of cactus and yucca, white bursage and creosote bush specified to

be salvaged for project or BLM use.

2.1.2 Substitutions

Plant substitutions will not be permitted without written request and approval from the Contracting Officer.

2.1.3 Quality

Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging, extraction, storage, or preparation for shipment, method of shipment, or shipment.

2.1.4 Growing Conditions

Plant material shall be native to or well-suited to the growing conditions of the project site. Plant material shall be grown under climatic and elevation conditions similar to those at the project site. Elevation changes between place of growth and project shall not exceed 61 meters (200 feet).

2.1.5 Method of Shipment to Maintain Health of Root System

2.1.5.1 Balled and Potted Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be done by hand digging or mechanical devices. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. Before shipment the root ball shall be dipped in gels containing mycorrhizal fungi inoculum. Container shall be used to retain the ball unbroken. Container shall be rigid to hold ball shape and protect root mass during shipping.

2.1.5.2 Bare-Root (BR) Plant Material

Minimum root spread shall be in accordance with ANLA Z60.1. A well branched root system characteristic of the species specified shall be provided. Roots shall not be pulled from the ground. Bare-root plant material shall be inoculated with mycorrhizal fungi during storage in the temporary nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. Bare-root plant material shall be dormant. The root system shall be protected from drying out.

2.1.5.3 Container-Grown (C) Plant Material

Container size shall be in accordance with ANLA Z60.1. Plant material shall be grown in a container over a duration of time for new fibrous roots to have developed and for the root mass to retain its shape and hold together when removed from the container. Container-grown plant material shall be inoculated with mycorrhizal fungi during root development in the

nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. The container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

2.1.6 Shrubs

Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.7 Plant Material Size

Plant material shall be furnished in sizes indicated on the Contract Drawings. Plant material larger in size than specified may be provided at no additional cost to the Government.

2.1.8 Plant Material Measurement

Plant material measurements shall be in accordance with ANLA Z60.1.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing 203 mm (8 inch) of surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the laboratory analysis and soil tests for the plant material specified.

Topsoil shall be free from slag, cinders, lumps of soil, sticks, roots, trash or other material over a minimum 76 mm (3 inch) diameter. Topsoil shall be free from plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of fertilizer and any other amendments recommended by the soil analysis report.

2.3.1 Fertilizer

The fertilizer composition shall be as recommended by the soil test. Fertilizer shall be controlled release, commercial grade; free flowing, pellet or tablet form; uniform in composition; and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients as recommended in the soil analysis report.

2.4 SOIL STABILIZER

Soil stabilizer shall be a mixture of plaster and natural cellulose fiber mulch. The plaster cellulose fiber mulch stabilizer shall be Plas-Tex(tm) Soil Stabilizer as formulated by Soil-Tech Co., 5375 Cameron Dr., Las Vegas, NV 89118 (702) 873-2023) or approved equal. Proposed substitutions

must be submitted to the Contracting Officer for review and approval.

2.4.1 Soil Stabilizer Properties

The plaster shall consist of naturally occurring high purity gypsum and necessary additives, such as retarders and accelerators and water to formulate a binder that will produce a protective crust-like barrier within 4 to 8 hours after application.

The gypsum shall be produced from a quarried or mined source. In addition, the processed gypsum shall be composed of a crushed dry calcium sulfate hemihydrate (CA S04 1/2H2O) having a purity of not less than 88 percent. The processed gypsum plus necessary additives shall be furnished either in bags or bulk and be accompanied by certificates stating 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 cellulose fiber mulch shall be produced from grinding clean, whole wood chips. The wood chips shall be thermally dehydrated to produce a high quality blend of fibers, dyed with a non-toxic vegetable based dye to aid in visual metering during application. The moisture content shall average 12 percent.

A color pigment shall be added to the slurry at the time of application. The pigment color shall be selected to blend with the existing site colors. Sample test plots of the proposed pigment color(s) shall be tested at the project site and approved by the Contracting Officer prior to application on the specified areas.

2.5 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.6 IRRIGATION WATER

Unless otherwise directed, irrigation water shall be the responsibility of the Contractor. Irrigation water shall not contain elements toxic to plant life.

2.7 IRRIGATION EQUIPMENT

The Contractor shall supply all temporary irrigation equipment necessary to water stored and transplanted plant materials throughout the duration of the contract.

