



SPORTSPLEX OUTFALL IMPROVEMENTS

BID & CONTRACT DOCUMENTS

VOLUME 2 of 2: PROJECT SPECIFICATIONS

Southern Sandoval County Arroyo Flood Control Authority

IFB # 2026-05

SSCAFCA PROJECT NUMBER: MO_P0030-02

FUNDING SOURCES:

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The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal as a professional engineer licensed to practice in the state of New Mexico, is affixed below:



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TECHNICAL SPECIFICATION 1503

MOBILIZATION

Revised 08/19/2025

1503.1 DESCRIPTION

This work shall consist of preparatory and final work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to and from the project site; for the establishment of all offices, buildings and other facilities necessary for work on the project; and, for all other work and operations which must be performed or costs incurred prior to beginning work on the project.

1503.2 ADMINISTRATION REQUIREMENTS

1503.2.1 DEFINITIONS

“Total Original Contract Amount” shall mean the total amount bid as compensation for the contract.

“Total Original Contract Amount Less Mobilization” shall mean the total amount bid as compensation for the contract less the amount bid for mobilization.

1503.2.2 GENERAL

It is the intent of this specification to provide for the contractor to receive 100% of the amount bid for Mobilization by the time the Contractor has performed 10% of the total original contract amount less Mobilization.

1503.2.3 PAYMENT PROCEDURES

The following will apply in effecting mobilization payments:

- A. When the Contractor is eligible for payment of less than 5% of the total original contract amount bid less mobilization, the Contractor will be paid 25% of the amount bid for mobilization.
- B. When the Contractor is eligible for payment of from 5% to less than 10% of the total original amount bid less mobilization, the Contractor will be paid 50% of the amount bid for mobilization minus any mobilization amount already paid.
- C. When the Contractor is eligible for payment of 10% or more of the total original contract amount less mobilization, the Contractor will be paid 100% of the amount bid for mobilization minus any mobilization amount already paid.

1503.2.4 PAYMENT CALCULATION

PM = Mobilization Payment

M = Total amount bid for Mobilization

fM = Mobilization payment percentage factor (0.25, 0.50, or 1.0, as applicable)

PM = M x fM

EXAMPLE MOBILIZATION PAYMENT CALCULATION

Total Original Contract Amount Bid	\$110,000
Amount Bid for Mobilization	\$ 5,000
Total Original Contract Amount Less Mobilization	\$105,000

Percent of Work Completed	Fm	M	PM
< 5% of \$105,000	0.25	5,000	\$1,250
> 5% to < 10% of \$105,000	0.50	5,000	\$2,500*
≥ 10% of \$105,000	1.00	5,000	\$5,000*
<i>*minus previously paid amounts</i>			

1503.3 METHOD OF MEASUREMENT

See example provided in 1503.2.4.

1503.4 BASIS OF PAYMENT

Mobilization will be paid for at the contract price provided in the Unit Cost Bid Proposal, in accordance with this specification.

No additional payments will be made for demobilization and remobilization due to shutdowns or suspensions of the work or for other mobilization and demobilization activities required to complete the contract.

END OF SECTION

TECHNICAL SPECIFICATION 1507

MATERIALS TESTING

Revised 08/19/2025

1507.1 DESCRIPTION

This specification includes materials testing and quality control measures required on this project. This specification is additional to requirements specified for testing and quality assurance in the construction plans.

Materials and equipment are subject to inspection, sampling, and testing before acceptance of the work.

1507.2 RELATED WORK

General and Supplemental General Conditions of the Contract.

1507.3 REFERENCES AND DEFINITIONS

- 1507.3.1 All materials and equipment shall be tested, by the CONTRACTOR, pursuant to their technical specification (unless otherwise specified herein) and the manufacturer's recommendations.
- 1507.3.2 "Structure" shall include but is not limited to: parking lots, pavement, sidewalk, curb and gutter, foundations, structural concrete, piping, wet-wells, manholes, retaining walls, junction boxes, and buildings.

1507.4 TESTING SUBMITTALS

- 1507.4.1 Test Reports from tests performed by independent testing firm: Submit for acceptance, complete test reports from approved independent testing laboratories certifying that product conforms to performance characteristics and testing requirements specified herein and in other supplemental/standard specifications. Independent firm to submit reports to the ENGINEER and CONTRACTOR, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- 1507.4.2 Test Reports from tests performed by CONTRACTOR: Submit for acceptance, complete test reports from CONTRACTOR certifying that product conforms to performance characteristics and testing requirements specified herein and in other supplemental/standard specifications.

1507.5 QUALITY ASSURANCE

- 1507.5.1 Quality Assurance/Control of Installation – The CONTRACTOR shall:
 - A. Comply fully with manufacturers' instructions, including each step in sequence.
 - B. Request clarifications from ENGINEER before proceeding should manufacturers' instructions conflict with Contract Documents.
 - C. Request clarification from ENGINEER before proceeding if the specified reference standards conflict with Contract Documents. The contractual relationship of the parties

to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

- D. Comply with specified standards as a minimum quality for the work except when more stringent specified tolerances, codes, or requirements indicate higher standards or more precise workmanship are required.
- E. Make sure work is performed by qualified persons.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1507.5.2 Testing Laboratory Services

- A. Reports will be submitted by the independent firm to the ENGINEER and CONTRACTOR, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

1507.6 TESTING METHODS

Testing methods shall comply with ASTM Standards and as specified in the technical specifications and construction plans for the project.

1507.7 EXECUTION

1507.7.1 Testing Laboratory Services

- A. The CONTRACTOR will employ and pay for services of an independent testing firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual Specification Sections and as required by the OWNER.
- C. CONTRACTOR shall:
 - I. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - II. Notify ENGINEER and independent firm **8 hours** prior to expected time for operations requiring services.
 - III. Make arrangements with independent firm and pay for additional samples and tests required for CONTRACTOR's use.

1507.7.2 Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the ENGINEER. No additional payment will be made for re-testing due to failing tests.

1507.8 TESTING FREQUENCY & TYPES OF TESTING

Frequency and type of testing shall be per the requirements listed in the specifications for each type of Work. The ENGINEER may increase and/or add testing for any Work items. The Testing Allowance will be adjusted for increases in testing by [Section 1507.9](#).

1507.9 MEASUREMENT & PAYMENT

1507.9.1 Testing shall be paid for as an ALLOWANCE. The CONTRACTOR may request percent of MATERIALS TESTING payments during construction, however, the CONTRACTOR shall provide

actual testing lab invoices as back-up for the percent complete that is being requested in a Pay Application.

1507.9.2 Testing Allowances are provided as part of the project. Invoices for testing will be paid for through this allowance.

1507.9.3 Costs included in testing price include:

- A. Cost of engaging an independent testing firm, execution of tests by the testing firm, and reporting results by the testing firm.
- B. Costs of incidental labor and facilities required to assist testing firm.
- C. Costs of testing laboratory services used by CONTRACTOR separate from Contract Document requirements
- D. Costs of re-testing due to failure of previous tests will be included in the cost for testing and no additional payment will be made for this work.

1507.9.4 The CONTRACTOR shall submit copies of the testing firm's invoice to OWNER with Pay Application. Reimbursement to the CONTRACTOR will be for actual invoiced costs and no mark-up will be added to this invoice. CONTRACTOR shall receive reimbursement for actual invoice of testing firm upon certification that payment has been made to the testing laboratory. Payment will be made at the next application for payment from OWNER.

END OF SECTION

TECHNICAL SPECIFICATION 1508

PROJECT RECORD DOCUMENTS

Revised 08/20/2025

1508.1 GENERAL

This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

1508.2 RECORD DRAWINGS

Record Prints: Maintain one set of red-lined prints of the Contract Drawings and Shop Drawings. These prints shall be updated no less frequently than once per week. These prints will be reviewed for verification of updates by the OWNER or OWNER's representative on a regular basis, depending on the length of the contract.

Immediately before inspection for Certificate of Substantial Completion, CONTRACTOR will review marked-up Record Prints with ENGINEER.

- 1508.2.1 Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Mark whichever drawing is most capable of showing field conditions fully. Require individual or entity who obtained record data, whether individual or entity is Installer, SUB-CONTRACTOR, or similar entity, to prepare the marked-up Record Prints.
- a) Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b) Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
- 1508.2.2 Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-references on the Contract Drawings.
- 1508.2.3 Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 1508.2.4 Note Construction Change Directive numbers (field orders or Request for Information changes), alternate numbers, Change Order numbers, and similar identification, where applicable.
- 1508.2.5 Verification of current record prints status will be included in the [monthly payment approval process](#) that will be noted by the Construction Observer's field reports.

1508.3 RECORD SPECIFICATIONS

Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Give

particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

Note related Change Orders, field order notes, Request for Information (RFI) notes, Record Product Data, and Record Drawings where applicable.

1508.4 MISCELLANEOUS RECORD SUBMITTALS

Assemble Certifications, Lab Test Reports, and Field Test Reports required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1508.5 SUBMITTALS

See New Mexico Standard Specifications For Public Works Construction [Section 1502](#).

1508.6 RECORDING & MAINTENANCE

- 1508.6.1 Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur.
- 1508.6.2 Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. It is not advisable to use Project Record Documents for construction purposes. Provide access to Project Record Documents for ENGINEER's reference on the project site.

1508.7 MEASUREMENT & PAYMENT

The cost of project record documents shall be incidental to the Work and no separate payment shall be made for this effort. However, the Project Record Documents shall be reviewed per [Section 1508.2.5](#) and they shall be updated prior to pay applications being processed.

END OF SECTION

TECHNICAL SPECIFICATION 1510

EXCAVATION, OVER-EXCAVATION, BORROW, AND FILL

Revised 08/20/2025

1510.1 GENERAL

- 1510.1.1 Excavation, over-excavation, borrow, and fill shall consist of all earthwork operations involved in grading and construction in accordance with the plans and specifications, except for: Excavation and backfill for structures, Excavation and backfill for trenching, and any other earthwork operations separately designated.

1510.2 REFERENCES

This section incorporates the following publications by reference:

- | | |
|---------------|-----------------------|
| • ASTM D-1557 | This publication: |
| • ASTM D-422 | • NM APWA Section 201 |
| • ASTM D-4318 | • SSCAFCA 1513 |
| • ASTM D-6938 | • SSCAFCA 1514 |

1510.3 MATERIAL CLASSIFICATIONS

1510.3.1 UNSUITABLE MATERIAL

Unsuitable materials shall include all material that contains debris, roots, organic matter, stones or boulders too large to be used in the intended construction, or other materials that are determined by the Engineer to be unsuitable. Otherwise suitable materials, which are unsuitable due to excess moisture content, will not be classified as unsuitable material unless it cannot be dried by manipulation, aeration or blending with other materials satisfactorily as determined by the Engineer.

Material that is unsuitable for the intended use shall be excavated and removed from the site or otherwise disposed of as approved by the Engineer. Unsuitable material shall be disposed of in accordance with environmental requirements and as approved by the Project Manager.

1510.3.2 FILL MATERIAL

All fill material shall be free of vegetation and debris. Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up. Fill materials shall be free of vegetation and debris and contain no rocks larger than 3 inches. All fill and backfill material, including selection and blending of material, shall be subject to approval by the Engineer. All fill material shall conform to the requirements for Structural Fill as outlined below.

1510.3.3 STRUCTURAL FILL AND BACKFILL

Structural fill and backfill shall consist of material excavated from on-site or Borrow Material that meets the requirements described in this section. The blended excavated site soils from within the area will be generally suitable for use as structural fill. Blending of soils shall be considered incidental to the Work and no separate payment will be made for this effort. Gradation of the fill material, as determined in accordance with ASTM D-422, shall be as follows:

Sieve Size (Square Openings)	Percent Passing (by Weight)
3 inch	100
No. 4	60-100
No. 200	5-40

All structural fill shall be blended as necessary to produce a homogeneous material. The plasticity index of the structural fill shall be no greater than 15 when tested in accordance with ASTM D-4318.

1510.3.4 BORROW MATERIAL

Borrow material is defined as material obtained from an approved borrow source to be used as structural fill material for construction. If borrow material is required, the Contractor shall identify a borrow site and obtain soils tests to verify compliance of the material with structural fill requirements per this specification. The Contractor shall not import any borrow material prior to verification that material meets the requirements contained herein and he has received approval to import the material by the Owner.

1510.3.5 SURPLUS MATERIAL

The Contractor shall make all arrangements for disposal of surplus material in accordance with environmental requirements and as approved by the Project Manager. If the material is disposed of on-site, the Contractor shall place material in locations as designated by the Owner. Do not remove materials from the project limits without the approval of the Owner. The Contractor shall satisfy themselves that there is sufficient material available for the completion all items requiring fill material before disposing of any indicated surplus material inside or outside of the project area. Any shortage of material caused by premature disposal of surplus material by the Contractor shall be replaced by the Contractor and no payment will be made for such replacement.

1510.4 CONSTRUCTION REQUIREMENTS

1510.4.1 GENERAL

Contractor shall perform necessary clearing, grubbing and stripping in accordance with [Section 201](#) of the Specifications and [Supplemental Technical Specification 201](#), "Clearing and Grubbing", prior to any excavation, grading, or other earthwork operations. Excavation, fill construction and backfill shall be finished to reasonably smooth and uniform surfaces.

All slopes and cuts should be made in accordance with CFR 29 Part 1926 Subpart P, and all other applicable regulations.

1510.4.2 EXCAVATION

Excavation shall consist of the removal of earth involved in grading and construction according to the plans, except other excavations separately designated.

Temporary construction excavations shall be made in accordance with CFR 29 Part 1926 Subpart P, and all other applicable regulations. Surface water shall be routed such that it does not flow down the face of the excavation slopes. Where insufficient space exists for open cut excavations, a shoring system will be required. All required shoring systems shall be considered incidental to the cost of excavation and no additional payment will be made for this item. All excavations shall comply with all applicable safety regulations.

1510.4.3 OVER-EXCAVATION

Over-excavation shall consist of removal and replacement (backfill) of earth to the limits and depths provided in the plans. Backfill of over-excavated areas shall be in accordance with 1510.3.2.

1510.4.4 FILL CONSTRUCTION

Fill construction shall consist of constructing embankments, the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of suitable materials in holes, pits, and other depressions.

1510.4.5 PLACING AND COMPACTING

Fill or backfill, consisting of soil approved by the Engineer and/or recommended in the project's Geotechnical Report, should be placed in controlled compacted layers not exceeding 8 inches (compacted) with approved compaction equipment. All fill material should be blended as necessary to produce a homogeneous fill.

The fill should be raised uniformly and should be benched into the native soils. All compaction should be accomplished to a minimum of 95 percent of maximum dry density. No lifts of high permeability material or material differing substantially from the lift below shall be permitted.

At locations where it would be impractical to use mobile power compacting equipment, fill layers shall be compacted to the specified requirements by any approved method that will obtain the specified compaction.

1510.5 TESTING

- 1510.5.1 Tests for degree of compaction should be determined in accordance with ASTM D-1556 or ASTM D-6938.
- 1510.5.2 A compaction test is required on every lift or every 500 SY, whichever is less.
- 1510.5.3 Continuous, full time observation and field tests should be conducted during fill and backfill placement by a representative of the Engineer to assist the contractor in evaluating the required degree of compaction. If less than the required compaction is obtained, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

1510.6 MEASUREMENT AND PAYMENT

1510.6.1 UNSUITABLE MATERIAL

The removal and disposal of unsuitable material will be paid for as “[Excavation, Removal, and Disposal of Unsuitable Material](#)” for the quantities involved. This item will be created via Change Order, if the situation arises.

1510.6.2 EXCAVATION

Payment will be made on the unit price per cubic yard for “[Unclassified Excavation](#)” as provided in the Unit Price Bid Proposal. Payment will include the cost for all excavation, removal, storage and disposal of unsuitable material, hauling of surplus material to the designated location(s), hauling of select material within the construction site, placement, and compaction.

No payment will be made for excavation of stockpiled materials, structural excavation of previously placed materials and over depth (over-excavation) cuts. No payment will be made for shrink or swell. Excavation beyond the limits shown in the plans will not be included in measurement or payment.

1510.6.3 OVER-EXCAVATION

Payment will be made on the unit price per cubic yard for “[Over-Excavation](#)” as provided in the Unit Price Bid Proposal. Payment will include the cost for all excavation, removal, storage and disposal of unsuitable material, hauling of select material within the construction site, placement, and compaction.

No payment will be made for excavation of stockpiled materials. No payment will be made for shrink or swell. Excavation beyond the authorized over-excavation limits shown in the plans will not be included in measurement or payment.

1510.6.4 BORROW

Borrow material will be measured by the cubic yard in-place after compaction. Field topographic surveys, as described in [SSCAFCA Technical Specification 1513 or 1514 "Construction Staking"](#), will be used to determine in-place quantities.

Payment will be made on the unit price per cubic yard for ["Borrow"](#) as provided in the Unit Price Bid Proposal. Payment will include excavation & haul from Borrow Area, moisture conditioning, required blending of soils, placement, compaction, and other related work.

END OF SECTION

TECHNICAL SPECIFICATION 1511

NPDES COMPLIANCE

Revised 01/07/2026

1511.1 SCOPE OF WORK

The work under this section includes compliance with the U.S. Environmental Protection Agency (EPA), National Pollutant Discharge Elimination System (NPDES) Regulations for Storm Water Discharges from construction sites. This work consists of implementing and maintaining a plan to control erosion, pollution, sediment and runoff during the construction of the project.

1511.2 MEASUREMENT AND PAYMENT

1511.2.1 UNIT PRICE BID PROPOSALS

For Unit Price Bid Proposals, NPDES Compliance shall be a Lump Sum (LS) item, paid for as follows:

1511.2.1.1 Fifteen (15) percent of the Lump Sum unit price amount shall be paid after the Contractor has completed an EPA Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under a NPDES General Permit, Form 3510-9, or a Low Erosivity Waiver (LEW) form, if applicable. A copy of the NOI or LEW form must be delivered to the Owner and the original filed with the EPA. All required erosion control measures sufficient to begin construction must also be in place. This will be defined in the plan specifications and/or the SWPPP.

1511.2.1.2 Payment for an additional sixty percent (60%) of the Lump Sum unit price amount shall be prorated based on the Actual Percent Complete on the Application for Payment as approved by the Architect, Engineer or Landscape Architect. For example, if the Contractor is 20% complete, the contractor can take the 20% (0.2) and multiply it by 60% (0.6) of the Lump Sum unit price amount and receive that portion.

In order to receive payments, the field inspection forms must be sent in with the Application for Payment each month. If there are deficiencies maintaining or implementing the SWPPP and its Best Management Practices (BMPs), the payment will be withheld until the deficiencies are corrected.

1511.2.1.3 The remaining twenty-five (25) percent of the Lump Sum unit price amount will be based on the completion of an EPA Notice of Termination (NOT) of Coverage Under a NPDES General Permit for Storm Water Discharges Associated with Construction Activity and BMP removal. A copy of the NOT must be delivered to the Owner and the original filed with the EPA. BMPs must be removed as defined in the plan specifications or SWPPP. This is done in case there are some BMPs that must remain until final stabilization is met, and that there are no more NPDES concerns for the Contractor.

END OF SECTION

TECHNICAL SPECIFICATION 1512

CONTROL OF STORM WATER AND NUISANCE FLOW

Revised 08/19/2025

1512.1 DESCRIPTION

This specification covers the requirements to control storm water and nuisance flows through the project area during construction.

Two (2) types of flow can be expected;

- 1) Continuous or intermittent flow through existing flow paths;
- 2) Local sheet flow from adjacent properties or adjacent streets.

1512.2 CONSTRUCTION REQUIREMENTS

All permanent work shall be performed in areas free from storm water and/or nuisance flows.

The CONTRACTOR shall construct and maintain diversion methods necessary to divert storm water and/or nuisance flows away from work areas, or otherwise ensure work is not damaged from storm water or nuisance flows. Diversion methods may include the use of sandbag and/or diversion channels, sandbag and/or earthen berms, pumping and/or piping around, over, or through work areas, or any method or combination of methods required to control storm water and/or nuisance flows within the project area.

The CONTRACTOR shall furnish, install, maintain, and operate all necessary pumping and other dewatering equipment required for dewatering the affected work areas. This effort shall also include removal of ice and/or snow within the work area, if applicable. The cost of dewatering work, including labor, shall be included in the lump sum price for this bid item.

The CONTRACTOR shall be responsible for removal of any sediment deposited by storm and nuisance water. The cost of sediment removal work shall be included in the lump sum price for this bid item.

If the CONTRACTOR's diversion methods are unsuccessful, at no additional cost to SSCAFCA, the CONTRACTOR will be responsible for providing a plan [within two working days](#) to repair all damage, including damage to the existing arroyo and/or flood control facility and damage to new work within the project area. The plan shall be acceptable to SSCAFCA. The cost of implementing this plan shall be included in the lump sum price for this bid item.

1512.3 BASIS OF PAYMENT

Control of Storm Water and Nuisance Flow will be measured on a Lump Sum (LS) basis and payment of this item will be made as a percentage of the dollar amount of work completed to date, minus the Mobilization bid item.

<u>Pay Item</u>	<u>Pay Unit</u>
Control of Storm Water and Nuisance Flow	LS

END OF SECTION

TECHNICAL SPECIFICATION 1513

CONSTRUCTION SURVEY & STAKING

Revised 08/20/2025

1513.1 DESCRIPTION

This work consists of construction survey and construction staking lines, grades, and layouts by the CONTRACTOR in accordance with the plans and specifications and as directed by the ENGINEER for the control and completion of the project.

1513.2 MATERIALS

CONTRACTOR shall furnish all stakes, templates, straightedges, surveying equipment and other devices necessary for establishing, checking, marking, and maintaining points, including P.I.'s, P.C.'s, P.T.'s, and lines, grades and layouts. As directed by the OWNER and/or ENGINEER, points shall be referenced so that they may later be re-established.

1513.3 CONSTRUCTION REQUIREMENTS

CONTRACTOR shall be responsible for all control, slope stakes, cut stakes, offset stakes, benchmarks, blue tops or other staking necessary for proper execution of the work, or as requested by the OWNER and/or ENGINEER, to assure compliance with the plans. [The OWNER and/or ENGINEER may request additional survey information at their discretion.](#)

1513.4 CONSTRUCTION SURVEYS

CONTRACTOR shall obtain and pay for the services of a Professional Surveyor licensed in the State of New Mexico to perform surveys consisting of the following phases:

- 1513.4.1 Phase 1 EG Survey: A topographic survey, with a contour resolution of 1-foot or less, to accurately reflect the Project Site [existing ground \(EG\)](#) elevations. Unless otherwise directed by the OWNER and/or ENGINEER, Phase 1 Survey shall **not** occur before Clear & Grub and Removals bid items are completed. Phase 1 Survey shall include Borrow Area, if applicable.

Phase 1 Survey shall include development of an EG digital terrain model (DTM) of the Project Site, which will be used to determine earthwork quantities to be paid to CONTRACTOR. The Phase 1 Survey DTM shall be submitted to the ENGINEER for [review and written acceptance](#) prior to proceeding with any earthwork.

- 1513.4.2 Phase 2 FG Survey: An as-built topographic survey, with a contour resolution of 1-foot or less, to accurately reflect the Project Site [finished ground \(FG\)](#) elevations and to determine final earthwork quantities to be paid to CONTRACTOR. Phase 2 Survey shall include Borrow Area, if applicable.

Phase 2 survey shall have sufficient detail to demonstrate compliance with the design grades, structure elevations, inverts, alignments/profiles, etc. shown on the construction plans. It is the responsibility of the CONTRACTOR to coordinate with the surveyor on a regular basis to provide as-built information to incorporate in the Phase 2 survey, especially for project elements that will be buried in the FG condition.

Phase 2 survey shall be stamped, signed, and certified by a Licensed Professional Surveyor and provided in pdf format.

Phase 2 Survey also includes development of an FG DTM of the Project Site. The Phase 2 Survey DTM shall be submitted to the ENGINEER for review and written acceptance prior to final Pay Application. Earthwork volumes shall not include surfacing treatments such as rock, riprap, concrete, etc. Earthwork volume computations shall be performed by the surveyor based on the "average end area" computation.

Phase 2 Survey shall be such that methods and computations can be fully verified and are subject to approval by the OWNER and/or ENGINEER. The OWNER and/or ENGINEER may request additional survey information at their discretion.

1513.5 METHOD OF MEASUREMENT

Submit a construction-staking schedule of values as part of each Pay Application to the Project Manager for approval.

1513.6 BASIS OF PAYMENT

SSCAFCA will make partial payments in accordance with the approved construction-staking schedule of values.

<u>Pay Item</u>	<u>Pay Unit</u>
Construction Staking	Lump Sum

END OF SECTION

TECHNICAL SPECIFICATION 1515

REMOVAL OF STRUCTURES & OBSTRUCTIONS

Revised 01/07/2026

1515.1 DESCRIPTION

This work shall consist of removing and disposing of surface and subsurface features to clear the project site for construction. This includes concrete debris, fences, structures, pavements, curb and gutter, sidewalks, buried pipes, and any other items listed within the construction plans. All removal and salvage features included in these items will be designated in the contract.

1515.2 MATERIALS

Suitable materials are those materials which can be compacted to the required embankment densities and meet all other contract requirements for embankment materials. If applicable, the project Geotechnical Report would include this information.

1515.3 CONSTRUCTION REQUIREMENTS

1515.3.1 SUITABLE MATERIALS

Suitable materials are those materials which can be compacted to the required embankment densities and meet all other contract requirements for embankment materials. If applicable, the project Geotechnical Report would include this information.

1515.3.1.1 Marking of Removal Limits

Prior to work on the site, the Contractor shall establish the right-of-way lines and construction limits confining the removal operations and will designate those surface and subsurface features for removal and those for preservation. The Owner or designee shall be offered the opportunity to review the removal limits before work commences.

1515.3.1.2 Temporary Erosion Control

Ensure all erosion control requirements and all necessary temporary sediment and erosion control protection devices (TESCP), if called for in the contract, are installed prior to initiating removal operations on the construction site. The TESCP items will be paid for under the SWPPP pay item.

1515.3.1.3 Protection of Site Features

The Contractor shall preserve and protect all existing improvements, adjacent property, utilities, and surface or subsurface features not to be removed from injury or damage resulting from their operations. This may require the Contractor to install temporary signing, temporary fencing, or other temporary features at their cost. Should any damage occur to these site features due to the Contractor's operations, the Owner or designee may withhold payment until the damage is remediated or require the damaged items to be replaced at the Contractor's expense.

1515.3.2 REMOVAL AND SALVAGE OPERATIONS

Remove all surface features and subsurface features designated for removal in the contract and dispose of them at a properly permitted disposal site. Provide the Owner or designee with a copy of the written permission from the property owner and copies of any other necessary disposal permits or approvals.

Carefully remove and salvage all surface features and subsurface features designated for salvage in the contract and store and deliver these materials in accordance with the contract requirements. The Contractor shall repair any damage to salvageable items that occurs during their removal, storage, or delivery operations at no cost to the Owner.

Backfill holes created by structure or obstruction removals as per SSCAFCA Standard Specification 1510 with suitable materials, unless the area is within the area of new construction.

1515.3.2.1 Removal of Pavements, Sidewalks, Curb and Gutter

Pavements, sidewalks, and curb and gutter shall be removed to neat saw cut lines as identified in the Contract, and dispose of them off the project site.

1515.3.2.2 Removal of Culverts and Drainage Structures

The Contractor shall sequence the removal of existing culverts and drainage structures so drainage is maintained on the project. This may require installation of temporary drainage features at Contractor's sole cost.

1515.3.2.3 Removal of Sanitary Sewer and Water Utilities

The Contractor shall sequence the removal of existing sanitary sewer and water utilities to minimize the impacts to local businesses and residents. The sequencing of removals shall be coordinated with SSCAFCA prior to performing removal operations in the field.

1515.3.2.4 Removal of Bridges and Arroyo Features

If the Contract includes the removal of a bridge or feature in an arroyo, remove the existing structures down to the arroyo bottom elevation OR an elevation sufficient to allow for proposed grading, proposed over-excavation, or proposed installation of infrastructure, as shown in the Contract documents.

Remove existing structures outside the arroyo to one (1) foot below ground surface, unless otherwise directed in the Contract.

1515.3.2.5 Removal and/or Salvage of Fencing

If the contract includes removal of fencing materials, remove all fence materials, including posts and post foundations and backfill holes with suitable materials.

If the Contract includes salvaging of fencing materials, place barbed wire into single-strand rolls and minimize the damage to fence posts when pulling them.

1515.3.2.6 Hauling and Stockpiling Salvageable Material

If the Contract requires the Contractor to haul and stockpile salvageable material, load, haul, unload, and stockpile the materials in accordance with the Contract.

Place the salvageable material on blocks or other approved materials and maintain the stockpile area, as directed by the Owner or designee.

1515.3.2.7 Site Appearance

The site shall have a neat and finished appearance when removal operations are finished, except for areas where construction activities are planned.

1515.3.2.8 Disposal

Dispose of all removal items outside the project at a permitted location. If applicable, a disposal plan, including written permission from private property owners used for debris material disposal, shall be submitted to the Owner or designee prior to commencement of disposal activities.

1515.3.2.9 Burying

No burying of any removed debris will be allowed on the project site.

1515.3.2.10 Burning

No burning of any removed debris will be allowed on the project site. In addition, no accumulation of combustible materials shall be stored on the project site near property lines or areas where an unexpected fire could cause damage to existing site features.

1515.4 METHOD OF MEASUREMENT

No measurement will be made for lump sum removal of structures and obstructions.

No measurement of the removal of surfacing will be made if the lump sum basis of payment is used.

Removal of surfacing will be made by the Square Yard if Square Yard basis of payment is used.

1515.5 BASIS OF PAYMENT

<u>Pay Item</u>	<u>Pay Unit</u>
Surfacing	Square Yard

Additional payment for minor removals not specified in the Contract shall not be made.

Unknown buried features not identified in the Contract are not included in this item.

Payments shall be made based on percentage of the pay item completed at the date of monthly Pay Application submittal.

END OF SECTION

TECHNICAL SPECIFICATION 1516

GALVANIZED GABION MAT

PART 1 GENERAL

1.1. SUMMARY

The work under this specification includes furnishing, assembling, filling and tying double twist woven wire mesh Gabion mats placed on a prepared surface as specified, and in accordance with the lines, grades, and dimensions shown on plans or otherwise established in the field by project engineer.

1.2. UNIT PRICES

1.2.1 Measurement

Gabion mats meeting the requirements of these specifications and acceptably placed within the limits indicated on the drawings or otherwise established in the field, shall be measured for payment by the cubic yard (cubic meter) of stone filled Gabion mats in place.

1.2.2 Payment

Payment shall be made for costs associated with Gabion mat, including the costs of furnishing, assembling, and placing the wire baskets, the stone fill, and all other materials, labor, equipment, tools, supplies, and incidental costs in connection with completing this item of work.

1.3. REFERENCES

ASTM A90/A90M	Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A370	Test Methods and Definitions for Mechanical Testing of Steel Products
A428/A428M	Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A764	Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
ASTM A641/A641M	Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A902	Terminology Relating to Metallic Coated Steel Products
ASTM A975	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Poly Vinyl Chloride (PVC) Coating)
ASTM B117	Practice for Operating Salt Spray (Fog) Apparatus
ASTM D412	Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D6711	Standard Practice for Specifying Rock to Fill Gabions, Revet Mattresses, and Gabion mats
AASHTO M288	Standard Specification for Geosynthetic Specification for Highway Applications

1.4. DEFINITIONS

1.4.1 Gabion mat

Gabion mat is a double twisted wire mesh container of variable sizes, uniformly partitioned into internal cells by diaphragms, interconnected with other similar units and filled with stone at the project site to form flexible, permeable, monolithic structures such as channel linings, revetments, scour protections and other erosion control applications.

Definitions of terms specific to this specification and to all materials furnished on the jobsite, except for the rock to fill the baskets and the geotextile, shall refer and be in compliance with ASTM A975.

1.5. FABRICATION

Gabion mats shall be manufactured and shipped with all components mechanically connected at the production facility except the lid which is produced separately from the base. All perimeter edges of the mesh forming the basket and lid shall be selvedged with wire having a larger diameter. The Gabion mat is divided into cells by means of diaphragms. The diaphragms shall be secured in position to the base so that no additional lacing is necessary at the jobsite.

1.6. SUBMITTALS

Preapproved product under these specifications is galvanized Gabion mat manufactured by Maccaferri Inc. info@us.maccaferri.com; Tel: 301-223-6910.

Submit the following list of items for Engineer's review and approval prior to material supply.

- i. Manufacturer's product technical specifications, and product installation instructions.
- ii. Wire mesh sample with edge and selvedge wires. Minimum sample size shall be 12 in. by 12 in.
- iii. Written manufacturer's certificate of compliance. Manufacturer's Certificate of Compliance shall be signed by person authorized to bind the manufacturer's certifications and must have Manufacturer's name and product manufacturing location.

Equivalent products or any value engineering proposal using alternate product is acceptable provided the following items in addition to above listed are submitted to the Engineer at least 14 days prior to bid.

- i. Test reports from a third-party test laboratory in USA to verify the product compliance with ASTM A975.
- ii. Test reports from a third-party test laboratory in USA to verify the performance and design parameters: admissible velocity and shear stress, Shield's coefficient and Manning's roughness coefficient.
- iii. Mill certifications of the wire used in manufacturing the products.
- iv. Manufacturer's Quality Control Manual.
- v. List of at least ten government projects where the product has been successfully installed.
- vi. Certified document that demonstrates manufacturer has at least 10 years of continuous experience in manufacturing Gabion mats and has manufactured at least 1.0 million cubic yards of Gabion mats.
- vii. Shop drawings and design calculations along with test reports, signed and sealed by the Professional Engineer registered in the state of project location.

1.7. QUALITY ASSURANCE

1.7.1 Wire and Ring Fastener

The owner or owner's representative reserves the right to test additional samples to verify the submitted test records. For equivalent products, furnish minimum three randomly selected field samples of lacing wire and ring fasteners 60 days prior to start of installation. Samples shall be tested to verify following property requirements in accordance with ASTM A975.

- i. Wire thickness
- ii. Tensile strength

- iii. Ring fastener individual pull apart strength

1.7.2 Installation

The General Contractor shall have personals with at least 3 years of experience installing Gabion mats and have installed a minimum of 500 SY of Gabion mats in each of the last three years. In case the General Contractor does not meet the qualifications based on the above requirements, acquire necessary onsite training from manufacturer prior to construction or the services of a qualified gabion /mattress subcontractor must be utilized. A manufacturer's representative shall provide reasonable installation support.

1.8. DELIVERY, STORAGE, AND HANDLING

Gabion mats shall be delivered with all components mechanically connected at the production facility except the lid which is delivered separately from the base. All Gabion mats are supplied in rolls which are banded together at the factory for ease of shipping and handling. Labels in the rolls show the dimensions of the Gabion mats included, the number of pieces and the color code. Lacing wire shall be shipped in coils, and fasteners in boxes.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Gabion mats

Double twisted wire mesh Gabion mats shall be manufactured with a non-raveling mesh made by twisting continuous pairs of wires through three half turns (commonly called double twisted) to form a hexagonal-shaped opening. Gabion mat sizes, wire diameters, mesh opening sizes, and tolerances shall comply with the requirements of ASTM A975. Gabion mats are classified according to the wire coating, which is applied prior to manufacturing the mesh. Galvanized Gabion mats are manufactured from a heavily zinc coated soft or medium temper steel as per ASTM A975. Wire and wire mesh used for manufacturing Gabion mats shall meet the following requirements:

2.1.1.1 Wire Tensile Strength

The wire used for the manufacturing Gabion mats and lacing wire, shall have a minimum tensile strength of 60,000 psi (415 MPa) to maximum tensile strength of 80,000 psi (550 MPa), in accordance with ASTM A641/A641M.

2.1.1.2 Elongation

The test shall be carried out on a sample at least 12 in. (300 mm) long, and the elongation shall not be less than 12%, in accordance with ASTM A370.

2.1.1.3 Metallic (Zinc) Coating

The minimum quantities of zinc shall be according to the ASTM A641/A641M, Class III soft or medium temper coating.

2.1.1.4 Adherence of Zinc Coating

The adherence of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with A641/A641M.

2.1.1.5 Standard Wire Diameters

All wire diameters shall comply with ASTM A975 as presented in Table 1.

Table 1 Standard Wire Diameters			
	Lacing Wire	Mesh Wire	Selvage Wire
Wire Diameter Int Ø in (mm)	0.087 (2.20)	0.120 (3.05)	0.153 (3.9)
Wire Tolerance ($\pm$) Ø in (mm)	0.004 (0.10)	0.004 (0.10)	0.004 (0.10)
Min. Zinc Qty. oz/ft ² (g/m ²)	0.70 (214)	0.85 (259)	0.90 (275)

2.1.1.6 Mesh Characteristics and Strength Requirements

The wire mesh characteristics and minimum strength requirements shall be in accordance with ASTM A975 as presented in Table 2. The tolerances on the wire mesh opening, D (see Fig. 1), shall not exceed $\pm 10\%$.

Table 2 Mesh Characteristics and Minimum Strength	
Mesh Type	8x10/ Galvanized
Mesh Opening, D	3.25 in. (83 mm)
Mesh Tensile Strength	3500 lb/ft (51.1 kN/m)
Punch Test Resistance	6000 lb (26.7 kN)
Connection Strength	1400 lb/ft (20.4 kN/m)

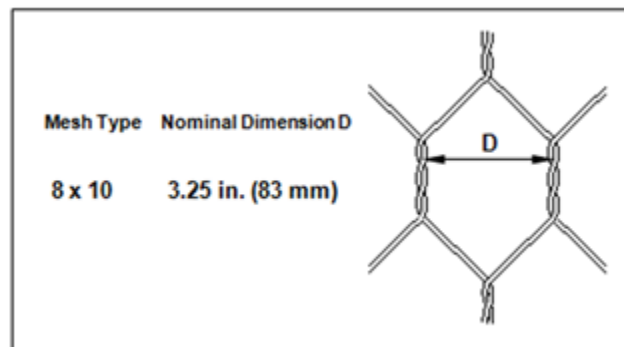


Fig. 1 Mesh type and opening

2.1.1.7 Standard Gabion mat sizes are listed in Table 3. All sizes and dimensions are nominal.

Table 3 Standard Gabion Mat Sizes			
L=Length ft (m)	W=Width ft (m)	H=Height ft (m)	# of cells
60 (19)	6 (1.83)	1 (0.3)	14
60 (19)	9 (2.74)	1 (0.3)	21
60 (19)	6 (1.83)	1.5 (0.45)	14
60 (19)	9 (2.74)	1.5 (0.45)	21
99 (30)	6 (1.83)	1 (0.3)	14
99 (30)	9 (2.74)	1 (0.3)	21
99 (30)	6 (1.83)	1.5 (0.45)	14
99 (30)	9 (2.74)	1.5 (0.45)	21

The tolerances on width, length and height of baskets shall not exceed $\pm 5\%$.

2.1.2 Ring Fasteners

Galvanized steel rings for Galvanized Gabion mats shall be in accordance with ASTM A975 section 6.3. The ring fasteners properties shall be as presented in Table 4.

Table 4 Ring fastener property requirements		
Property	Value	Test Method
Wire diameter	0.120 in. (3.05 mm)	ASTM A764, Type B, Class 3
Wire tensile strength	230,000 to 273,000 psi (1586 to 1882 MPa)	ASTM A764, Table 2

2.1.1 Stone Fill

2.1.1.1 Properties

Rocks shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure.

2.1.1.2 Gradation

The rock used to fill Gabion mats shall be large enough to prevent individual pieces from passing through the mesh openings. Gabion mat rocks shall range between 4 in. and 8 in. (100 mm and 200 mm). The range in sizes shall allow for a variation of 5% oversize and/or 5% undersize rock by weight. In all cases, the sizes of any oversize rock shall allow for the placement of three or more layers of rock within each Gabion mat compartment. In all cases, undersize rock shall be placed within the interior of the Gabion mat compartment and shall not be placed on the exposed surface of the structure.

2.1.1.3 Source

Rock may be naturally available or crushed rock produced by any suitable method and using any device that yields the required size limits. Alternatively, clean crushed concrete can be used to fill the Gabion mats.

2.1.2 Geotextile

Separation geotextile used behind or underneath Gabion mats shall meet AASHTO M288 and/or project specification requirements.

PART 3 EXECUTION

3.1 FOUNDATION PREPARATION

The foundation for Gabion mat wall shall be graded level for a width equal as shown in the project plans. Prior to begin the wall construction, the area under the wall footprint should be prepared and compacted. Any soft or loose material that is encountered should be compacted or removed and replaced. Any debris that will obstruct the proper installation shall also be removed, and the voids carefully backfilled and compacted. If frozen ground conditions are encountered, contact project geotechnical engineer for further recommendations.