2.8 BROWSE CONTROL DEVICES

Browse control devices shall be fabricated metal devices, durable enough to function for a period of not less than 3 years. The devices shall not contain any substance toxic to wildlife. The devices shall be fabricated and coated to inhibit rust and corrosion. The devices shall not inhibit normal plant growth.

2.9 PESTICIDES

Unless otherwise directed, pesticides and the use of any pesticides shall be the responsibility of the Contractor.

PART 3 EXECUTION

3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS

3.1.1 Planting Time

Plant material shall be installed from March 1 to April 30 and from September 1 to November 30.

3.1.2 Plant Material Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted for approval.

3.1.3 Tests

3.1.3.1 Soil Fertility Test

The Contractor shall collect a minimum of six composite soil samples from random locations on the site where revegetation activities will take place after the topsoil has been placed. Each of the three composite samples shall contain 725 grams (1.6 pounds) of topsoil for fertility testing. Soils shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the chemical analysis, and soluble salts analysis. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the plant materials specified. Three copies of the soil test results shall be provided to the Contracting Officer.

3.1.3.2 Soil Percolation Test

The Contractor shall conduct three on-site percolation tests to determine the rate of infiltration in the placed topsoil. The results of these tests shall be provided to the Contracting Officer. The information from the percolation testing shall be used to help determine irrigation requirements.

3.1.3.3 Temporary Irrigation Plan

The Contractor shall submit the temporary irrigation plan based on the test information.

3.2 SITE PREPARATION

3.2.1 Finished Grade, Final Slope Configuration, and Topsoil

The Contractor shall verify that preliminary finished grades are as indicated on drawings, and that the placing of topsoil that was stripped

and stored during the clearing and grubbing phase, and the compaction requirements have been completed in accordance with Section 02300 EARTHWORK. The final configuration of all embankment slopes shall be determined in the field in consultation with the Contracting Officer. Finished grades of all slopes shall be blended to the extent possible to match surrounding landforms. The Contracting Officer shall approve the final slope configuration prior to the commencement of the planting operation.

3.2.2 Layout

Plant material locations for cacti and yucca shall be staked on the project site with 24 inch colored pin flags a minimum of 48 hours prior to planting and approved by the Contracting Officer before any excavation for plant pits is made. A different color pin flag shall be used for each different species. Plant material locations may be adjusted by the Contracting Officer to meet field conditions and desired plant community composition.

The locations of all boulders and boulder groups shall be marked with 24-inch flags a minimum of 48 hours prior to placement of boulders. The boulder locations shall be marked with a different color flag than those used to mark plant materials. The flags shall be marked with a non-erasable marker identifying the number of boulders to be placed in each location.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to plant material location, type of plant and planting method shall be submitted for approval.

3.3.2 Plant Pits

Plant pits for container or salvaged plant material shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits for bare-root plant material shall be dug to a depth equal to the height of the root system. Plant pits shall be dug a minimum 50 percent wider than the ball or root system to allow for root expansion. The pit shall be constructed with sides sloping towards the base as a cone, to encourage well aerated soil to be available to the root system for favorable root growth. Cylindrical pits with vertical sides shall not be used.

3.4 INSTALLATION

3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown.

3.4.1.1 Bare-Root Plant Material

Bare-root plant material shall be placed in water a minimum 30 minutes prior to setting.

3.4.2 Cactus and Yucca Plant Orientation

All yucca and cactus shall be planted in the same north orientation as they were growing prior to being extracted and salvaged. The north marking on each plant shall be clearly visible so that the orientation may be checked by the Contracting Officer.

3.4.3 Backfill Soil Mixture

The plant pit backfill soil shall be the excavated soil from the plant pit.

3.4.4 Adding Mycorrhizal Fungi Inoculum

Mycorrhizal fungi inoculum shall be added as recommended by the manufacturer for the plant material specified.

3.4.5 Backfill Procedure

Prior to backfilling, all metal, wood, or synthetic products shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Additional requirements are as follows.

3.4.5.1 Bare-Root Plant Material

The root system shall be spread out and arranged in its natural position. Damaged roots shall be removed with a clean cut. The backfill soil mixture shall be carefully worked in amongst the roots and watered to form a soupy mixture. Air pockets shall be removed from around the root system, and root to soil contact shall be provided.

3.4.5.2 Container-Grown and Potted Plant Material

The plant material shall be carefully removed from containers that are not biodegradable. Prior to setting the plant in the pit, a maximum 1/4 depth of the root mass, measured from the bottom, shall be spread apart to promote new root growth. For plant material in biodegradable containers the container shall be split prior to setting the plant with container. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped.

3.4.5.3 Earth Berm

An earth berm, consisting of backfill soil mixture, shall be formed with a minimum 100 mm (4-inch) height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

3.4.6 Watering

Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

3.4.7 Browse Control

Approved browse control devices shall be provided for all nursery-grown and salvaged white bursage and creosote bush plant materials. One device shall be installed for each individual plant. The devices shall be installed in such a manner that they cannot be easily removed or damaged by indigenous wildlife.

3.4.8 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the pest management program.

3.4.8.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.4.8.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.5 FINISHING

3.5.1 Pruning

Pruning shall be accomplished by trained and experienced personnel. Only dead or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted.

3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant

establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes weeding, watering, maintaining berms around each plant, and adjustment of any settling. See ANSI A 300 for additional guidance.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Project areas and facilities that have been damaged from the planting operation and plant maintenance including watering shall be restored and/or planted to original condition or better at the Contractor's expense. Any plant materials destroyed outside of the specified work area shall be replaced at the Contractor's expense. Water truck haul routes shall be planted at the end of the maintenance period.

3.7.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

3.8 PLANT ESTABLISHMENT PERIOD

3.8.1 Commencement

Upon completion of the last day of the planting operation, the plant establishment period for maintaining installed plant material in a healthy growing condition shall commence and shall be in effect for 12 months. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described. The plant establishment period shall be coordinated with Section 02921 SEEDING. The plant establishment period shall be modified for inclement weather shut down periods, or for separate completion dates for areas.

3.8.2 Maintenance During Establishment Period

Maintenance of plant material shall include straightening plant material, straightening stakes; supplementing mulch; pruning dead or broken branch tips; watering; eradicating weeds, disease control ; post-fertilization; and removing and replacing unhealthy plants.

3.8.3 Irrigation System Approval

The Contractor shall review all short-term and long-term irrigation system proposals with the Engineer to ensure that said systems are adequate. No irrigation systems shall be installed or implemented without review and approval by the Engineer. Approvals from the Engineer shall be obtained 2 weeks prior to the time to begin required irrigation.

3.8.4 Watering Requirements

The plant material shall be watered once every other week during the hottest summer months and once per month during the remainder of the year

for the first year or as required to maintain the plant materials in a healthy condition. Run-off, puddling and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over seeded areas. Watering of other adjacent areas or existing plant material shall be prevented.

3.8.5 Soil and Plant Damage Caused by Irrigation

Any damage to soils or plants that result from the Contractor's excessive or irregular irrigation practices shall be repaired within 1 week by the Contractor at no additional cost.

3.8.6 Weeding

Weeds in the installed areas shall not be allowed to reach a maximum 75 mm (3 inches) height before being completely removed, including the root system.

3.8.7 Post-Fertilization

The plant material, except cactus and yucca, shall be topdressed at least once during the period of establishment with controlled release fertilizer, reference paragraph SOIL AMENDMENTS. Apply at the rate of 1 kilogram per 10 square meters of plant pit or bed area. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.8.8 Plant Pit Settling

When settling occurs to the backfill soil mixture, additional backfill soil shall be added to the plant pit or plant bed until the backfill level is equal to the surrounding grade. Serious settling that affects the setting of the plant in relation to the maximum depth at which it was grown requires replanting in accordance with paragraph INSTALLATION. The earth berm shall be maintained.

3.8.9 Maintenance Record

A bi-monthly plant maintenance record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

3.8.10 Unhealthy Plant Material

Cacti, yucca, white bursage and creosote bushes shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for improving survival of replacement plant materials. Unhealthy or dead plant material shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.8.11 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION, and recommendations in paragraph PLANT ESTABLISHMENT PERIOD. Plant material shall be replaced in accordance with paragraph WARRANTY. An extended plant establishment period shall not be required for replacement plant material.

3.8.12 Maintenance

3.8.12.1 Maintenance Instructions

The Contractor shall submit the maintenance instructions for year-round care of installed plant material. Schedule for irrigation and maintenance activities of stored and installed plant materials.