3.2 GEOTEXTILE PLACEMENT

Geotextile shall be placed uniformly on the surface as indicated on the drawings or as directed by the project engineer. Place the geotextile in close contact with the soil, eliminating folds or excessive wrinkles both longitudinally and transversely. The geotextile shall be installed with adequate overlap. The minimum overlap distance in the transverse or longitudinal direction is 2.0 ft (0.6 m), except in underwater installations where the minimum overlap is 3.0 ft (1.0 m). It is recommended that traffic not run on exposed geotextile.

3.3 ASSEMBLY

Gabion mats are supplied in rolls. The units shall be opened and unrolled one by one on their proper location. The sides, ends, and diaphragms shall be lifted into a vertical position to form an open box shape. The back and the front panels of the Gabion mat shall be connected to the end panels and center diaphragms using either lacing wire or ring fasteners. The end panels and the diaphragms shall be raised to a vertical position and the selvedge wire shall be wrapped around the edge wire of the top and back panels. Fig. 2 shows assembled double twisted wire mesh Gabion mat.

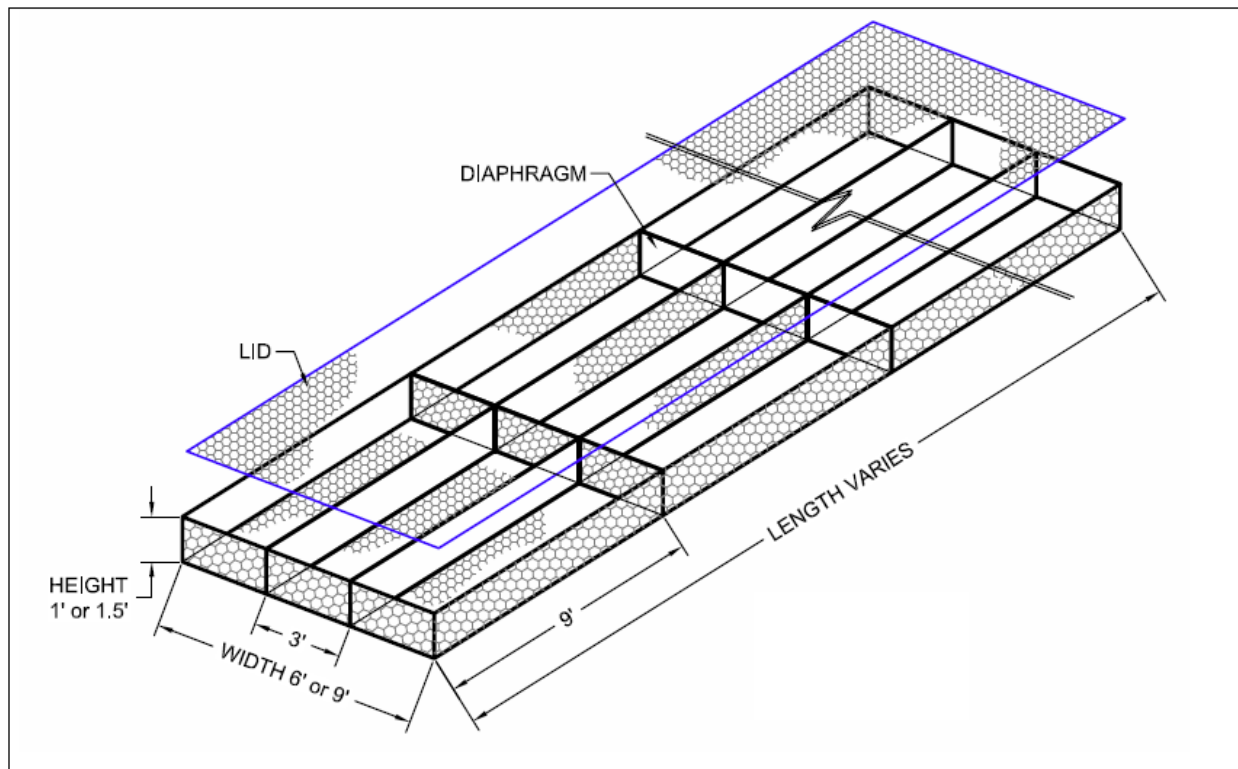


Fig. 2 Assembled double twisted wire mesh Gabion mat

3.4 FASTENING PROCEDURES

3.4.1 Lacing Wire

When using lacing wire, cut a piece of wire approximately 1.5 times the length of the edge to be laced. Longer edges shall be connected by several lengths of lacing wire. The mesh panels shall be pulled tightly together during the tying operation. For vertical joints, starting at the bottom end of the panel, the lacing wire shall be twisted and wrapped two times around the bottom selvedge and then double and single loops shall be alternated through at intervals not exceeding 6 in. (150 mm) as shown in Fig. 3. The operation shall be finished by looping around the top selvedge wire. The use of pliers to assemble the units with lacing wire is recommended to create tighter joints.

3.4.2 Ring Fasteners

When ring fasteners are used to connect Gabion mat panels, spacing of the rings shall be in accordance with ASTM A975, minimum strength requirements of mesh and connections. In any case, the maximum ring spacing along the edges shall not exceed 4 in. (100 mm) as shown in Fig. 3. Ring fasteners shall be installed at the end, diaphragms and along the edges. Each ring fastener shall be closed, and the free ends

of the fastener shall overlap a minimum of 1 in. (25 mm) as shown in Fig 3. The use of either a mechanical or a pneumatic fastening tool is required to install ring fasteners.

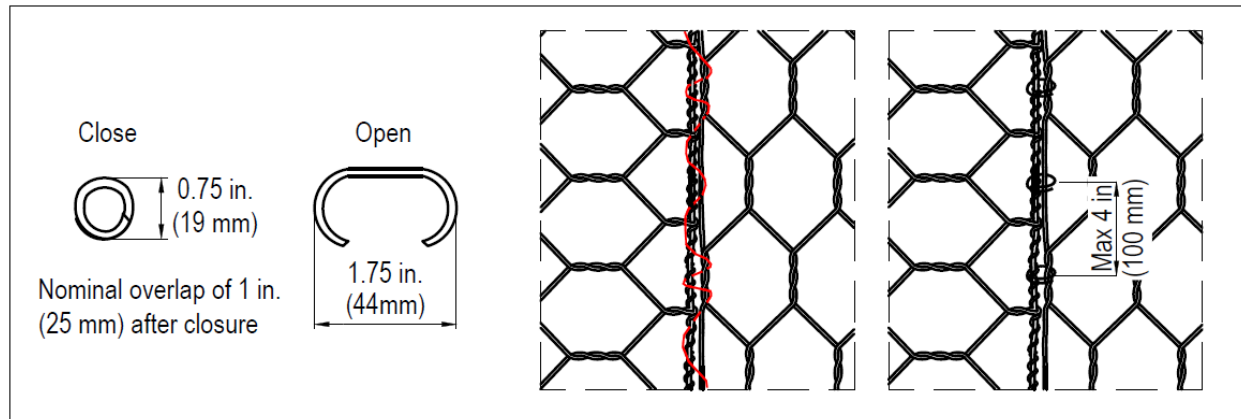


Fig. 3 Fastening procedures

3.5 INSTALLATION AND FILLING

Empty Gabion mat units shall be placed and assembled individually on the approved surface to the lines and grades as shown or as directed by project engineer. Gabion mats shall be connected to each other and aligned before filling the baskets with rock. All connections (panel-to-panel) and basket-to-basket shall be already carried out as described in ASSEMBLY section above. During the filling, some manual stone placement is required to minimize voids. Gabion mats shall be uniformly overfilled by about 1 to 1.5 in. (25 to 40 mm) to compensate for future rock movement.

3.6 CLOSING

After the Gabion mats are filled, lids shall be tightly secured along all edges, ends and diaphragms in the same manner as described for assembling. The panel edges shall be pulled and connected with the lid using the appropriate closing tools such as lid closer, where necessary. Adjacent lids shall be securely attached simultaneously, and all end wires shall then be turned in to avoid protrusions.

3.7 NON-RECTANGULAR SHAPES AND SPECIAL ADAPTATION

Where a complete Gabion mat cannot be installed because of space limitations, the Gabion mat shall be cut, folded or overlapped, and securely connected to suit existing site conditions. All modified Gabion mats shall form a closed cell when completed. Mattresses can be cut to form curves or bevels.

3.8 MAINTENANCE

No routine maintenance is required. Severely damaged Gabion mats shall be completely removed and replaced. If the damage is localized in the fascia, the Gabion mats can be repaired by filling the voids (if any) with rock, and patching it using a new piece of double twisted wire mesh. New piece of wire mesh shall be connected to undamaged mesh with a minimum overlap of 9 to 12 in. (225 to 300 mm) using lacing wire or fasteners.

-- End --

APWA Specifications

SECTION 109

RIPRAP STONE

109.1 GENERAL

The riprap stone provided and installed under this specification shall be angular rock, stone or recycled Portland cement concrete complying with the requirements of this specification. The material shall be certified to comply with the specification in accordance with the requirements of Section 13. If a change in material and/or source from that authorized occurs during a project, the CONTRACTOR shall resubmit to include the changed material and/or source for authorization by the ENGINEER. A riprap material shall not be used on a project without written authorization of the ENGINEER.

109.2 REFERENCES

109.2.1 ASTM:

C88
C127

109.2.2 AASHTO:

T103

109.2.3 This Publication

603
610

109.3 MATERIAL

109.3.1 Riprap stone shall be stone, rock or recycled Portland cement concrete complying with this specification. The material shall be free of seams, fractures and coatings and of such characteristics that it will not disintegrate when subject to the action of flowing water.

109.3.2 The minimum specific gravity of the stone shall be 2.65 for sizes and gradation specified in TABLE 209.A, as determined in accordance with ASTM C127, latest edition. If the specific gravity of a stone is less than 2.65, the minimum size of the stone and the depth of the riprap shall be increased in accordance with TABLE 109.8.

109.3.3 The maximum resistance to abrasion shall be fifty (50) percent determined in accordance with the requirements of ASTM C535.

109.3.4 The maximum soundness loss shall be twenty (20) percent determined in accordance with ASTM C88.

109.3.5 The maximum loss to freeze thaw shall be ten (10) percent for 12 cycles determined in accordance with the AASHTO T103, Ledge R, Procedure A.

109.4 SHAPE AND GRADATION

109.4.1 Riprap material shall be rectangular in shape rectangular in shape having maximum to minimum dimension ratio not more than 3:1.

109.4.2 Riprap stone shall comply with the gradation requirements of TABLES 109.A and A 109.B.

109.4.3 Waste Portland cement concrete complying with the requirements of this specification may be used as riprap as specified in the plans and specification, as directed by the ENGINEER.

109.5 PLACEMENT

109.5.1 The placement of riprap stone shall be to the line and grade shown on the plans or as authorized by the ENGINEER. The depth of the riprap shown on the plans shall be adjusted based on Table 109.B for the specific gravity of the material provided. The surface tolerances shall be within the maximum variations shown in Table 109.C.

109.6 MEASUREMENT AND PAYMENT

109.6.1 Riprap shall be measured by the cubic yard (cy) placed to the lines and grades in the plans and specifications complete in place.

109.6.2 Payment for riprap will be made at the contract unit price per cubic yard for the type of riprap required, which payment shall include all material, labor and equipment required in placing riprap stone as specified in Section 603 and/or 610.

TABLE 109.A
CLASSIFICATION GRADATION

DESIGNATION	MAX. DIMENSIONS inches (m)	% SMALLER	Km [1]
A. GABIONS			
TYPE VL	12 (0.30) 9 (0.25) 50-70 6 (0.15) 35-55 3 (0.08) 10	100	6
TYPE L	18 (0.45) 12 (0.30) 6 (0.15) 30-55 3 (0.08) 10	100 50-70	9
B. RIPRAP			
TYPE M	24 (0.60) 18 (0.45) 12 (0.30) 6 (0.15)	100 50-70 30-55 10	12
TYPE H	36 (0.90) 24 (0.60) 12 (0.30)	100 50-70 30-55	18
TYPE VH	48 (1.20) 36 (0.90) 18 (0.45) 9 (0.23)	100 50-70 30-55 10	24

[1] Km = mean particle size

TABLE 109.B
SPECIFIC GRAVITY MULTIPLIER

SPECIFIC GRAVITY	MULTIPLIER
2.65	1.00
2.65	1.05
2.50	1.15
2.40	1.25
2.30	1.35
<2.30	REJECT

TABLE 109.C
CONSTRUCTION TOLERANCES

RIPRAP DESIGNATION	MAXIMUM VARIATION FROM SPECIFIED FINISH GRADE inches (meters)
TYPE VL +/-	3 (0.08)
TYPE L	6 (0.15)
TYPE M	9 (0.25)
TYPE H	12 (0.30)
TYPE VH +/-	12 (0.30)

SECTION 201

CLEARING AND GRUBBING

201.1 GENERAL

This work shall consist of removing natural and man-made objectionable material from the right-of-way, construction areas, road approaches, material and borrow sites, areas through which ditches and channels are to be excavated, and such other areas as may be shown on the plans. Clearing and grubbing shall be performed in advance of grading operations except that in cuts over 3 feet in depth, grubbing may be done simultaneously with excavation, provided stumps, roots, embedded wood, foundations and slabs are removed as specified. Clearing and grubbing shall be in accordance with the requirements herein specified, such as erosion control requirements. Demolition of structures, other than foundations or slabs, shall be as shown on the plans.

201.2 REFERENCES

201.3 PRESERVATION OF PROPERTY

Existing improvements, adjacent property, utility and other facilities, and trees and plants not to be removed shall be protected from injury or damage resulting from the CONTRACTOR's operations. Only trees and plants designated or marked for removal by the ENGINEER shall be removed.

201.4 CONSTRUCTION METHODS

201.4.1 The natural ground surface shall be cleared of vegetable growth, such as trees, tree stumps, logs, roots or downed trees, brush, grass, weeds, and surface boulders, as well as fences, walls, rubbish, foundations and slabs.

201.4.2 Unless otherwise shown on the plans, the entire area of the project within the limit lines specified below shall be cleared and grubbed. No payment will be made to the CONTRACTOR for clearing and grubbing outside these limits, unless such work is authorized by the ENGINEER.

201.5 LIMIT LINES: Except when limit lines for clearing and grubbing are shown on the plans or are staked by the ENGINEER, clearing and grubbing shall extend only within reasonable limits of the work area.

201.6 REMOVAL OF TREES AND TREE BRANCHES

201.6.1 Trees shall be removed in such a manner as not to injure standing trees, plants, and improvements which are to remain. Tree branches extending over a roadway and which clear finish grade by 12 feet or

less shall be cut off close to the boles in a workmanlike manner.

201.6.2 Trees requiring trimming to facilitate normal construction operations shall be trimmed by a tree surgeon.

201.7 REMOVAL AND DISPOSAL OF DEBRIS

Debris to be removed shall be disposed of outside the right-of-way at a location satisfactory to the ENGINEER, except when burning of combustible debris is permitted. The area to be graded and adjacent areas shall be left with a neat and finished appearance. No accumulation of flammable material shall remain on or adjacent to the property line. In case burning precedes construction operations, the piles may be placed in the center of the area; otherwise, the piles shall be placed in the most convenient location at the side of the area and beyond slope lines where they may be burned without damage to surrounding forest cover or adjacent property. Burning shall be done in conformance with local regulations and at such times and in such manner as to prevent the fire from spreading to areas adjoining the construction site. In areas where burning is prohibited by local regulations, all removed material shall be disposed in an approved solid waste disposal site.

201.8 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS

Items and materials of salvage value as shown on the plans or as determined by the ENGINEER, unless incorporated in the new work, shall remain the property of the OWNER and shall be delivered to approved storage areas as directed by the ENGINEER. Such items and materials shall be carefully removed and delivered in such a manner as to permit re-use.

201.9 MEASUREMENT AND PAYMENT

201.9.1 CLEARING AND GRUBBING:

201.9.1.1 When the proposal includes an item for clearing and grubbing, the quantity for measurement shall be as indicated in the Bid Proposal.

201.9.1.2 The unit price per acre paid for clearing and grubbing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in clearing and grubbing as shown on the plans, as provided in these specifications and as directed by

the ENGINEER, including the removal and disposal of resulting material.

201.9.1.3 When the Bid Proposal does not include a pay item for clearing and grubbing as above specified and unless otherwise specified in the Supplementary Specifications, full compensation for any necessary clearing and grubbing required to perform construction operations specified shall be considered as included in the price paid for other items of work and no additional compensation will be allowed therefore.

201.9.2 REMOVAL AND DISPOSAL OF TREES: If the Bid Proposal includes separate estimates of quantities for the removal of trees, the trees shall be classified by size as follows:

201.9.2.1 Trees less than 12 inches in circumference at 3 feet above the original ground surface shall be considered as included in the price for clearing and grubbing or excavation, and no additional compensation will be allowed therefor.

201.9.2.2 Trees between 12 and 30 inches in circumference shall be measured as a unit price for each tree in the item provided in the Bid Proposal for trees of this dimension.

201.9.2.3 Trees more than 30 inches in circumference shall be measured as a unit price for each tree in the item provided in the Bid Proposal for trees of this dimension.

SUPPLEMENTAL TECHNICAL SPECIFICATION

APWA (2006) SECTION 201

CLEARING AND GRUBBING

Revised 07/24/2020

1. In the Subsection 201.1 GENERAL, delete the second sentence and replace with the following: Clearing and grubbing shall be performed in advance of the grading operations.
2. In the Subsection 201.4.1 CONSTRUCTION METHODS, add the following:

Clearing and grubbing operations shall include stripping of the existing ground surface. Stripping shall be achieved only by cutting, i.e., ground depressions or narrow sections of tributary arroyos should not be inadvertently filled during the foundation preparation. The resulting area shall be cut to provide a uniform, relatively level surface.

3. In Subsection 201.5 LIMIT LINES, add the following:

Unless otherwise approved by the Engineer or otherwise specifically designated on the plans, limits of clearing & grubbing shall not exceed slope limits as shown with finished grade contours on plans.

END OF SECTION

SECTION 301

SUBGRADE PREPARATION

301 GENERAL

301.1 The work performed under this specification shall include, but not be limited to providing the equipment, labor and materials for the preparation of soil subgrade and maintenance of the prepared subgrade for the construction of graded aggregate base, asphalt treated base, cement treated base, asphalt concrete, Portland cement concrete, sidewalks, curb and gutter, drive pads, valley gutter, median pavements and/or any other roadway improvements.

301.2 REFERENCES

301.2.1 ASTM:

C136	D423
D424	D698
D1140	D1557
D2844	D2922
D3017	

301.2.2 This publication Section 204

301.3 MATERIAL

301.3.1 Subgrade material may be on site soil, combinations of pulverized asphalt concrete and soil, and/or pulverized Portland cement concrete and soil, imported soils, complying with the requirements of this specification. Flowing, sugar sands shall not be used for subgrade material.

301.3.2 All soft and unstable material and other portions of the subgrade which will not compact readily or serve the intended purposes shall be removed and replaced with suitable material from excavation or borrow or suitable materials shall be added and, by manipulations, be incorporated into the subgrade to produce a material meeting subgrade requirements.

301.3.3 All subgrade material shall have a minimum Resistance Value (R-Value), as determined by ASTM D-2844, equal to or greater than the design R-Value for the pavement section. If the subgrade soils encountered during construction have a R-Value less than the design R-Value, those subgrade materials shall be removed to a depth of not less than two (2') feet below the finished subgrade elevation or as authorized by the ENGINEER and to the horizontal limits authorized by the ENGINEER, and replaced with subgrade material having an R-

Value greater than the design R-Value. On small projects, in areas that just involve replacement of existing roadway items or when no design R-Value has been established this R-Value requirement may be waived if authorized by the ENGINEER.

301.4 SUBGRADE COMPACTION

301.4.1 Subgrade preparation shall extend to one foot (1') beyond the limits of the improvement to be placed on the subgrade except when that improvement abuts an existing structure and/or the limits of the right of way. Where an improvement abuts an existing structure and/or the limits of right of way, the subgrade preparation shall extend to the edge of the existing structure and/or the limits of right of way, as specified in the plans, specifications, supplemental technical specifications or as directed by the ENGINEER. Where existing structures are in the right of way or construction easements, subgrade preparation shall extend to the face of the structure, as specified above. Subgrade preparation shall not extend below the bottom of the foundation of an existing structure without specific authorization by the ENGINEER.

301.4.1.1 Subgrade preparation for roadway improvements shall be performed after completion of earthwork construction, subsurface utility installation and trenching back fill within the limits specified, as directed by the ENGINEER. The subgrade preparation shall extend the full width of the roadway to either one (1) foot back of new curb and gutter, and/or to the face of existing structures, and/or the limits of right of way, as specified in the plans and specifications, as directed by the ENGINEER.

301.4.1.2 Subgrade preparation for sidewalks and drive pads shall extend a minimum of one (1') beyond the free edge of the improvement, and/or to the limits of right of way, and/or to the face of existing structures.

301.4.1.3 The subgrade preparation for roadway construction without curb and gutter, shall extend one (1') beyond the edge of the pavement, and/or to the face of existing structures, and/or to the limits of right of way, as specified in the plans and specifications, as authorized by the ENGINEER.

301.4.1.4 Subgrade preparation shall extend the full width of roadway medians four (4) feet wide or less. In areas that the medians are wider than four feet (4') the subgrade compaction shall extend one foot

(1') beyond the median edge of the pavement or back of the median curb.

301.4.2. The subgrade for arterial/collector roadway shall be ripped to a minimum depth of one (1) foot, brought to uniform moisture content, and compacted to the requirements of plans and specification, as authorized by the ENGINEER. Subgrade material with either 20 per cent or more material passing a no. 200 sieve shall be uniformly mixed and moisture conditioned using a tractor mounted mixer or disced after ripping, as specified in the plans and specifications, as authorized by the ENGINEER. The subgrade for reconstructed curb and gutter, sidewalks, drive pads, residential roadways, bicycle paths and other roadways shall be scarified to a minimum depth of six (6) inches, brought to uniform compaction moisture content, and compacted to the requirements of plans and specification, as authorized by the ENGINEER.

301.4.3 Subgrade area shall be compacted to a dry density greater than 95 per cent of maximum dry density in a moisture range of optimum moisture $\pm 2\%$ as determined in accordance with ASTM D1557, unless the material contains 35% or more material finer than the No.200 sieve. If the subgrade material has 35% or more material finer than the No.200 sieve, the subgrade shall be compacted to a dry density greater than 95 percent of maximum dry density in a moisture content range of at least optimum moisture to optimum moisture $+4\%$, as determined in accordance with ASTM D698.

301.4.4 Areas on which roadway pavement items are to be placed shall be compacted uniformly to the required subgrade density at the same time. Obtaining the required subgrade density in trench areas at a different time than obtaining the required subgrade density in the adjacent pavement areas will not be permitted.

301.4.5 Upon completion of the subgrade preparation, the CONTRACTOR shall maintain the compacted subgrade density and moisture content at the specified levels until the next lift of material is completed. The CONTRACTOR shall provide continuous moisture protection of the subgrade by either sprinkling or the application of a prime coat, as directed by the ENGINEER.

301.5 SUBGRADE TOLERANCES

Subgrade upon which pavement, sidewalk, curb and gutter, drive pads, or other structures are to be placed shall not vary more than $+1/4$ inch or $-1/2$ inch per 10 foot in any direction from the specified grade and cross section. Subgrade upon which base material is to be placed shall not vary more than $+1/2$ inch or -1 inch per 20 foot in any direction from the specified grade and cross section. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.

301.6 TESTING:

301.6.1 A sample of each type of soil encountered shall be classified in accordance with the requirements of ASTM D2487, the moisture density relationship determined in accordance either ASTM D698 or D1557, whichever is applicable and an estimated resistance R-value assigned based on plasticity index, PI, and percent material passing the No.200 sieve.

301.6.2 Compaction tests shall be taken for each 500 sy or less, as directed by the ENGINEER. Compaction tests shall be taken in accordance with ASTM D2922 and D3017. Areas represented by non complying tests shall be reworked as specified, and retested for compliance.

301.6.3 Test reports shall include but not be limited to the requirements of TABLE 301.A.

TABLE 301.A
TEST REPORT INFORMATION

A. Field Data

Date of Sampling/Field Test
Project Number or
Permit Number
Project Title
Location of sample/field test as defined by the project plans and specifications
Time of Sampling/field testing
Field test results with reference specification limits

B. Laboratory Data

Soil classification
Soil gradation
Plasticity index

Liquid limit
Optimum moisture/maximum dry density relationship and graph
Estimated soil resistance R-Value

301.6.4 Test results shall be reported to the ENGINEER, CONTRACTOR, and Materials and Testing Laboratory, Construction Division, Public Works Department, in writing, within 4 working days of completion of the sampling and or field test. Non-complying test shall be reported within 1 working day of completion of the test.

301.7 MEASUREMENT AND PAYMENT:

301.7.1 Measurement for payment of roadway subgrade preparation will be by the square yard to the limits of the surfacing, as authorized by the ENGINEER. Payment for subgrade preparation shall include all labor and equipment required to shape, mix, add moisture, compact, bring to grade and maintaining the prepared subgrade moisture and density until the next course of material is placed.

301.7.2 The measurement of payment for subgrade preparation for non-pavement roadway items such as curb and gutter, valley gutter, drive pads and sidewalks etc., shall be included in that item. No separate payment will be made.

SECTION 302

AGGREGATE BASE COURSE CONSTRUCTION

302.1 GENERAL

The work provided under this specification shall include the furnishing, placement and compaction of aggregate base course (ABC) to the lines, grades, dimensions, moisture, density and typical sections as specified in the plans and specifications, and or as directed by the ENGINEER. The CONTRACTOR shall be solely responsible for the aggregate base course either batched at and/or delivered to the site. A job mix formula for aggregate base course, shall be certified in accordance with the requirements of Section 13 of these specifications. Each job mix formula submitted and authorized for use under this specification shall be identified by a number, unique to that job mix formula and aggregate production plant/pit. If a change in material(s) from that specified in the job mix formula occur during a project, the CONTRACTOR shall submit a new job mix formula to include the changed materials for approval by the ENGINEER. A job mix formula shall not be used on a project without written approval of the ENGINEER. A job mix formula, upon request by an aggregate supplier, may be authorized by the OWNER for a period of 14 months, from the date of sampling of aggregates used in the job mix formula.

302.2 REFERENCES

302.2.1 ASTM:

C136	D75
D422	D423
D424	D1557
D2419	D2844
D2922	D2940
D3017	

302.2.2 This Publication:

Section 113
Section 301

302.3 MATERIALS

302.3.1.1 Aggregate base course shall be coarse aggregate of either crushed stone, or crushed gravel, or crushed asphalt concrete, or crushed Portland cement concrete, or any combination, and natural sand, the combination of materials conforming to the requirements of ASTM D2940 and the plans and specifications, as authorized by the ENGINEER.

302.3.1.2 Coarse aggregates retained on the No.4 sieve shall consists of durable particles of either

crushed gravel, or crushed asphalt concrete pavement, or crushed portland cement concrete, or any combination, capable of withstanding the effects of handling, spreading and compacting without degradation production of deleterious fines. At least 50% of the particles retained on the 3/8-inch sieve, shall have two or more fractured faces. Coarse aggregate shall comply with the requirements of TABLE 302.A.

302.3.1.3 Fine aggregate passing the No.4 sieve shall consists of fines from the operation of crushing coarse aggregate; where available and suitable, natural sand or finer mineral matter or both, may be added. Fine aggregate shall comply with the requirements of TABLE 302.A.

302.3.1.4 The job mix formula and gradation shall comply with the requirements of TABLE 302.B, and have the same or similar characteristic gradation curve as either range limit, when graphically plotted on a standard "0.45 POWER" Gradation Chart.

302.3.1.5 Aggregate base course furnished and placed under this specification shall have a resistance value, (R-Value), not less than 76 as determined by ASTM D2844.

302.3.1.6 A job mix formula, certified by a Registered New Mexico Professional Engineer to comply with the requirements of this specification, shall be submitted to and authorized for use by the ENGINEER before the material may be incorporated in the construction. A submittal shall include, but not be limited to, the items in TABLE 302.C. Prior to delivery of the material, the CONTRACTOR may be required to furnish samples of the aggregates base course to the ENGINEER for testing. Gradations for the aggregate base course used in a particular day's placement shall be submitted to the ENGINEER upon request.

302.3.2 Prime coat for surface sealing of compacted aggregate base course shall comply with the requirements of CSS-1H Cationic Emulsified Asphalt as specified in Section 113.

302.4 TRANSPORTATION AND PLACEMENT

302.4.1 Aggregate base course shall be transported in suitable vehicles with a cover. A load shall be covered immediately after loading and remain covered until unloading.

302.4.2 The CONTRACTOR shall provide to the ENGINEER with each load of batched and/or delivered to the job site, before unloading at the site.

a copy of the delivery ticket on which is printed, stamped or written. the information defined in TABLE 302.D.

302.4.3 Aggregate base course shall be placed on prepared subgrade, prepared in accordance with the requirements of SECTION 301, the plans and specifications, and or as directed by the ENGINEER.

302.4.4 Aggregate base course shall be placed in lifts which will provide not less than four (4) inches and not more than 6 inches compacted thickness. The material shall be moisture conditioned within a range of optimum moisture plus or minus two percent (+/-2%), and compacted to a dry density greater than ninety-five (95) percent of maximum dry density as determined in accordance under the procedures specified in ASTM D1557.

302.4.5 The finish surface of the compacted aggregate base course shall not deviate from finish grade in excess of 1/2 inch in 10 feet when tested with a 10-foot straight edge in any direction. All deviations in excess of the specified shall be corrected by the CONTRACTOR prior to authorization for placement of the next life of material.

302.4.6 Immediately upon completion of compaction, the CONTRACTOR shall seal the surface of the compacted aggregate base course with a prime coat. The prime coat shall be applied as required to provide a uniform coverage of the surface. Application shall be between 0.05 and 0.15 gallons per square yard of surface. If final surfacing is to be placed within twenty four (24) hours after completion of compaction, the prime coat may be waived as authorized by the ENGINEER. The surface shall be kept at compaction moisture until the final surfacing is placed in the event the prime coat is waived.

302.4.7 Traffic on compacted aggregate base course shall be limited to moisture control application and final surfacing traffic only, as authorized by the ENGINEER.

302.5 TESTING

302.5.1 A sample of material delivered to the project shall be taken for each 300 tons placed or each days placement, whichever is greater, and tested for gradation and moisture density relationship. The average value of individual gradation tests, for all sieve size determinations, shall comply with the job mix formula within the tolerances specified in TABLE 302.B. Individual sample gradation test results, for all sieve size determinations, shall comply with the tolerance range plus two (2) percent. Non complying material shall be re-sampled and tested for compliance. Material not in compliance after the

initial and follow up testing shall be removed and replaced by the CONTRACTOR at no cost to the OWNER, as directed by the ENGINEER.

302.5.2 Compaction tests shall be taken at the rate of one test for each 500 sy/lift placed, or as directed by the ENGINEER, in accordance with the requirements of ASTM D 2922 and D 3017. Areas represented by non complying tests shall be reworked and retested for compliance.

302.5.4 Test reports shall include but not be limited to the requirements of TABLE 302.E.

302.5.5 Test Results shall be reported to the ENGINEER, CONTRACTOR, and OWNER in writing, within 4 working days of completion of the sampling and or field test. Non-complying test shall be reported within 1 working day of completion of the test.

302.6 MEASUREMENT AND PAYMENT

302.6.1 Measurement of aggregate base course shall be by the square yard per each thickness required, complete in place.

302.6.2 Payment shall be at the contract unit price per square yard per each thickness required, complete in place which shall include all material, labor and equipment required in placing, grading and compacting the aggregate base course.

**Table 302.A
ENGINEERING REQUIREMENTS**

CHARACTERISTIC Aggregate Type	SPECIFICATION LIMIT(S)	
	Fine	Course
Los Angeles Abrasion Wear (ASTM C 131)		40% max.
Soundness (5 cycles ASTM C 88)	15% max.	15% max.
Crushed Aggregate (% Material Retained on 3/8inch sieve by wt., having at least two (2) fractured faces)		50% max.
Maximum % passing No. 200	60% of -No.30	
Plasticity Index (Material finer than No.40 sieve)	4.0 max.	
Sand Equivalent Value	35 min.	

**TABLE 302.B
GRADATION RANGES AND TOLERANCES**

SIEVE SIZE/TYPE	PRODUCTION RANGE (% passing)		PRODUCTION TOLERANCES (+/-%)
	I	II	
1-1/2 inch	100	100	
1 inch	95-100	100	
¾ inch		90-100	8
½ inch	64-75		8
3/8 inch		65-80	8
No.4	35-46	48-55	8
No.30	12-18	18-25	5
No.200	5-12	6-15	3

**TABLE 302.C
SUBMITTAL REQUIREMENTS**

- A. Supplier
- B. Date
- C. Design Mix Identification Number
- D. Contractor
- E. Construction project number
- F. Construction Project Title (contract)
- G. Certification of compliance
- H. Target Gradation of Material
- I. Optimum moisture and maximum dry density relationship of material and graph

The submittal shall be rejected without review if the specified data is not included.

**TABLE 302.D
DELIVERY TICKET INFORMATION**

- A. Name of Supplier
- B. Date of Delivery
- C. Delivery Ticket Number
- D. Name of Contractor
- E. Project Name (optional)
- F. Job mix formula identification number
- G. Weight of load
- H. Time loaded

**TABLE 302.E
TEST REPORT INFORMATION**

A. Field Data

Date of Sampling/Field Test
Project Number or
Permit Number
Project Title
Location of sample/field test as defined by the project
plans and specifications
Time of Sampling/field testing
Field test results with reference specification limits

B. Laboratory Data

Base course classification
Gradation
Plasticity index
Liquid limit
Optimum moisture/maximum dry density relationship and graph
Estimated soil resistance R-Value

SECTION 603

RIPRAP SURFACE TREATMENT

603.1 GENERAL

The construction of riprap surface treatment shall consist of furnishing and placing stone, with or without grout, with or without wire mesh, or sacked concrete riprap. The depth and type of riprap shall be as shown on the construction plans.

603.2 REFERENCES

603.2.1 ASTM C 143

603.2.2 This publication: SECTION 101 SECTION 109

603.3 MATERIAL

603.3.1 Riprap stone shall be as specified in Section 109 of these specifications.

603.3.2 Other materials necessary for completion of various types of Riprap Surface Treatments shall be as specified in the following subsections.

603.4 PREPARATION OF GROUND SURFACES

603.4.1 The bed for the riprap shall be shaped and trimmed to provide even surfaces. A footing trench shall be excavated along the toe of the slope as shown on the plans.

603.4.2 Specified filter cloth shall be placed on earth bed prior to placement of stone.

603.4.3 Earth surface shall be shaped and trimmed to conform to the construction plans prior to the placement and compaction of the gravel type of filter material.

603.5 PLACING RIPRAP STONE

603.5.1 When the required riprap is less than 20 inches in depth, stone shall be placed by hand unless otherwise authorized by the ENGINEER. Stone shall be placed to provide a minimum of voids. The larger stone shall be placed in the toe return, foundation course, and on the outer surface of the riprap. Stones shall be placed with their longitudinal axis normal to the face of the embankment and so arranged that each rock above the foundation course has at least a 3 point bearing on the underlying

stones. Bearing on smaller stones used to chink voids will not be acceptable. Interstices between stones shall be chinked with small stones and spalls.

The finished surface shall be even and tight and shall not vary from the planned surface by more than 3 inches per foot of depth. When the required riprap is 20 inches or more in depth, the stone may be placed by dumping and spread in layers by bull-dozers or other suitable equipment.

603.5.2 Riprap shall be placed to its full design thickness (depth) in one operation.

603.6 GROUTED RIPRAP

603.6.1 Riprap shall be placed as specified and grouted with Portland cement mortar. The grout shall consist of one part cement and 3 parts by volume of aggregate. The Portland cement shall be Type I or Type II as specified in Section 101 and the aggregate shall be 2 parts sand and 1 part gravel passing a 3/8 inch square mesh screen. The amount of water shall be such as to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the ENGINEER.

603.6.2 Except when hand mixing is permitted by the ENGINEER, grout shall be mixed in an approved machine mixer for not less than 1 1/2 minutes. Should hand mixing be permitted, the cement and aggregate shall be thoroughly mixed in a clean, tight mortar box until the mixture is of uniform color after which clean water shall be added in such quantity as to provide a grout of the specified consistency.

603.7 SACKED CONCRETE RIPRAP

603.7.1 The Portland cement, aggregates, and mixing shall be as specified in Section 101 and as herein specified. The aggregate may be pit-run material, at least 80 percent of which shall pass a 1 1/2 inch square mesh screen. Separating aggregates by primary sizes will not be required. Los Angeles abrasion tests and soundness tests will not be required.

603.7.2 The mixed concrete shall contain 376 pounds (4 sacks) of Portland cement per cubic yard.

603.7.3 The amount of water shall be such as to produce a mixture with a slump of 3 to 5 inches when tested in accordance with ASTM C 143.

603.7.4 Sacks shall be made of at least 10 ounce burlap and shall be approximately 19 1/2 inches by 36 inches measured inside the seams when the sack is laid flat.

603.7.5 Slopes on which the sacked concrete riprap is to be placed shall be finished within 0.2 foot of the designated grades. The first course shall be a double row of stretchers laid in a neatly trimmed trench. The second course shall be a single row of headers. The third and remaining courses shall be stretchers or headers as shown on the plans and shall be placed so that joints between courses are staggered. Dirt and debris shall be removed from the tops of sacks before the next course is laid thereon. Headers shall be placed with the folds upward. Not more than 4 vertical courses shall be placed in any tier until the initial set has taken place in the first course of any such tier.

603.7.6 When, in the opinion of the ENGINEER, there will not be proper bearing or bond due to delays in placing succeeding layers or the hampering of work by storm, mud, or for any cause, a small trench shall be excavated back of the row of sacks already in place and this trench filled with fresh concrete before more sacks are placed. Payment for the concrete in the trenches shall be at the price per cubic yard for sacked concrete riprap. Payment for excavating the trenches shall be considered as included in the payment for the concrete in the trench.

603.7.7 Sacked concrete riprap shall be cured by sprinkling with a fine spray of water every 2 hours during daylight for not less than 3 days.

603.8 WIRE ENCLOSED RIPRAP

603.8.1 Wire enclosed riprap shall consist of a layer of rock of the required thickness enclosed on all sides in wire fabric in conformity with the details shown on the plans. The wire fabric shall be drawn tightly against the rock on all sides and tied with galvanized wire of the required gauge. The ties shall be spaced approximately 2 feet on centers and shall be anchored to the bottom layer of wire fabric, extended through the rock layer, and tied securely to the top layer of wire fabric. When indicated on the plans, wire enclosed riprap shall be anchored to the slopes by steel stakes driven through the riprap into the embankment. Stakes shall be spaced as shown on the plans. Wire fabric used for riprap shall conform to the mesh, gauge, and weight shown on the plans. Tie wire shall be galvanized and of the gauge shown on the plans. Wire fabric shall be furnished in such lengths and widths as to reduce

the number of splices to a minimum.

603.8.2 Steel stakes shall be cut to the required length from steel railroad rails, galvanized steel pipe, or steel angles of the dimension and weight shown on the construction plans.

603.9 FILTER CLOTH

603.9.1 MATERIAL: The filter cloth shall be a non-woven polyester geotextile, such as: Mirafi No. 140N drainage Fabric, Mirafi Inc., Charlotte, North Carolina, or approved equal.

603.9.2 INSTALLATION: The surface to receive the cloth shall be prepared to a relatively smooth condition free of obstructions, depressions, and debris. The cloth shall not be laid in a stretched condition but shall be laid loosely with a long dimension perpendicular to the channel centerline. The cloth shall be placed so the upstream edge overlaps the downstream edge a minimum of 12 inches, with securing pins inserted through both layers at no greater than two-foot intervals. Cloth damaged or displaced before or during installation or placement of the overlaying riprap shall be replaced or repaired to the satisfaction of the ENGINEER at the CONTRACTOR'S expense.

603.10 GRAVEL TYPE OF FILTER MATERIAL

603.10.1 MATERIAL: Filter material shall be comprised of sand, gravel, and cobble in mixes as specified on the plans. Alternate materials such as milled Portland cement concrete, concrete wash, or reclaimed material may be substituted with the ENGINEER'S approval.

603.10.2 INSTALLATION: Filter material shall be used as a subbase for riprap as shown on the plans. The minimum depth of filter material shall be one foot unless the plans provide an alternate detail for filter blanket construction.

603.11 MEASUREMENT AND PAYMENT

603.11.1 Riprap, such as: plain stone, grouted, wire enclosed, or sacked concrete, shall be measured by the cubic yards placed to the lines and grades shown on the construction plans. Payment for riprap will be made at the unit price per cubic yard for the type of riprap as specified in the Bid Proposal and shall include materials, labor, and equipment necessary to complete the work.

603.11.2 Filter cloth shall be measured by the square foot and overlaps shall be measured as a

single layer of cloth. Payment shall be made at the unit price per square foot as per Bid Proposal, and shall include shipping, handling, storage, seams, special fabrication, securing pins, and/or installation.