3.8.12.2 Maintenance Activities

Routine maintenance activities shall be performed by the Contractor including but not limited to routine watering, maintenance of water berms around shrubs, weeding, reseeding bare spots, determining cacti, yucca and shrub plant survival, providing and planting replacement plants and repair of browse control devices. Maintenance activities shall be documented on the Bi-Monthly Plant Maintenance Record form provided by the Contracting Officer or a substitute form provided by the Contractor and approved by the Contracting Officer.

-- End of Section --

BI-MONTHLY PLANT MAINTAINCE RECORD

F-1 and F-2 DEBRIS BASINS

This record shall be submitted to the US Army Corps of Engineers Bi-Monthly During the 1-Year Maintenance Period. A separate form shall be submitted for each site.

LANDSCAPE CONTRACTOR: _____				
Telephone Number: Office _____		Cell _____		
Employee Name (Responsible for Work) _____			Date: _____	
Site: _____		Time: _____		
Weather: _____				
Watering Record				
Date	Watering Method (Hose, Truck, Other)	Temp.	Gallons Applied	Comments
Plant Maintenance (Weeding, Plant Replacement, Fertilizing, Pruning, etc.)				
Date	Plant Species	Maintenance Activity Description		
Other Observations and Issues to be Resolved				
Comments				

Other Notes Regarding Plant Conditions (Mortality, Stress, etc.)

Signed: _____ **Date:** _____

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE WORK

SECTION 02950

SIMULATED DESERT VARNISH ROCK COLOR MITIGATION

PART 1 GENERAL REQUIREMENTS

1.1 Submittals

PART 2 PRODUCTS

2.1 Simulated Desert Varnish Rock Color Mitigation

PART 3 EXECUTION

3.1 General

3.2 Surface Preparation

3.3 Sample Area

3.4 Application of Simulated Desert Varnish

-- End of Section Table of Contents --

SECTION 02950

SIMULATED DESERT VARNISH ROCK COLOR MITIGATION

PART 1 GENERAL REQUIREMENTS

The Contractor shall furnish qualified personnel, equipment, labor, and materials, and perform all work for applying desert varnish in the locations shown on the Contract Drawings, and as directed by the Contracting Officer.

1.1 Submittals

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The "RE" designates that the Resident Office will review the submittal for the Government. Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment.

A listing of equipment to be used for the application of simulated desert varnish.

Simulated Desert Varnish; G, RE.

Manufacturers printed information for simulated desert varnish to be used to stain boulders, road surfaces, and embankment slopes where soils contrast with surrounding color.

PART 2 PRODUCTS

2.1 Simulated Desert Varnish Rock Color Mitigation

The coloring material shall be a single step, simulated desert varnish that will impart or restore natural patinas to the designated areas in an environmentally friendly way without the use of caustic or acidic materials. The material shall produce stable, oxidized colors with a projected life of 100 years. The rock coloring material shall be PERMEON or an approved equal. PERMEON is available from the following manufacturer or manufacturer's licensees.

Manufactured by:

Advanced Concrete Technologies
11622 Newport Avenue
Santa Ana, CA 92705
(714) 731-0906

Authorized Permeon Applicators:

Soil-Tech

5375 Cameron Drive
Las Vegas, NV 89118
(702) 873-7585

Desert Rock Supply

P.O. Box 924
La Quinta, CA 92253
(760) 360-1354

Arizona Rain Sprinkling

129 West Elwood
Phoenix, AZ 85041
(602) 268-8100

PART 3 EXECUTION

3.1 General

The rock coloring material shall be applied only by licensed applicators or by applicators approved by the manufacturer. Variegated patinas that develop shall be controlled by custom blending of the rock coloring material and/or application techniques. The rock coloring material shall be clear when applied and full color development shall occur within two to four weeks. A listing of equipment to be used for the application of simulated desert varnish shall be submitted prior to beginning of operation.

3.2 Surface Preparation

The rock coloring material shall be applied directly to clean rock surface. There shall be no dust or soil on the rock surface at the time of the application. The conditions of the rock shall be inspected and approved by the Contracting Officer prior to application of the simulated desert varnish.

3.3 Sample Area

The Contractor shall apply the rock coloring to a test section to be reviewed by the Contracting Officer. Upon approval of the test section(s) and application procedures, by the Contracting Officer, the Contractor may proceed.

3.4 Application of Simulated Desert Varnish

The soil and rock surfaces to be treated shall be uniformly stained to blend with the surrounding colors in the environment. The Contracting Officer shall approve the stain coverage of all treated areas.

-- End of Section --

This page was intentionally left blank for duplex printing.