603.11.3 Gravel type filter material shall be measured by the cubic yard of material in place, in accordance with the construction plans. Payment will be made at the unit price per cubic yard as per Bid Proposal and shall include all materials, labor, and equipment necessary for the installation of the material.

SECTION 701

TRENCHING, EXCAVATION AND BACKFILL

701.1 GENERAL

Trench excavation and backfill for underground utilities, sanitary sewer, storm sewer, water lines, and appurtenances shall conform to these specifications or as specified in the Supplemental Technical Specifications or as authorized, in writing, by the ENGINEER.

701.2 REFERENCES

701.2.1 ASTM:

D-422 D-698
D-1557 D-2321
D-2487 D-2922
D-3017 D-4318

701.2.2 This Publication:

Section 207
Section 301
Section 302
Section 336
Section 337
Section 340

701.3 TERMINOLOGY

701.3.1 For the purpose of these specifications in this Section, the descriptive terms "flexible," "plastic" and "non-rigid" are similarly interchangeable as utilized in these specifications and appurtenant reference material.

701.3.2 Rigid pipe: shall be reinforced concrete, concrete cylinder, and vitrified clay pipes.

701.3.3 Flexible pipe shall be polyvinyl chloride, polyethylene, ductile iron, and corrugated metal pipes.

701.3.4 Standard Detail Drawings show the trench cross-sections which identify the meaning and limits of terminology used in these specifications for the terms "foundation, bedding, haunching, initial backfill, final backfill, embedment, pipe zone, cover, springline, and pipe width."

701.3.5 The Unified Soil Classification System in ASTM D2487 Shall be utilized for the purpose of

material classifications. See Table 701.3.A for a listing of referenced soil classes.

701.4 NOTIFICATION OF FORTHCOMING WORK

701.4.1 To assure that the construction work progresses in a timely manner and that good public relations are maintained with the property owners, the following actions are considered essential:

701.4.1.1 Prior to the start of construction the CONTRACTOR shall assist the ENGINEER in notifying the adjacent property owners as to when construction will start, the estimated completion date, anticipated access blockages.

TABLE 701.3.A
EMBEDMENT SOILS CLASSIFICATIONS

SOILS CLASS	SOIL TYPE	DESCRIPTION
CLASS I SOILS*		Manufactured angular, granular material, ¼ to 1-1/2 inches (6 to 40 mm) size, including materials having regional significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells, complying to the requirements of Class II soils.
CLASS II SOILS**	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more of coarse fraction retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS**	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more of coarse fraction retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS**	SW	Well-graded sands and gravelly sands, little or no fines. More than 50% of coarse fraction passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS II SOILS**	SP	Poorly graded sands and gravelly sands, little or no fines. More than 50% of coarse fraction passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS III SOILS***	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more of coarse fraction retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more of coarse fraction retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	SM	Silty sands, sand-silt mixtures. More than 50% of coarse fraction passes No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS III SOILS***	SC	Clayey sands, sand-clay mixtures. More than 50% of coarse fraction passes No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS IV SOILS	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS IV SOILS	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays, Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS IV SOILS	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS IV SOILS	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS V SOILS	OL	Organic silts and organic silty clays or low plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
CLASS V SOILS	OH	Organic clays of medium to high plasticity. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS V SOILS	PT	Peat, muck and other highly organic soils.

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- * Soils are as defined in ASTM D2487, except for Class I Soil which is defined in ASTM D2321
 - ** In accordance with ASTM D2487, less than 5% passes No. 200 sieve.
 - *** In accordance with ASTM D2487, soils with 5% to 12% passing No. 200 sieve fall in a borderline classification that is more characteristic of Class II than of Class III.

701.4.1.2 Prior to the start of trenching operations, including pavement cutting and removal, the CONTRACTOR should coordinate with the ENGINEER any problem areas and involving traffic control, access to private properties, stockpiling of excavated materials, and other utility conflicts.

701.4.1.3 The CONTRACTOR shall provide the ENGINEER with the name and telephone number of at least two contact persons during non-working hours.

701.5 TRENCH SAFETY

The CONTRACTOR shall be responsible for maintaining all trenches in a safe condition; thereby protecting the workers and the general public. Trench slopes and other protection shall be in accordance with applicable regulations such as the Department of Labor's Occupational Safety and Health Administration Standards 29CFR Part 1926, subpart P *or* any applicable amendments.

701.6 BRACING EXCAVATIONS

701.6.1 Excavation for pipe shall normally be by open unsupported trenches unless local conditions warrant trench bracing.

701.6.2 Excavations shall be braced and sheeted. to provide complete safety to persons working therein and bracing shall comply with applicable Federal (OSHA), State and local laws and ordinances. Support systems for trenches in excess of 20 feet deep and adjacent to existing improvement or subject to vibrations or ground water shall be in accordance with OSHA regulations. The CONTRACTOR shall be fully responsible for sufficiency and adequacy of bracing excavations with respect to work under construction and adjacent utility lines and private property.

701.6.3 If the soil conditions within the trench area require support, the CONTRACTOR may elect to use tight sheeting, skeleton sheeting, stay bracing, trench jacks, or movable trench shield to support the trench during pipe laying operations, such as: bedding preparation, pipe laying, backfilling of haunches and initial zone.

701.6.4 No sheeting shall be permitted to remain in the trench except when, in the opinion of the ENGINEER, field conditions or type of sheeting or methods of construction used by the CONTRACTOR, warrant the supports must remain. The ENGINEER may opt to have the lower portion (within the pipe zone) of the sheeting to remain. If the CONTRACTOR plans on removing the sheeting, he shall submit method to the ENGINEER for approval to treat the void created by the removal of the sheeting within the pipe zone and below.

701.6.5 When a movable trench shield is used, the trailing half of the shield should be notched to the height of the top of the pipe. This will allow the haunch area of the pipe to be compacted properly to the wall of the trench. If the trench shield is not notched, a subtrench shall be excavated for pipe installation such that the bottom of the trench shield does not enter the pipe zone.

701.7 DEWATERING

701.7.1 Trenching and pipe laying operations may encounter standing water or ground water which would preclude the proper placing of bedding, backfilling, and laying pipe. The water shall be removed by pumps and associated equipment, such as well points, to lower the water level. Dewatering shall continue for a minimum 24 hours after placement of any concrete.

701.7.2 Dewatering operations shall remove the water to achieve a stable foundation for pipe embedment and backfilling. The ENGINEER shall determine if adequate foundation has been attained. The ground water shall be lowered to a minimum depth of 6 inches below pipe grades. Should over excavation be necessary due to unsuitable foundation conditions, the ground water shall be additionally lowered as necessary.

701.7.3 The CONTRACTOR shall submit a plan for approval by the ENGINEER as to how and where the waste water will be disposed. Waste water will not be discharged into traffic and pedestrian lanes or onto private properties.

701.7.4 The CONTRACTOR shall obtain permit from the New Mexico State Engineer prior to commencing dewatering operations.

701.7.5 The CONTRACTOR shall also responsible for any adverse effect his dewatering operation has to private property, including providing temporary water to residences and/or business necessitated by the effect on private wells.

701.7.6 The CONTRACTOR shall arrange dewatering operation in a neat and orderly manner such that access to adjacent, properties is maintained, the discharge system does not leak and that any power generation complies with applicable noise limit regulations .

701.8 REMOVAL OF EXISTING PAVEMENT SIDEWALK, AND DRIVEWAY

701.8.1 Existing concrete pavement, sidewalk, or driveway removed in connection with construction shall be replaced , neatly sawed edges. Cuts shall be neat and to true straight lines with no shatter outside the removal area. If a saw cut would fall within 30 inches of a construction joint, cold joint, expansion joint, or edge, the concrete shall removed and replaced to the joint or edge. Concrete sidewalk and/or driveway may removed so that a minimum of 30-inch square is replaced. If the saw cut would fall within 12 inches of a score mark, the score mark.

701.8.2 Existing bituminous pavement removed in connection with construction shall be cut with a saw, pavement break cutting wheel, or other suitable tool approved by the ENGINEER. Care shall taken to assure that the edge of removed pavement does not vary from a straight line more than 2 inches from r mean.

701.8.3 Saw cutting shall be 1-1/2 inches in depth or 1/4 the thickness of the pavement, sidewalk, or driveway, whichever is greater. All saw cuts or other scoring shall be made perpendicular to the surface of the material to be cut.

701.8.4 Any unnecessarily irregular breakage or cracking caused by the CONTRACTOR shall be removed and replaced by the CONTRACTOR without added expense to the OWNER.

701.8.5 The CONTRACTOR shall be responsible for the disposal of removed materials.

701.8.6 Saw cutting is required on all concrete or asphalt paving on State maintained streets or roads.

701.8.7 Paving cuts for manholes and valve boxes and other utility appurtenances shall be square and at dimensions specified the Standard Detail Drawings or on the construction plans.

701.9 MAXIMUM LENGTH OF OPEN TRENCH

In developed areas, no more than 300 feet of trench shall be opened in advance of pipe laying operations. This distance may be reduced due to traffic control considerations. Backfilling shall begin as soon as pipe is laid and inspected and shall keep pace with the pipe laying. In advance of trenching operations in undeveloped areas, the CONTRACTOR shall submit in writing or on plans for the ENGINEER'S approval, the maximum length of trench that will be open at anyone time. Except by permission of the ENGINEER, the maximum length of open trench in anyone location where concrete structures are cast in -place will be that which is necessary to permit uninterrupted progress. Construction shall be pursued as follows: excavation, formwork, and setting of reinforcing steel, placing of floor slab, walls, and cover slab or arch shall follow each other without anyone of these operations preceding the next nearest operation by more than 200 feet. Failure by the CONTRACTOR to comply with the limitations specified herein or as may be specifically authorized by the ENGINEER may result in a written order from the ENGINEER to halt progress of the work until such time as compliance with this paragraph has been achieved and the work can be proceeded in an orderly sequence of operations.

701.10 WIDTH OF TRENCHES

Trench widths will vary according to the type of pipe used, size of pipe, depth of trench, and soil conditions, The minimum width requirements, indicated below, are for proper laying, aligning and jointing of pipe as well as trench grading, bedding preparation, and backfilling.

701.10.1 TRENCH WIDTH FOR RIGID PIPE MATERIALS: Trench widths from bottom of pipe to a point 12 inches above the top of the pipe shall be kept to the practical minimum required for properly laying, aligning, grading, jointing, and backfilling of the pipe, but no less width than pipe outside diameter plus 16 inches. For stable soils which will stand a vertical cut, the maximum trench width at a point 12 inches above the top of pipe or at a point 5 feet above the bottom of the trench, whichever is less, shall be as follows:

701.10.1.1 The pipe outside diameter plus 2 feet for pipes 27 inches in diameter and smaller.

701.10.1.2 1.6 times the nominal diameter for pipes 30 inches in diameter or larger.

701.10.1.3 When soil will not stand vertical. the trench sides shall be sloped to provide not less than the outside diameter plus 16 inches at the pipe invert.

701.10.2 TRENCH WIDTH FOR NON-RIGID PIPES: The minimum clear width of the trench measured at the springline of the pipe should be 1 foot greater than the outside diameter of the pipe. The maximum clear width of the trench at a point 1 foot above the top of the pipe is equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width must be exceeded *or* if the pipe is installed in a compacted embankment, then pipe embedment should be compacted to a point of at least 2-1/2 pipe diameters from the side of the pipe or to the trench walls.

701.11 ROCK EXCAVATION

701.11.1 Rock is defined as material which cannot be excavated without drilling and blasting. All stone or boulders less than 8 cubic feet in volume will be classified as earth; all larger boulders shall be classified as rock. If blasting is necessary to excavate such materials as shale, hardpan, soft sandstone, cemented gravel, or loose rock which normally can be classified as earth excavation, then this excavation shall be classified as rock excavation. Whenever a ledge of solid rock encountered with earth below it or where alternate layers of solid rock and earth occur, the earth shall be included in the allowance for rock when the thickness of the layer of earth is less than 12 inches, thus requiring it to be removed by blasting along with the ledges of rock. Blasting will be considered necessary when the soil and rock cannot be excavated at a rate of 50 cubic yards per hour by a competent operator with a back-hoe that has a minimum bucket curling force of 25,000 pounds (John Deere 690 or equivalent).

701.11.2 Whenever rock is encountered in the trench or elsewhere in any excavation required to be made, it shall be excavated to the line and grade as shown on the plans and within the limits described therein, unless otherwise authorized, in writing, by the ENGINEER.

701.11.3 For trenches, rock shall be excavated to a depth of 6 inches minimum below the outside bottom of the conduit except at points of rock and earth transitions at which points the rock shall be

excavated to a minimum of 12 inches below the outside bottom of the conduit as shown on the detail sheets for trench cuts and backfill of rock. Any depression in the bottom of the trench caused by overshoot and/or excavating and being 6 inches or greater in depth from a theoretical bottom of trench grade shall be filled to the theoretical bottom of the trench with select soils. The trench shall be backfilled with select backfill material to a point 1 foot above the top of the conduit. The remainder of the trench shall be backfilled as specified herein. The complete trench backfill from the bottom through to the top of the subgrade shall meet the compaction and/or moisture requirements as specified herein.

701.11.4 BLASTING: Suitable weighted covering or mats shall be provided to confine all materials lifted by the blasting within the limits of the trench and to prevent injury of persons or damage to property. Blasting shall be under the supervision of a person qualified and experienced in the use and handling of explosives. All blasting operations shall be done in accordance with applicable local, state, and federal laws, ordinances, and codes regulating the transportation, storage, and use of explosives. Forty-eight hours prior to blasting operations, the CONTRACTOR shall notify the local law enforcement agency.

701.12 FOUNDATION

701.12.1 All pipe shall be bedded on a stable foundation in a trench which is completely free of water. The ENGINEER shall determine the adequacy of the foundation. Class V soils shall not be used as a foundation. If Class V soils are encountered at the bottom of the trench it shall be removed to the depth authorized by the ENGINEER and replaced with Class I, II or III soils.

701.12.2 Where an unstable foundation condition is encountered, it must be stabilized before laying pipe or alternative foundation methods utilized. The CONTRACTOR will be paid for foundation stabilization when required by the ENGINEER. Failure to notify the ENGINEER of an obvious unstable foundation condition prior to proceeding with placement of the pipe shall result in complete removal of the affected pipe, foundation stabilization, and replacement of the pipe at the CONTRACTOR'S expense.

701.12.3 Should the trench be inadvertently over-excavated below the foundation, the area of over-excavation shall be filled with select material in 6 inch lifts and compacted to a density of not less than 95 percent of maximum density, as determined by ASTM D 1557.

701.12.4 Unless specifically approved in writing by the ENGINEER, the CONTRACTOR shall not proceed with pipe embedment in a trench where water is present or the foundation is saturated. Adequate dewatering, as specified in Section 701.7, shall be utilized.

701.13 PIPE EMBEDMENT

701.13.1 GENERAL:

701.13.1.1 The class of bedding used for each pipe shall be as shown on the plans or as specified in the Supplemental Technical Specifications.

701.13.1.2 The CONTRACTOR may request a change in the class of bedding required on a pipe, if authorized by the ENGINEER, all increase in the cost of labor and materials required to include upgrading of the pipe class will be at the CONTRACTOR'S expense with no additional cost to the OWNER.

701.13.2 RIGID PIPE EMBEDMENT:

701.13.2.1 The trenches shall be excavated in conformance with the trench width requirements in Section 701.10 and 701.5.

701.13.2.2 Embedment material shall be Class I, II, III, or IV soils, or lean fill as specified in Section 207.

701.13.2.3 All soil in the embedment zone shall be placed in lifts not exceeding 8 inches in uncompacted depth, except that material along the side of the pipe shall not be placed above the springline until the haunch area of the pipe is adequately filled and sliced such that no voids remain.

701.13.2.4 All soil shall be compacted to a density not less than 90 percent of maximum density, as determined by ASTM D 1557. The CONTRACTOR shall take care to assure that the pipe is not damaged or misaligned during compaction of the embedment.

701.13.3 FLEXIBLE PIPE EMBEDMENT:

701.13.3.1 Proper placement of soils in the embedment zone is extremely important in achieving a satisfactory installation of flexible pipe. The CONTRACTOR shall be aware that the soil classes have differing requirements relative to embedment. There are also differing requirements for embedment in dry and wet conditions (wet conditions meaning that the embedment zone will be subject to ground water).

701.13.3.2 Embedment material shall be Class I, II, or III soils, or lean fill as specified in Section 207.

701.13.3.3 Embedment soil shall be placed in lifts not exceeding 8 inches loose depth. The haunch shall be properly compacted by hand tampers utilizing due caution such that the pipe is not damaged or misaligned. Mechanical tampers shall not be utilized directly over the pipe in the embedment zone.

701.13.3.4 The CONTRACTOR may utilize acceptable on site soils in the embedment area which are in conformance with these specifications. The CONTRACTOR has the option of importing a different soil, however, additional compensation will only be allowed if the on site soils are Class IV or V.

701.13.3.5 Class I soil shall comply with the requirements of Section 302, AGGREGATE BASE COURSE.

701.13.3.6 Class II and III soils shall be compacted to a density of not less than 95 percent of maximum density in the embedment area, as determined by ASTM D 1557. The moisture content shall not exceed 5 percent above optimum.

701.14 FINAL BACKFILL

701.14.1 Final backfill shall consist of homogeneous soil except that boulders, frozen clumps, rubble, and Class V soils are excluded.

701.14.2 Final backfill shall be compacted to a density of not less than 90 percent of maximum density, as determined by ASTM D 1557 unless otherwise specified in the Contract Documents.

701.14.3 The upper portion of the final backfill may require specific soils and compaction in order to provide a suitable foundation for pavements, curb and gutter, sidewalk, or other type of structure.

701.15 COMPACTION METHODS

701.15.1 The CONTRACTOR shall be responsible for the compaction method utilized during foundation preparation, embedment placement, and final backfill except as otherwise specified herein or in the Supplemental Technical Specifications.

701.15.2 The use of mechanical vibratory compactors directly over the pipe is prohibited in the embedment area. Extreme care shall be taken when utilizing mechanical compactors in the haunch and initial backfill area in order to avoid damage to or misalignment of the pipe. The ENGINEER shall examine any damaged pipe and has the authority to

direct that it be replaced with new pipe at no additional cost to the OWNER.

701.15.3 Flooding or jetting shall be allowed if the subsurface soils are compatible to its usage, as authorized by the ENGINEER. It shall not be used for compaction of flexible pipe, when the soil has a plastic limit of 7 or greater, and in areas of collapsible soils. The CONTRACTOR shall take any necessary precautions to minimize to negligible flotation of the pipe.

701.15.4 The CONTRACTOR shall, at the direction of the ENGINEER, excavate the compacted fill as necessary for the purpose of determining the adequacy of the compaction.

701.16 PAVEMENT

701.16.1 Either new street construction or pavement replacements shall satisfy the following design and construction requirements:

701.16.1.1 Unless permanent pavement is specified to be placed immediately, a temporary dust-free patch shall be placed wherever excavation is made through existing pavements, sidewalks, or driveways. The patch shall be placed, rolled, and maintained by the CONTRACTOR to provide a smooth surface for traffic until a permanent pavement is constructed within the time frame specified by the ENGINEER.

701.16.1.2 The subgrade preparation of the area to be paved shall be in accordance with Section 301 of these specifications. The asphalt pavement placed shall be in accordance with Section 336 and the concrete pavement shall be in accordance with Section 337. The placement of the other roadway items shall be in accordance with Section 340.

701.16.1.3 Material thickness for all pavement replacements within residential or arterial streets shall conform to the plans or the Standard Detail Drawings or match the existing pavement as authorized by the ENGINEER.

701.16.1.4 Pavement cuts of 8 ft. or more in width and 100 ft. or more in length shall be paved with a laydown machine.

701.16.1.5 When authorized by the ENGINEER, asphalt concrete base course may be used to replace surface course thickness requirements on streets that are scheduled for overlay.

701.16.1.6 The edges of all trenches at the base course level shall be neatly trimmed before

beginning any paving replacement. All edges of the existing pavement adjacent to the trench cut shall be inspected. Undermined, broken, cracked, or unevenly cut portions shall be removed and the pavement edges retrimmed prior to pavement replacement. All vertical edges of the existing asphalt pavement adjacent to the trench cut and all surface areas for a width of at least 4 inches and no greater than 8 inches, shall be thoroughly cleaned and a tack coat applied prior to placing any hot mix asphalt. The finished surface of the pavement replacement shall be graded to conform to the existing contour both in cross section and profile.

701.16.1.7 Concrete pavement to replace cuts made in concrete paved streets, arterials, etc., shall conform to the Standard Detail Drawings for concrete pavement or in accordance with New Mexico Department of Transportation requirements where applicable.

701.16.1.8 When more than one-half of the surface area of a manhole, lamphole or valve box is found to extend into the area to receive a permanent asphaltic hot-mix surfacing and/or base pavement replacement, the existing pavement surrounding the manhole, lamphole, or valve box shall be removed to within those limits which will permit a permanent pavement replacement to be made in accordance with the approved plans.

701.16.1.9 Asphaltic hot mix shall not be placed upon the concrete collar, nor shall traffic be permitted upon the collar for at least 24 hours, or longer, if so directed by the ENGINEER. A tack coat of asphaltic emulsion may be applied after the concrete has taken its final set. During this time adequate barricading of the area shall be maintained by the CONTRACTOR.

701.16.1.10 If in the course of a pavement removal, a manhole, lamphole, and/or valve box is encountered and has a concrete collar about it and the collar is performing adequately, no special construction need be made in the permanent pavement replacement.

701.16.1.11 The CONTRACTOR shall make any small grade or alignment adjustment of the manhole, lamphole, and/or valve box encountered that is necessary to provide a smooth riding surface between the existing pavement and the patch and/or within the patch itself.

701.16.1.12 TESTING

701.16.1.12.1 A sample of each type of soil encountered shall be classified in accordance with

the requirements of ASTM D2487, and the moisture density relationship determined in accordance either ASTM D698 or D1557, whichever is applicable.

701.16.1.12.2 A compaction test shall be taken for each 2 feet depth per 200 feet trench length or less, as directed by the ENGINEER. Compaction tests shall be taken in accordance with ASTM D2922 and D3017. Areas represented by non-complying tests shall be reworked and re-tested for compliance.

701.17 MEASUREMENT AND PAYMENT

701.17.1 TRENCHING, BACKFILLING, AND COMPACTION:

701.17.1.1 Trenching, backfilling, and compaction shall be combined into one unit and shall be measured and paid for as follows:

701.17.1.2 Measurement shall be made along the centerline of the pipe.

701.17.1.3 The unit of measurement shall be by the linear foot *per* pipe diameter per specified increment of depth.

701.17.1.4 The following depth increments will apply:

701.17.1.4.1 For water line installations the costs for trenching, backfilling and compaction shall be included in the unit price per linear foot of pipe per pipe diameter for maximum depth, such as: 4 to 14 inch diameter at 6 feet, 16 to 24 inch diameter pipe at 7 feet and all pipe larger than 24 inch at 8 feet. Separate payment will be specified in the Bid Proposal when required depths exceed the above depths.

701.17.1.4.2 For sewer installations the increments shall be 8 feet or less, 8 feet to 12 feet, 12 feet to 16 feet, 16 feet to 20 feet and thereafter at 4 foot intervals.

701.17.1.4.3 All depths shall be measured to the nearest foot.

701.17.1.5 All depths shall be measured from the invert of the pipe to the top of existing ground elevation. The existing ground elevation shall be the elevation of the surface that exists along the centerline of the pipe at the time of construction staking for said trenching.

701.17.1.5.1 Whenever a special pipe embedment detail is specified, on the plans, the trench depth shall be measured from the bottom of the embedment to the top of existing ground elevation.

However, no additional trench depth shall be measured as a result of inadvertent over-excavation nor to accommodate trench dewatering.

701.17.1.6 Payment will be made at the unit price per linear foot per diameter of pipe per depth increment as specified in the Bid Proposal, and will include trenching, backfilling, and compaction for all trench zones. No additional payment will be made for compacted materials to bring trench backfill up to required depth.

701.17.2 OVER-EXCAVATION: Required over-excavation for foundation stabilization shall be measured by the cubic yard of material removed and replaced with compacted suitable material. Payment will be made at the unit price per cubic yard of compacted replacement material and shall include excavation, backfill material, and compaction.

701.17.3 ROCK EXCAVATION: Rock excavation will be measured by the cubic yard within the specified limits of the trench configuration. Blasting will be included in the rock excavation. Payment will be made at the unit price per cubic yard.

701.17.4 UNSUITABLE MATERIALS: Removal and disposal of unsuitable materials from the construction site shall be measured by the cubic yard of excavated material. Payment will be made at the unit price per cubic yard of excavated material.

701.17.5 PAVEMENT, SIDEWALK, AND DRIVEWAYS: Removal and disposal of existing pavement, sidewalks, and driveways will be measured by the square yard or square foot whichever is apropos. Payment will be made at the unit price per square yard or square foot as specified in the Bid Proposal.

701.17.6 SELECT MATERIALS: Where selected material is required in the backfilling operations, the quantity of material will be measured by the cubic yard of compacted material in place in the trench. Payment will be made at the unit price per cubic yard of select material as indicated above.

701.17.6.1 Whenever a special pipe embedment detail is specified, measurement and payment shall be as identified in the Bid Proposal.

701.17.7 DEWATERING: Dewatering operations for trench work shall be measured by the linear foot along the center-line of that portion of the trench which requires dewatering. Payment will be made at the unit price per linear foot of dewatered trench.

701.17.8 PAVEMENT:

701.17.8.1 Permanent or temporary pavement surfacing shall be measured and paid for in accordance with the paving section elements as defined under Section 300 for the specific item of work.

701.17.8.2 Permanent resurfacing or permanent surface patching will be measured on the basis of the square yard for new surfacing as provided in the applicable section of these specifications. For payment purposes, the normal maximum pavement cut width shall be as defined in the Table No. 701.17.8.2

TABLE No. 701.17.8.2

NORMAL MAXIMUM PAVEMENT CUT WIDTHS ALLOWED FOR PAYMENT PURPOSES

Soil Stability	Trench Depth (TD)	Pipe Size	Max. Pavement Cut Width
Stable. Soil stands in a vert. cut	Less than or equal to 5 feet	ND less than or equal to 27"	00 + 2 feet
"	Greater than 5'	ND less than or equal to 54"	TD + 2 feet
"	"	ND greater than 54"	1.6 X ND + TD + 3'
Unstable. Soil does not stand in vert. cut	Any	Any	2 X TD + OD

- NOTES: 1. TD is trench depth; ND is nominal pipe diameter; and OD is outside pipe diameter.
2. Individual locations or conditions may warrant greater cut widths than those specified above. The ENGINEER shall authorize in writing the increase in the above pavement cut widths.

SECTION 910

STORM SEWER PIPE INSTALLATIONS

910.1 GENERAL

910.1.1 The construction items, specified in this section, are common to storm sewer pipe installation and pipe type culverts.

910.1.2 Reinforced concrete pipe may be used for storm sewer pipe installations or pipe type culverts. Corrugated metal pipe will only be used for pipe-type culverts.

910.2 REFERENCES

910.2.1 ASTM

C 43	C 478
C 361	D 3034
C 425	F 679
C 443	

910.2.2 AWWA

C 603

910.2.3 This publication per SECTIONS:

101	125
102	129
105	135
106	136
108	137
121	161
123	801
124	

910.3 MATERIALS

910.3.1 PIPE: Sewer line pipe and fittings shall be as specified in other sections, as follows:

Reinforced Concrete Pipe	Section 123
Reinforced Concrete Pressure Pipe	Section 124
Corrugated Metal Pipe and Arches	Section 135
Structural Plate for Pipe, Arches, and Pipe Arches	Section 136
Corrugated Aluminum Pipe and Arches	Section 137

910.4 CERTIFICATION

The OWNER/ENGINEER will be supplied with a certification on each item or type of material required in the sewer line, as to that item meeting the

specifications and/or the reference specifications before that item is installed.

910.5 INSTALLATION

910.5.1 GENERAL:

910.5.1.1 Pipe and appurtenances shall be new and unused. The type of pipe to be installed shall be as approved by these specifications or unless otherwise shown on the drawings. Pipe and appurtenances shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken to prevent damage to any pipe coating.

910.5.1.2 The interior of the pipe shall be thoroughly cleaned of foreign material before being lowered into the trench and shall be kept clean during construction operations. When work is not in progress, the open ends of pipe shall be securely closed so that no foreign materials will enter the pipe. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe, or repaired in a manner satisfactory to the ENGINEER, without additional expense to the OWNER.

910.5.1.3 The CONTRACTOR shall install a plug in the new sewer at any point of connection to an existing system. The plug shall remain in place until the ENGINEER authorizes its removal in writing. The CONTRACTOR shall not flush or otherwise discharge any flow into an existing system unless approved in writing by the ENGINEER.

910.5.1.4 Pipe shall be laid to line and grade as shown on the plans and as staked in the field. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel. Suitable excavation shall be made to receive the bell of the pipe and the joint shall not bear upon the bottom of the trench. All adjustment to the line and grade shall be made by scraping away or filling in with pipe zone material under the body of the pipe, and not by wedging or blocking. When connections are to be made to any existing manhole, pipe, or other improvement, the actual elevation or position of which cannot be determined without excavation, the CONTRACTOR shall excavate for and expose the existing improvement before laying the connecting pipe or conduit. When existing underground improvements may reasonably be expected to conflict with the line or

grade established for the new sewer line, the ENGINEER shall request and the CONTRACTOR shall excavate as necessary to expose and locate such potentially conflicting underground improvements prior to laying the new pipe. Any adjustment in line or grade which may be necessary to accomplish the intent of the plans will be made, and the CONTRACTOR will be paid for any additional work resulting from such change in line or grade in the manner provided for in the General Conditions.

910.5.1.5 CONTRACTOR shall submit to the ENGINEER the proposed method for making connections to existing manholes. Connection methods will be dependent upon manhole size and pipe sizes. Unnecessary damage to the existing manhole should be avoided.

910.5.1.6 Pipe shall be laid upgrade in a continuous operation from structure to structure, with the socket or collar ends of the pipe upgrade unless otherwise permitted by the ENGINEER. Concrete pipe with elliptical reinforcement shall be laid with the minor axis of the reinforcement cage in a vertical position. Corrugated metal pipe shall be laid with the external laps of the circumferential seams toward the inlet end.

910.6 JOINTS FOR PIPE

910.6.1 JOINT FOR CONCRETE PIPE:

910.6.1.1 The type of joint to be used shall be O-ring rubber gasket joints conforming to ASTM C 361 and C 443.

910.6.1.2 Gasketed Type of Joints for Reinforced Concrete Pipe

910.6.1.2.1 General--The ends of the pipe shall be so formed that when the pipes are laid together and joined, they shall make a continuous and uniform line of pipe with a smooth and regular surface.

910.6.1.2.2 Rubber gaskets for making compression-type joints for concrete pipe shall be factory fabricated in accordance with ASTM C 443; for pipes 12 inches in diameter and larger shall be O-ring and shall be handled, primed, installed, etc. in strict accordance with the manufacturer's recommendations.

910.6.1.2.3 The CONTRACTOR'S attention is particularly called to ASTM C 443, regarding storage of gaskets.

910.6.1.2.4 The CONTRACTOR shall furnish the ENGINEER complete information concerning the type

and make of all joint material which he intends to use under the contract, including certification that the joint material meets the requirements of the specifications.

910.6.2 JOINTS FOR CORRUGATED METAL PIPE:

910.6.2.1 The seams of the pipe are to be placed at the sides, not on the bottom. The inside circumferential seams should be placed pointing downstream. Care should be taken to insure that dirt or other particles do not get between the outside of the pipe and the pipe coupling. Paved inverts should be placed and centered on the bottom of the trench. Any damage to the protective lining and coating shall be repaired prior to the backfilling around the pipe.

910.6.2.2 If waterproof joints are called for on the plans or specified in the Supplementary Specifications, the caulking compound or other waterproofing material used shall be subjected to the approval of the ENGINEER.

910.7 TESTING FOR LEAKAGE

Normally storm sewer lines need not be tested, but if in the opinion of the ENGINEER, the workmanship or materials do not appear to be satisfactory, the ENGINEER may require that a section of the storm sewer line be tested in a similar manner as that for a sanitary sewer line, see Section 905.

910.8 CLEANING AND INSPECTION

910.8.1 CLEANING: No pipe spalls, rocks, dirt, joint compounds, cement mortar and other trash or obstructions shall be left in a sewer pipe of any size or type. During flushing operations the manhole outlet shall be bagged or plugged so that the debris will not be carried into an existing active line.

910.8.2 INSPECTION: Before lines become operational or final acceptance of the installation, small size lines shall be inspected by a television camera and larger size lines will be inspected by walking through the line.

910.8.3 TELEVISION: After the CONTRACTOR has cleaned and flushed the line, the CONTRACTOR will notify the ENGINEER that the line is ready for television inspection, if required. Prior to the television inspection (possibly during flushing operation) the CONTRACTOR will insert a 1/4-inch nylon rope in the line for the purpose of towing the television unit through the pipe. The OWNER will perform the first television inspection at no cost to the CONTRACTOR. If during the first inspection debris is found in the line, the television inspection will cease. When further

cleanup has been completed, the CONTRACTOR will request the ENGINEER to have a second inspection performed. The cost of the second inspection and any subsequent inspections of that segment of the line will be paid for by the CONTRACTOR at the rate of \$75.00 per hour while the television crew is at the line site.

910.9 MEASUREMENT AND PAYMENT

910.9.1 STORM SEWER PIPE: Installed pipe shall be measured and paid for as follows:

910.9.1.1 For straight lines the pipe length shall be the intervening distance between the centers of manholes along a line parallel to the pipe invert.

910.9.1.2 For curvilinear lines the pipe length shall be the intervening arc distance between the centers of manholes along a line parallel to the pipe invert.

910.9.1.3 For lateral lines, such as from main or manhole to a storm inlet, the pipe length shall be the distance between the center of a manhole or centerline of the main to the interior wall face of the storm inlet along a line parallel to the pipe invert.

910.9.1.4 Payment for pipe will be in accordance with the unit price per linear foot per size and material as defined in the Bid Proposal, and shall include pipe installed in the trench, jointing and coupling materials, and other materials necessary to connect to other sections of pipe, manholes, and other appurtenances.

910.9.2 REMOVAL AND DISPOSAL OF STORM SEWER PIPE: Removal and disposal of storm sewer pipe shall be measured by the linear foot within the specified pipe size increments. Payment will be made on the unit price per linear foot of specified pipe size in the Bid Proposal. Trenching, backfilling, and pavement removal and replacement will be paid for based on the unit prices for each appropriate bid item in the Bid Proposal. If new pipe is to be installed in the same trench as the removed pipe, only one payment will be made for trenching, backfilling, and pavement removal and replacement.

910.9.3 TESTING OF PIPE: No payment will be made for required initial or subsequent tests on sections of the storm sewer line.

SECTION 920

SANITARY AND STORM SEWER MANHOLES

920.1 GENERAL

This section contains items which are relative to the installation of sanitary and storm sewer manholes.

920.2 REFERENCES

920.2.1 ASTM

C 43	C 497
C 139	C 1557
C 478	

920.2.2 This publication

SECTION 101	SECTION 106
SECTION 102	SECTION 161
SECTION 105	

920.3 MANHOLE MATERIALS

Sewer manhole materials shall be as specified in other sections, as follows:

Portland Cement Concrete	Section 101
Steel Reinforcing	Section 102
Concrete Curing Compound	Section 105
Cement Mortar and Grout	Section 106
Gray Iron Castings	Section 161

920.4 MANHOLE CONSTRUCTION

920.4.1 GENERAL:

920.4.1.1 Soil Foundations for manhole base shall be compacted to a density of 95 percent of the maximum density per ASTM D 1557. Compaction limits shall be one foot beyond the perimeter of the concrete base and shall be a minimum of one foot in depth.

920.4.1.2 Manholes shall be constructed in accordance with the Standard Detail Drawings and as shown on the construction plans. Precast reinforced concrete units, concrete blocks or formed in place, reinforced concrete may be used to construct the manhole.

920.4.1.3 Invert elevation of the pipes entering or exiting the manhole and interior inverts shall not vary more than 0.05 foot from the elevations indicated on the construction plans.

920.4.1.4 All cement used for poured foundations. Mortar, fillets, grout, and concrete shelf construction shall be Type II or approved equal.

920.4.1.5 All concrete for formed in place foundations or bases, concrete shelves, and pipe supports shall be 3000 psi compressive strength concrete.

920.4.1.6 Depending on the size of the pipe, connections to existing and new manholes shall be made by either core drilling through the manhole wall, pre-formed for new precast units, or for large-size pipe the manhole wall may be removed by carefully chipping the wall segment which will permit entry of the pipe. In the latter operation, exposed manhole reinforcement should be bent and tied to the reinforcement of the pipe collar. If core drilling is not practical, the CONTRACTOR shall request the ENGINEER to authorize the chipping operation. During either operation the CONTRACTOR shall take care to avoid unnecessary damage to the manhole surfaces or walls.

920.4.2 PRECAST CONCRETE MANHOLES:

920.4.2.1 The vertical sections of the manhole may be of different dimensions in order that manholes of various depths can be readily assembled.

920.4.2.2 Concrete, used for precast bases, vertical sections, and eccentric cones, shall be 4000 psi compressive strength concrete.

920.4.2.3 Vertical sections of the manhole shall conform to the requirements of ASTM C 478.

920.4.2.4 The CONTRACTOR shall submit shop drawings of the precast base and eccentric cone to the ENGINEER for review and approval.

920.4.2.5 Circular precast manhole sections shall be provided with mastic gasket to seal joints between sections, such as RAM-NEK, KENT SEAL, or approved equal.

920.4.2.6 All lifting holes, except Type "C" manhole covers, and gaps at joints shall be filled with a nonshrink grout.

920.4.2.7 Precast concrete manhole bases may be used when approved by the ENGINEER. If approved, it shall be with the understanding that the CONTRACTOR shall be responsible for placing the bases at the specified elevation, location, and alignment.

920.4.3 FORMED INPLACE REINFORCED CONCRETE MANHOLE:

920.4.3.1 The CONTRACTOR shall submit preconstruction drawings of the proposed manholes to the ENGINEER for review and approval.

920.4.3.2 Concrete used for this type of manhole construction shall be 4000 psi compressive strength concrete.

920.4.3.3 If desired, a precast eccentric cone or a flat cover can be used.

920.4.4 CONCRETE BLOCK MANHOLE:

920.4.4.1 The CONTRACTOR shall submit preconstruction drawings of the proposed manhole to the ENGINEER for review and approval.

920.4.4.2 Concrete masonry units for the construction of this type of manhole shall conform to ASTM C 139 and the Standard Detail Drawings. All blocks shall be mortared into place.

920.4.4.3 Eccentric cone or flat-type cover shall be used.

920.4.5 TEE PIPE MANHOLE:

920.4.5.1 Tee pipe manholes will be used for all 4-foot-diameter mainline pipes and larger. Horizontal section of the tee pipe shall be the same class of pipe as the adjacent sections. The vertical sections shall comply with the requirements set forth in ASTM C 478.

920.4.5.2 Top of the vertical portion of tee pipe unit will extend a minimum of 18 inches above the outside diameter of the horizontal pipe. The 4-foot-diameter vertical section of the tee pipe shall be connected at the longitudinal center point of the horizontal pipe section. The minimum length of horizontal pipe section shall be 8 feet.

920.4.5.3 The CONTRACTOR shall submit to the ENGINEER for review and approval preconstruction shop drawings on the fabrication of the tee pipe section as developed by a precast reinforced concrete pipe manufacturer. Field fabrication of this eccentric pipe unit will not be accepted. Shop drawings for the eccentric cone will also be submitted for review and approval.

920.4.5.4 RAM-NEK, Kent Seal, or OWNER - approved equal sealants shall be used to seal the joints in the vertical portion of this manhole.

920.4.5.5 All lifting holes, except for Type "C" manhole covers, and gaps at joints shall be filled with a nonshrink grout.

920.4.5.6 Standard Detail Drawings show some of the components of the tee-type pipe manhole.

920.4.6 COATING OF MANHOLES:

920.4.6.1 Exterior of Manholes: Exterior coating of manholes shall be required in areas where ground water is present. The coating shall be a water-proofing type of bitumastic or asphaltic material, as approved by the ENGINEER. Application shall be in accordance with the manufacturer's published recommendations.

920.4.6.2 Interior of Manholes: Interior coating of manholes shall be required only when specified on the construction plans. The coating shall be an epoxy resin-type material, be an epoxy resin-type material such as: "Zebtron," "Plastite 7122," or approved equal, and shall be capable of protecting the concrete from deterioration due to a gaseous environment. Application shall be in accordance with the manufacturer's published recommendations.

920.4.6.3 Plastering of Manholes: The work shall include the coating of the surface of existing block manholes with plaster as required on the plans.

920.4.7 MANHOLE STEPS:

920.4.7.1 Manhole steps shall be 1/2" diameter, grade 60, reinforcing rod completely encapsulated in copolymer polypropylene or corrosion resistant rubber compound. Steps shall be designed to be cast in place or hammered into holes in manhole walls.

920.4.7.2 Approved manhole steps of only one manufacturer model shall be used on any specific project and shall not be intermixed with other approved steps. Approved steps must bear the manufacturer name and model on the exposed surface of the step and shall be one of the following products or approved equals: M.A. Industries, Inc. - Model PS-2-PFS H. Bowen Co.-Bowco, Model 81213 or 93813 Delta Pipe Products -WEDG-LOK, Model W-II

920.4.7.3 The minimum width of step tread shall be 11 inches. Steps will be spaced uniformly in each manhole. Spacing may be between 12 inches to 16 inches on center. Lower step will be 12 inches above manhole shelf or top of main. The upper step shall be 6 inches below the top portion of the eccentric cone or 6 inches below the bottom of the flat cover.

Also the steps shall be aligned vertically with the opening of the cone or cover.

920.4.7.4 Steps shall be embedded in the manhole wall a minimum of 3" inches and protrude from the manhole interior surface a minimum of 4 3/4 inches.

920.4.7.5 Holes for step installation shall be drilled or precast per manufacturer's recommended size. or of sufficient size to allow for step insertion into the wall. Cast-in-place sockets or tapered holes recommended by the step manufacturer may be used with prior approval of ENGINEER. If the hole has been drilled too large, then the step shall be secured in place by using epoxy grout for the full depth of the drilled hole.

920.4.6 Acceptable manhole step installations must be capable of withstanding a 400 pound. horizontal, pull out load applied in accordance with ASTM C-497.

920.4.8 ADJUSTMENT BRICKS:

920.4.8.1 Manhole adjustment bricks shall conform to the requirements for manhole bricks. per ASTM C 32 for Grade MS.

920.4.8.2 Mortar shall be used to lay the bricks. as well as coating the interior and exterior surfaces of the laid brick. Thickness of the mortar coating shall be 1/2 inch.

920.4. 9 MANHOLE FRAME AND COVER:

The manhole frame and cover for either the sanitary or storm sewer manholes shall conform to the specifications contained in Section 161.

920.5 TESTING OF SEWER MANHOLES:

920.5.1 All sanitary sewer manholes shall be tested for leakage by either a water exfiltration test or a vacuum test. Whichever test is utilized it is recommended that the test be performed prior to backfilling around the manhole and prior to placement of the manhole frame and cover. All inlet and outlet lines shall be properly plugged and the lift holes and barrel joints filled and sealed as specified. The CONTRACTOR shall be responsible for all materials and equipment necessary to perform the test and shall conduct the test in the presence of the ENGINEER or his representative. The CONTRACTOR has the option of performing a manhole test in increments appropriate to the depth of the manhole.

920.5.2 The water exfiltration test shall consist of filling the entire manhole with water to the bottom of

the frame elevation. A stabilization period of one hour will be allowed for absorption. After which the manhole shall be refilled as necessary before starting the test. The test period shall be two (2) hours. After which the manhole shall be refilled, measuring the necessary quantity of water. The allowable leakage shall be 0.25 gallons per foot diameter per vertical foot per day, and is represented by the following formula:

$$V = 0.25 \text{ DHT}/24$$

where; V = Allowable loss in gallons

D = Manhole diameter in feet

H = Initial depth of water to invert in feet

T = Duration of test in hours

920.5.3 The vacuum test shall consist of utilizing an inflatable compression band, vacuum pump, gauges and appurtenances specifically designed for vacuum testing. Test procedures shall be in accordance with the manufacturer's printed recommendations. The ENGINEER shall be the sole judge as to the adequacy of the equipment.

920.5.3.1 A vacuum of 10" Hg shall be placed in the manhole and the time measured for a drop to 8.5" Hg. The test shall be considered to be successful if the measured time exceeds the test period. Should the test fail, the man- hole shall be repaired as necessary and the test rerun. The test periods are:

920.5.3.2 Sixty (60) seconds for four (4) foot diameter manholes.

920.5.3.3 Seventy-five (75) seconds for five (5) foot diameter manholes.

920.5.3.4 Ninety (90) seconds for six (6) foot diameter manholes.

920.5.3.5 One hundred and Twenty (120) seconds for eight (8) foot diameter manholes.

920.5.4 Normally storm sewer manholes need not be tested unless specifically required by the project plans or supplemental technical specifications. However, if in the opinion of the ENGINEER, the workmanship or materials do not appear to be satisfactory, the ENGINEER may require that any storm sewer manhole be tested in a similar manner as that for a sanitary sewer manhole.

920.6 ABANDONMENT OF MANHOLES

920.6.1 Abandonment of manhole, which is part of a sewer line being abandoned, shall entail the following work and materials:

920.6.2 Manhole will not be removed but will be abandoned in place.

920.6.3 All manhole inlet and outlet lines shall be plugged with a 12-inch- thick concrete or concrete mortar plug.

920.6.4 Salvageable material shall be stockpiled on the job site. The CONTRACTOR shall contact the OWNER to arrange for a representative to inspect the materials for usability. Salvageable materials shall be transported by the CONTRACTOR as directed by the OWNER. CONTRACTOR will receive a receipt for the turned-in materials. Receipts will be submitted to the ENGINEER prior to final acceptance of the Project. Unusable materials will be disposed of by the CONTRACTOR.

920.6.5 Manhole bottom will be pulverized.

920.6.6 The manhole shall be filled with cement treated base (CTB) material to the bottom elevation of the asphalt base course of the pavement or to the ground surface level.

920.6.7 All labor, materials, and equipment necessary to complete this work shall be furnished by the CONTRACTOR.

920.6.8 For historical information the ENGINEER shall have a survey performed which will locate the abandoned manhole, relative to permanent survey markers.

920.7 SEWER MANHOLE REHABILITATION IN REPLACEMENT WORK

920.7.1 The work under this item shall be to replace the existing manhole frame and cover and to place a concrete pad around the existing manhole as required per the construction plans. This work will be done only when an existing man- hole is encountered in the normal course of the replacement work that has a light- weight, vented, multi-holed manhole cover.

920.7.2 The work and materials shall include the following:

920.7.2.1 Remove any and all existing brick under frame and replace with new Grade MS brick as necessary to bring new frame and cover up to street grade.

920.7.2.2 Remove and replace existing concrete pad, or construct a new pad.

920.7.2.3 Remove existing steps and replace with new steps or, if steps are nonexistent, install new steps. Steps will be installed as per Subsection 815.4.7.

920.7.2.4 Remove and replace pavement.

920.7.2.5 Excavation and compaction of backfill as necessary.

920.7.2.6 All materials, labor, and equipment necessary to do the work under this item shall be furnished by the CONTRACTOR.

920.7.2.7 The work and materials under this item shall be done according to the manner set forth in the Standard Detail Drawings and other sections of these specifications.

920.7.3 Salvageable material shall be stockpiled on the job site. The CONTRACTOR shall contact the OWNER to arrange for a representative to inspect the materials for usability. Salvageable materials shall be transported by the CONTRACTOR as directed by OWNER. CONTRACTOR will receive a receipt for the turned-in materials. Receipts will be submitted to the ENGINEER prior to final acceptance of the Project. Unusable materials will be disposed of by the CONTRACTOR.

920.8 MEASUREMENT AND PAYMENT

920.8.1 NEW MANHOLES:

920.8.1.1 Type "C," "E," "F," or "G" manholes of 4-foot or 6-foot diameters shall be measured per each within the following increments of depth: 3 to 6 feet, 6 to 10 feet, and 10 to 14 feet. Manholes which are greater in depth than 1 foot shall be measured by the vertical foot. Measurements will be made to the nearest foot and will be from the manhole rim elevation to the manhole invert elevation.

920.8.1.2 Payment for manholes 14 feet deep or less will be made on the unit price per manhole diameter per depth increment as specified in the Bid Proposal. Payment for manhole depths which exceed 14 feet will be made on the unit price per manhole diameter per vertical foot. This payment is in addition to the manhole unit price for the portion above the 14 foot depth.

920.8.1.3 Type "A" or Tee-type manholes shall be measured and paid for by the methods described in 920.8.1.1 and 920.8.1.2. Measurement will be from the invert of the main line to the manhole rim. Payment under this item will include the normal manhole costs described below, as well as any additional pipe costs for the precast tee and for the concrete cradle under the tee.

920.8.1.4 Payment for any type diameter or depth of manhole will include excavation, compacted backfilling, shelving, cover or cone, leveling bricks, frame and cover, and concrete pad or collar.

920.8.2 ELEVATION ADJUSTMENTS:

920.8.2.1 When a new manhole is installed, no measurement or payment will be made for rim elevation adjustments to conform to street surface grades.

920.8.2.2 The following measurements and payments for rim elevation adjustments on existing manholes will be made for indicated conditions:

920.8.2.2.1 Unit price per inch of adjustment ring for adjustment to manhole frame by the addition of adjustment ring.

920.8.2.2.2 Unit price per inch of leveling brick adjustment.

920.8.2.2.3 Unit price per manhole diameter per vertical foot of adjustment to cone and/or barrel.

920.8.2.3 As required, the following items will be included in the unit price per appropriate adjustment: pavement removal and replacement, excavation, compacted backfilling, concrete collar or pad, leveling bricks, adjusting rings, and/or frame and cover.

920.8.3 COATING OF MANHOLE: Plastering or epoxy coating for manholes shall be measured and paid for on the unit price per square foot of surface area covered.

920.8.4 MANHOLE STEPS: Unless otherwise shown on the Bid Proposal, the cost of manhole steps shall be incidental to the unit prices for construction of manholes of various types and depths.

920.8.5 ABANDONMENT OF MANHOLES: Measurement and payment for abandonment of a manhole shall be the unit price per manhole for defined work in Subsection 920.6.

920.8.6 MANHOLE REHABILITATION IN REPLACEMENT WORK: Work under this item shall be measured and paid for by the unit price per manhole for work specified in the Bid Proposal.

920.8.7 TESTING: There will be no payment for required testing of sewer manholes.

SECTION 1200

BARRICADING AND TEMPORARY TRAFFIC CONTROL

1200.1 GENERAL: The work under this section includes, but is not limited to, traffic control standards needed to ensure safety to motorists, the public, construction workers, and special event participants when City roadways are temporarily disrupted due to construction efforts or special events.

1200.2 REFERENCES

1200.2.1 Manual on Uniform Traffic Control Devices, (MUTCD), Part VI, FHWA.

1200.2.3 The American Traffic Safety Services Association (ATSSA), Quality Standards for Work Zone Traffic Control Devices.

1200.2.3 This Publication, Latest Edition

SECTION 19 CONSTRUCTION TRAFFIC CONTROL SECTION 400 TRAFFIC CONTROL

1200.3 BARRICADING STANDARDS

1200.3.1 Before construction begins all traffic control signs and barricades must be installed in accordance with the approved traffic control plan, construction plans, barricading detour plan or as directed by the OWNER. No construction signing and barricading shall commence until CONTRACTOR is assured that all equipment, manpower, and resources are available to start and complete the work. Where applicable, all signs, barricades, and/or barrels will be moved forward as the construction progresses.

1200.3.2 The name and telephone number of the owner shall be permanently stenciled on all barricades and traffic control equipment. The name and telephone number shall be a non-retroreflective color not over 2 inches in height, and be placed on a non-retroreflective surface of all equipment. Graffiti shall be promptly removed from any all barricades and traffic control equipment. If notified by the OWNER or the ENGINEER, graffiti shall be removed, or the equipment replaced with clean equipment, within four hours or the barricade permit is subject to revocation.

1200.3.3 All advance warning signs approaching a construction zone shall be double indicated (one sign each on left and right sides of approaching traffic) for all multiple-lane roadways with painted or raised medians and where adequate space is available. All double indicated signs shall be the same size. When a sign is placed in a painted median, especially a two-way continuous left-turn lane, a reflectorized barricade must be placed on the back side of the sign to alert

motorists approaching from the opposite direction.

1200.3.4 It shall be the responsibility of the CONTRACTOR to remove all construction barricades, signing, and traffic control devices not required at the end of the working day.

1200.3.5 All advance warning signs shall be a minimum of thirty-six inches by thirty-six inches in size with super engineering grade sheeting or better. On high-speed (posted 45mph and above), rural section roadways where adequate pedestrian space is available, forty-eight inch by forty-eight inch signs is preferred. The use of forty-eight inch signs shall be required at locations as published on a list by the ENGINEER. All advance-warning signs not directly applicable shall be removed when not needed, and shall not be left in public right-of-way. All construction signing shall be black on a reflectorized orange field unless otherwise specified.

1200.3.6 Existing posts may be used at some locations, with approval of the ENGINEER. Portable sign supports will be acceptable as an alternate for signs which are to be in place for less than three (3) weeks. The bottom of advance warning signs mounted on barricades or temporary sign supports shall be no less than one foot above the traveled way. All regulatory and advisory signs shall be mounted on sign stands or as otherwise approved by ENGINEER. The placement of portable sign supports shall not block or impede pedestrian access. All signs ground mounted on single or double posts shall have the bottom of the sign seven (7) feet above pavement level.

1200.3.7 Barrels and different types of barricades are generally not intended to be intermixed in the same series of channelization. All barrels may have sand or water ballast limited to one hundred (100) pounds. All barricades shall be placed correctly with diagonal stripes sloping downwards in the direction traffic is to pass. Where barricades extend entirely across a roadway, the stripes must slope downward in the direction toward which traffic must turn. Where both right and left turns are provided, the stripes must slope downward in both directions from the center of the barricade or barricades. Where no turns are intended, the stripes must slope downward toward the center of the barricade or barricades.

1200.3.8 The CONTRACTOR shall inspect and maintain all barricades at least once each day except for barricades on or adjacent to arterial and collector streets which shall be checked twice daily, including inspection during hours of darkness. A log of these

inspections showing project, location, date, and time shall be kept and a copy sent to the Construction Coordination Division upon request. Upon request, the CONTRACTOR shall immediately produce current traffic control logs. Failure to do so may result in suspension of work or revocation of barricade permit.

1200.3.9 All traffic control devices required within traveled lanes after dark are to be equipped with warning lights. Type (A) flashing warning lights shall be used on all devices which are intended to warn motorists or pedestrians of hazards or obstructions in or near the travel path. Type © steady burn lights shall be used on all devices which are intended to define the travel path. All lights shall be operational. Traffic control devices that are damaged, dirty or have substandard reflectorization shall be immediately brought up to standard. Reflectorized sheeted panels shall not be considered as a replacement for a required warning light. Warning lights shall be incidental to payment for traffic control.

1200.3.10 Equipment and materials are not to be stored within fifteen (15) feet of a traveled lane during non-working hours, unless approved by the ENGINEER, which approval cannot be unreasonably withheld.

1200.3.11 CONTRACTOR shall provide and maintain a safe and adequate means of channelizing pedestrian traffic around all work areas throughout the periods of construction. All such channelization shall be arranged to prevent pedestrians from having to enter the roadway in order to pass around the work area. Where required, pedestrian detour signs will be installed by the CONTRACTOR. Where construction impedes or obstructs sidewalk access, CONTRACTOR shall barricade sidewalks and place "Sidewalk Closed" signs accompanied with the appropriate pedestrian detour signing. Pedestrian detour signs shall be incidental to payment for traffic control.

1200.3.12 CONTRACTOR shall provide and maintain a safe and adequate means of channelizing bicycle traffic around all work area throughout the periods of construction when existing bicycle trails, lanes, or routes are designated. Where possible, adequate space for bicyclists must be provided, and bicycle detour signs, including "Share the Road" signs shall be installed. When adequate space is not available to provide for bicycle access, the bicycle facilities shall be adequately detoured around the construction site. The detour route shall minimize out-of-direction travel distance, and shall be adequately signed and directed. Bicycle detour signs shall be incidental to payment for traffic control.

1200.3.13 All barricades, signs, and traffic control equipment shall be properly and adequately ballasted

for normal wind loads. For equipment placed for extended periods (seven days or more), or during the months of February through May, additional ballast shall be required.

1200.3.14 The use of roll-up advance warning signs is allowed, so long as the reflectivity required in the MUTCD is provided. Such signs shall be adequately braced to resist rotation under normal wind loads.

1200.3.15 The use of orange warning flags mounted atop construction warning signs is encouraged and is required in certain instances. Flags mounted atop construction signs is required on all "Reduced Speed Ahead (R2-5a)" signs, "Reduced Speed (R2-5b and R2-1)" signs, all "Double Fine Zone" signs, "Road Closed Ahead (W20-3)" signs, "Detour Ahead (W20-2)" signs, "Flagger Ahead (W20-7)" signs, "Flagger Symbol (W20-7a)" signs, and "Be Prepared to Stop (W20-7b)" signs.

1200.3.16 Cones are an acceptable traffic control device under certain situations. Traffic cones are not to be used to separate traffic traveling in different directions. All cones must be a minimum of 28 inches tall. The use of cones as traffic control devices is not allowed during nighttime hours; however if used, all cones used at night must include white, reflectorized bands per MUTCD standards. The use of cones is encouraged for daytime moving closure operations, projects in duration of two hours or less, and special events.

1200.3.17 Type III barricades must be used at all road closures. Multiple type III barricades of the same configuration placed next to each other in the same direction is allowed. A type III barricade or illuminated arrow panel must be used for each lane closure. A minimum of two feet of exposed railing is required on the traveled side (open lanes) of type III barricades. The minimum length of type III barricade for each lane closure is eight (8) feet per lane twelve (12) feet or less in width, and the minimum length of type III barricade required for a sidewalk closure is four (4) feet. The minimum length of type III barricades for a double lane closure is sixteen (16) feet. Additional barricades above the minimum required may be required to fill in gaps for wide lanes, multiple lane closures, or shoulder areas.

1200.3.18 Road closures shall be pre-warned by the use of a "Road Closed to Through Traffic" (R11-4) sign, where appropriate. These signs shall be placed at intersections approaching the road closure with appropriate detour signing. When mounted on a three rail barricade support, the maximum width of sign support shall be six feet. If the detour route is more than one intersection before the road closure, then additional R11-4 signs shall be placed at each

intersection between the detour route and the road closure. "Road Closed to Through Traffic" signs are encouraged to be placed on or near the center of the roadway, but R11-4 signs shall not be placed in an area that block sight distance for motorists and pedestrians. Where sight distance becomes a problem, low-volume intersections may be temporarily converted to a four-way Stop condition, with the approval of the ENGINEER.

1200.3.19 Illuminated arrow panels with a minimum size of 32 square feet may be used in lieu of type III barricades for lane and roadway closures. Arrow panels must be battery or solar powered. The use of diesel, or other noise generating power sources, is not allowed. For roadways with a previously posted speed limit of 35 mph or higher, the use of arrow panels is required for all lane closures. An arrow panel is required for each lane reduction, but is not required for shifting tapers. In residential areas where the arrow panel will be used at night, directional lighting limited to 30 degrees or less must be used to reduce glare into nearby properties. When illuminated arrow panels are used for a lane closure, then the use of vertical panels at the regular MUTCD minimum spacing for the lane reduction taper is allowed.

1200.3.20 For work expected to last one hour or less and for moving closures, reduced barricading may be allowed as approved by the ENGINEER. Reduced barricading on arterial or collector roads shall consist of a minimum of one advance warning sign, a minimum of a three barricade or cone taper, and an illuminated arrow panel.

1200.3.21 For emergency utility work on arterial or collector roadways, the CONTRACTOR must notify the traveling public. If a variable message board is not required by the ENGINEER, a "Utility Emergency Ahead" sign must be installed for each direction of arterial / collector traffic approaching the work site. The "Utility Emergency Ahead" sign must be placed in addition to, and preceding, the three normally required advance warning signs at the same spacing required in the MUTCD for advance warning signs.

1200.3.2 Double fine zones shall be delineated by the use of "Double Fine Zone" signs as outlined in this section. Double fine zones shall be delineated for construction zones and construction curtilage zones at the request of either the OWNER or ENGINEER. In addition, double fine zones are required on all arterial / collector roadways where there is a: 1.) reduced speed limit; 2.) lane reduction; 3.) reduced design speed; or 4.) traffic hazard. Double fine zones are required for all flagging operations, and work zones with an imminent danger to workers, regardless of the roadway classification. The beginning of the double

fine zone shall be clearly marked with a sign stating: "*Construction* - Begin Double Fine Zone". The end of the double fine zone shall be clearly marked with a sign stating: "*Construction* - End Double Fine Zone". If the double fine zone extends beyond one-half mile in length, intermittent signs must be placed no more than one-half mile apart stating: "*Construction* - Double Fine Zone". Additional intermittent signs are needed following side street entrances. Details for the double fine zone signs are on file with the ENGINEER. Placement of the Begin Double Fine Zone sign shall be immediately following the "Road Work Ahead" sign. Placement of the End Double Fine Zone sign shall be immediately preceding the "End Road Work" sign.

1200.3.23 On arterial or collector roadways with multiple lane closures, the advance warning signs shall indicate the correct number of lanes closed. Arrow panels are required for each lane closure of multiple lane closures on arterial or collector roadways, regardless of the previously posted speed limit.

1200.4 CONFLICTS WITH EXISTING SIGNING, STRIPING, AND SIGNALS

1200.4.1 CONTRACTOR shall not remove, realign, or adjust any official OWNER traffic control device including stop signs, warning signs, or any other traffic or parking control signs, unless approved by the OWNER. CONTRACTOR shall give the OWNER three (3) working day's prior notice of any official OWNER traffic control device that needs to be moved. The OWNER shall take all appropriate actions as soon as practical thereafter. When CONTRACTOR places regulatory signing reducing the posted speed limit as approved by the OWNER, the CONTRACTOR must temporarily cover any and all conflicting speed limit signs. Such covers must be immediately removed once the temporary speed limit reductions are removed.

1200.4.2 The CONTRACTOR is responsible for obliteration of any conflicting striping and responsible for all temporary striping. For temporary situations lasting seven days or less, conflicting pavement markings may be addressed with the proper use of channelization devices and signing, unless otherwise approved or required by the ENGINEER.

1200.4.3 When the construction activity or traffic detouring plans result in less than two signals being visible in any direction at a signalized intersection, additional temporary traffic signals shall be required. A minimum of two signals must be visible within a twenty degree horizontal and vertical cone of vision, as measured from the stop bar for each lane approaching a signalized intersection.

1200.5 STREET AND LANE CLOSURES

1200.5.1 CONTRACTOR shall maintain access to all public and private facilities adjacent to the construction area at all times, including businesses and/or residents. When denying access is unavoidable, CONTRACTOR must coordinate access restriction to times and locations that are reasonably convenient to the property owners and/or residents affected. CONTRACTOR shall construct and maintain access roads, including paved ramps, where deemed necessary by ENGINEER to maintain traffic flow. Business access signs may be required to direct traffic to existing businesses, as directed by ENGINEER or OWNER. No more than three businesses shall be placed on a single sign. In areas of multiple adjacent businesses, only generic "Business Access Only (arrow)" signs are required. For shopping centers with multiple business tenants, the name of the shopping center shall be placed on a sign at each access location. Access signs shall have 5 inch high, white letters with a directional arrow on a reflectorized blue background. Business access shall be rectangular in shape, no taller than wide, and shall be no larger than four feet wide by three feet tall. Business access signs shall not be placed where they block sight distance for either motorists or pedestrians.

1200.5.2 CONTRACTOR shall notify the following services forty-eight (48) hours in advance of any complete street or access closures: Police Department, Fire Department, U.S. Postal Service, Solid Waste Department, Ambulance Services, local schools, and the Transit Department. The CONTRACTOR shall also notify all businesses and residents directly affected by the road closure. For the total closure of arterial or collector roadways, a variable message board must be installed for a minimum of two days prior to the road closure notifying motorists of the dates and times for the closure. A minimum of one variable message board is required for each direction of closure. For the total closure of a local roadway, a sign must be installed for a minimum of two days prior to the road closure notifying motorists and residents of the dates and times of the closure. A minimum of one sign is required for each direction of closure.

1200.5.3 The CONTRACTOR shall be responsible, and shall make appropriate accommodation, for garbage and trash collection, mail delivery, and other essential services needed by residents and businesses affected by CONTRACTOR operations. This effort shall include coordination with U.S. Post Office, Solid Waste Department, and other agencies. Where required, CONTRACTOR shall notify all residents in writing at least two days prior. Such notice shall include at a minimum: dates and times of construction activities and the name and telephone number of the CONTRACTORS contact person. CONTRACTOR

shall collect all trash and garbage in the project area and deliver to an accessible location for collection by 7:00 a.m. on the designated trash collection day. Such trash and garbage cannot be deposited onto private property, must not block access, and shall be immediately cleaned up by CONTRACTOR upon pick up by the Solid Waste Department or private trash collection company.

1200.5.4 Total or partial closure of some streets may be restricted to certain hours of the day by the OWNER. Streets having working hour limitations may be noted on the approved construction plans. In cases of emergency work or permit work, streets having working hour limitations will be designated by the ENGINEER. Waivers of the working hour limitations can be obtained from the ENGINEER.

1200.5.5 If construction on streets with working hour limitations is expected to extend past the allowed working hours, plating of the trench and/or temporary asphalt concrete pavement shall be provided so that the roadway is opened to traffic within the allowable work hours. Such excavations must be plated, temporarily patched or resurfaced prior to opening to traffic. A minimum width of 11 feet for each lane of traffic shall be provided, unless otherwise directed by the ENGINEER.

1200.5.6 When detouring low and moderate-volume traffic onto a previously unpaved area, see Table 1200.1 for surfacing requirements.

Table 1200.1

Time	Shoulder Residential	Shoulder (Other)	Local Residential /	Major Local	Collector	Arterial
Under one day	Compacted Subgrade	Compacted Subgrade	Compacted Subgrade	Compacted Subgrade	Gravel or millings	Gravel or millings
1-3 days	Compacted Subgrade	Gravel or millings	Gravel or millings	Gravel or millings	Treated Millings	2" Asphalt
4-7 days	Gravel or millings	2" Asphalt	Gravel or millings	Treated Millings	2" Asphalt	2" Asphalt
8-30 days	Treated Millings	2" Asphalt	Treated Millings	2" Asphalt	4" Asphalt	4" Asphalt

Table Notes:

The contractor shall be responsible to continually maintain all detours, providing a smooth, drained, and safe roadway surface. All compacted subgrade areas shall be graded regularly to provide a smooth driving surface, and must be treated regularly with water or other approved dust control palliative. During periods of dry and/or windy weather, a water truck must be on-site at all times, and frequent watering may be necessary.

Gravel, millings, or treated millings must be bladed and compacted to provide a stable, smooth driving surface prior to opening to traffic. Such surfacing shall be regularly maintained to provide a smooth and stable driving surface. All temporary asphalt pavement shall be placed upon a compacted subgrade which shall be graded to drain. Treated millings includes millings stabilized with an applied emulsive asphalt.

1200.6 MEASUREMENT AND PAYMENT

1200.6.1 Measurement and payment for barricading and temporary traffic control shall be per lump sum per project except for the items listed below. Payment of additional items will only be made if such traffic control device or services is either approved in the construction plan set or requested by the OWNER in writing. Payment shall include the cost of obtaining all permits and approvals; preparation of traffic control plans; working restricted or extended hours when required; notification to all affected residents, businesses, agencies, or other public contacts; setting and resetting barricades, maintaining barricades, daily removal of barricades when required, flagman operations when required, installation of temporary traffic signals when not required by the OWNER or in the construction plans; coordination with ENGINEER on traffic signal re-timing; hiring of off-duty Police Department Officers; and any and all other costs associated with temporary traffic control except the following:

1200.6.1.1 Measurement and payment of the installation of temporary striping shall be made per lineal foot of striping installed per four inch wide.

1200.6.1.2 Measurement and payment of business access and special signs shall be made on a per square foot basis project duration.

1200.6.1.3 Measurement and payment of Variable Message Boards shall be made per each on a per day (24-hour period) basis.

1200.6.1.4 Measurement and payment of illuminated arrow boards required by the OWNER, or required in the construction plans, shall be made per each on a per day (24-hour) basis.

1200.6.1.5 Measurement and payment of temporary wall barrier shall be made per lineal foot of wall barrier installed and removed at each location per project.

1200.6.1.6 Measurement and payment for temporary traffic signals required by the OWNER, or required in the construction plans, shall be made per each per project duration at each location.

COA Specifications

SECTION 1012
MISCELLANEOUS SEEDING

1012.1 GENERAL

1012.1.1 SCOPE

Furnish all labor, materials and equipment necessary for preparation of seedbed, furnishing and installation of seed, fertilizer, erosion control measures, soil amendments, and related work specified herein and as indicated on plans or as authorized by the LANDSCAPE ARCHITECT or ENGINEER.

1012.1.2 APPLICABLE STANDARDS & REFERENCES:

1012.1.2.1 Drawings and general provisions of the Contract, including City of Albuquerque Standard Specifications for Public Works Construction, Latest Edition. General Conditions and any Supplemental Special Provisions, apply to this Section.

1012.1.2.2 All seed shall be certified by state of origin. The certification authority for the state of New Mexico is the New Mexico Crop Improvement Association.

1012.1.2.3 Reclamation efforts are controlled by the requirements stipulated in the National Pollution Discharge Elimination System General Permit for Region VI of the Environmental Protection Agency.

1012.1.3 PERFORMANCE REQUIREMENTS

1012.1.3.1 The CONTRACTOR shall be responsible for protecting and caring for seeded areas until final acceptance of the work and shall repair at CONTRACTOR expense any damage to seeded areas caused by pedestrian, vehicular traffic, vandalism or other cause.

1012.1.4 SUBMITTALS

1012.1.4.1 THIS PUBLICATION - Section 1502 - Submittals

1012.1.4.2 Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging. Include state, origin and name and telephone number of supplier.

1012.1.4.3 Product Certificates: For fertilizers and organic amendments, from manufacturer.

1012.1.4.4 Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1012.1.4.5 Sources of supply for native grass hay,

straw, hydro-mulch, erosion control blankets, and/or gravel mulch.

1012.1.5 DELIVERY, STORAGE & HANDLING

1012.1.5.1 Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

1012.1.5.2 Bulk Materials:

a. Do not dump or store bulk materials near fuel containers, herbicides, structures, utilities, walkways and pavements, or on existing turf areas or plants.

b. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

c. Accompany each delivery of bulk materials with appropriate certificates.

1012.2 PRODUCTS

1012.2.1 SEED

1012.2.1.1 Native Seed: The native seed species and rate of application shall be as shown below and shall be used based on the type of soil or as specified on the plans or in the Supplemental Technical Specifications.

1012.2.1.2 Grass seed shall be fresh, re-cleaned seed of the latest crop, mixed in the proportions by weight, and be pure live seed as denoted within these specifications or as per the plans.

1012.2.1.3 Seed shall be delivered to the site in the original unopened containers which shall bear the vendor's guarantee of analysis. Labeling of seed shall be in accordance with Federal Seed Laws and the New Mexico Department of Agriculture labeling laws. Federal seed laws require that analysis shall be no older than five months for seed shipped interstate and no older than nine months for seed shipped intra-state. Seeds may be pre-mixed by a seed dealer.

Documentation must be provided, the same as if the seeds were sold or bagged separately. The LANDSCAPE ARCHITECT or ENGINEER shall receive all labels from all bags of seed used for verification. For each species included in the mix the following information will be found on each bag tag:

a. Variety - specify if certified.

SECTION 1012
MISCELLANEOUS SEEDING

- b. Kind of seed
- c. Lot number
- d. Purity
- e. Germination
- f. % of Crop seed, % inert, % noxious weed
- g. Origin
- h. Test date
- i. Pounds of this species or percentage of total lot.

1012.2.1.4 Seed Mixture and Rate: Seed species mixtures and application rates shall be as follows and shall be used based on the soil type unless otherwise specified in the plans or Supplemental Technical Specifications.

a. Gravelly Uplands and Slopes (Mainly East Foothills): Seed rate is given in pounds of pure live seed (PLS) per acre. Shrub species noted shall only be included in the seed mix if required in the plans or approved by the LANDSCAPE ARCHITECT or ENGINEER prior to seeding. Contractor shall use at least two of the shrub species listed below at a total application rate of 0.5# PLS/AC. If the area to be seeded is along a recreational trail or roadway the shrub species shall not be included in the mix. Perennial wildflower species shall be included if required in the plans. Contractor shall use at least four of the perennial wildflower species listed below at a total application rate of 1.0# PLS/AC.

a. Gravelly Uplands & Slopes	#PLS/AC	Notes
<i>Bouteloua gracilis</i> 'Hachita' – Blue Grama	7.0	
<i>Bouteloua curtipendula</i> 'Niner' - Sideoats Grama	5.0	
<i>Stipa neomexicana</i> – Needle & Thread Grass	2.0	
<i>Oryzopsis hymenoides</i> - Indian Rice Grass	2.0	
<i>Koeleria macrantha</i> – June Grass	1.0	
<i>Pleuraphis jamesii</i> 'Viva' – Galleta	1.0	
<i>Fallugia</i>	.25	Shrub

<i>Paradoxa</i> - Apache Plume		
<i>Krascheninnikovia lanata</i> - Winterfat	.25	Shrub
<i>Yucca glauca</i> – Soapweed Yucca	.25	Shrub
<i>Ericameria nauseosa</i> – Chamisa	.25	Shrub
<i>Dalea purpurea</i> var <i>purpurea</i> – Purple Prairie Clover	.25	Perennial Wildflower
<i>Ratibida colum-nifera</i> forma <i>pul-cherrima</i> – Mexican Hat	.25	Perennial Wildflower
<i>Gaillardia aris-tata</i> - Blanket Flower	.25	Perennial Wildflower
<i>Sphaeralcea par-vifolia</i> - Nelson Globemallow	.25	Perennial Wildflower
<i>Oenothera pallida</i> - White Evening Primrose	.25	Perennial Wildflower
<i>Baileya multiradi-ata</i> - Desert Mari-gold	.25	Perennial Wildflower
<i>Abronia fragrans</i> or <i>Abronia villosa</i> - Sand Verbena	.25	Perennial Wildflower

b. Sandy Soils: (Mainly Westside Areas) Seed rate is given in pounds of pure live seed (PLS) per acre. Shrub species noted shall only be included in the seed mix if required in the plans or approved by the LANDSCAPE ARCHITECT or ENGINEER prior to seeding. Contractor shall use at least two of the shrub species listed below at a total application rate of 0.5# PLS/AC. If the area to be seeded is along a recreational trail or roadway the shrub species shall not be included in the mix. Perennial wildflower species shall be included if required in the plans. Contractor shall use at least four of the perennial wildflower species listed below at a total application rate of 1.0# PLS/AC.

b. Sandy Soils	#PLS/AC	Notes
<i>Hilaria jamesii</i> 'Viva' - Galleta	7.0	
<i>Oryzopsis hymenoides</i> 'Paloma' - Indian Rice	5.0	

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b. Sandy Soils	#PLS/ AC	Notes
Grass		
<i>Bouteloua gracilis</i> 'Hachita' – Blue Grama	2.0	
<i>Bouteloua curtipendula</i> 'Vaughn' – Sideoats Gramma	1.0	
<i>Agropyron smithii</i> 'Arriba' – Western Wheat	1.0	
<i>Sporobolus cryptandrus</i> – Sand Dropseed	1.0	
<i>Sporobolus airoides</i> 'Salado' – Alkali Sacaton	1.0	
<i>Rhus trilobata</i> – Three Leaf Sumac	.25	Shrub
<i>Artemisia frigida</i> – Fringed sagebrush	.25	Shrub
<i>Atriplex canescens</i> – Fourwing Saltbush (NM Origin)	.25	Shrub
<i>Artemisia filifolia</i> – Sand Sage	.5	Shrub
<i>Yucca glauca</i> – Soapweed Yucca	.5	Shrub
<i>Sphaeralcea ambigua</i> – Desert Globemallow	.25	Perennial wildflower
<i>Sphaeralcea parvifolia</i> – Nelson Globemallow	.25	Perennial wildflower
<i>Oenothera pallida</i> – White Evening Primrose	.25	Perennial wildflower
<i>Baileya multiradiata</i> – Desert Marigold	.25	Perennial wildflower
<i>Abronia fragrans</i> or <i>Abronia villosa</i> – Sand Verbena	.25	Perennial wildflower
<i>Dalea purpurea</i> var <i>purpurea</i> – Purple Prairie Clover	.25	Perennial Wildflower
<i>Ratibida columnifera</i> <i>forma pulcherrima</i> – Mexican Hat	.25	Perennial Wildflower

c. Clay, Clay Loam Soils: Mainly Valley & Bosque areas). Seed rate is given in pounds of pure live seed (PLS) per acre. Shrub species noted shall only be included in the seed mix if required in the plans or approved by the LANDSCAPE ARCHITECT or ENGINEER prior to seeding. Contractor shall use at least two of the shrub species listed below at a total application rate of 0.5# PLS/AC. If the area to be

seeded is along a recreational trail or roadway the shrub species shall not be included in the mix. Perennial wildflower species shall be included if required in the plans. Contractor shall use at least three of the perennial wildflower species listed below at a total application rate of 0.5# PLS/AC.

c. Clay, Clay Loam Soils	#PLS/AC	Notes
<i>Hilaria jamesii</i> 'Viva' - Galleta	4.0	
<i>Bouteloua curtipendula</i> 'Vaughn' – Sideoats Gramma	3.0	
<i>Oryzopsis hymenoides</i> 'Paloma' - Indian Rice Grass	2.0	
<i>Sporobolus airoides</i> 'Salado' – Alkali Sacaton	2.0	
<i>Agropyron smithii</i> 'Arriba' – Western Wheat	1.0	
<i>Bouteloua gracilis</i> 'Hachita' – Blue Gramma	1.0	
<i>Sporobolus cryptandrus</i> – Sand Dropseed	1.0	
<i>Sorghastrum nutans</i> – Indian Grass	.5	
<i>Krascheninnikovia</i> <i>lanata</i> - Winterfat	.25	Shrub
<i>Artemisia ludoviciana</i> – Prairie Sage	.25	Shrub
<i>Ericameria nauseosa</i> – Rubber Rabbitbrush	.25	Shrub
<i>Atriplex confertifolia</i> - Shadscale	.25	Shrub
<i>Oenothera hookeri</i> – Evening Primrose	.25	Perennial wildflower
<i>Oenothera pallida</i> – White Evening Primrose	.25	Perennial wildflower
<i>Baileya multiradiata</i> - Desert Marigold	.25	Perennial wildflower
<i>Linum lewisii</i> – Blue Flax	.25	Perennial wildflower
<i>Dalea purpurea</i> var <i>purpurea</i> – Purple Prairie Clover	.25	Perennial Wildflower
<i>Ratibida columnifera</i>	.25	Perennial

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<i>forma pulcherrima</i> – Mexican Hat		Wildflower
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d. Specific seed mixture application areas shall be determined in the field with the LANDSCAPE ARCHITECT or ENGINEER prior to seed installation. Alternate seed mixes, variations of species, and variations of application rates are acceptable if noted on the plans or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER. Variations in application rates due to the presence of irrigation are acceptable if noted on the plans or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER.

1012.2.2 NATIVE GRASS AND WILDFLOWER MEADOWS

1012.2.2.1 Native grass and wildflower meadow seeding shall be installed to the extents shown on the plans. Seed mix for meadow plantings shall differ from those identified in 1012.2.1.4 as follows:

1012.2.2.2 Wildflower Seed: Fresh, clean, and dry new seed, of mixed species as follows:

a. Wildflower seed mix shall be developed based on soil type from seed mixes listed in Section 1012.2.1.4 and applied at a rate of 50# PLS/AC or as specified on the plans

1012.2.2.3 Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:

a. Native-grass seed mix shall be 50% / 50% (by weight) combination of *Bouteloua gracilis* 'Hachita' – Blue Grama, and *Buchloe dactyloides* – Buffalo grass, applied at a rate of 100# PLS/AC, or as specified on the plans

1012.2.2.4 Wildflower and Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:

a. Wildflower and native grass seed mix shall be an equal combination of 1012.2.2.2 and 1012.2.2.3 above applied at rates noted.

1012.2.2.5 Seed Carrier: Inert material, sharp clean sand, or perlite.

1012.2.3 MULCHES

1012.2.3.1 Hydro-mulch/Tackifier:

- a. Hydro-mulch shall consist of a mulch/tackifier combination independently laboratory tested for erosion control performance using a rainfall simulator raining at 4 inches per hour and mulch/tackifier applied

at 1,600 lbs. per acre. No combination of mulch and tackifier shall be used unless laboratory test results based upon the above conditions show the mulch-tackifier combination to give a calculated apparent erosion rate of 5 tons per acre per hour or less.

b. The mulch shall include anionic Poly Acrylamide Tackifier (P.A.M) or approved equal tackifier. This tackifier shall be adhered to the fibers during manufacturing, or added during mixing in the hydraulic mulching equipment. The tackifier shall be homogenous within the unit package. It shall have no growth or germination inhibiting factors and be nontoxic.

c. The mulch material shall consist of fibers manufactured expressly from annually renewable organic fibers. The fibers shall be processed in such a manner as to contain no growth or germination inhibiting factors. Fiber shall not be produced from residue from wood pulp and paper plants.

d. The fibers of the mulch must maintain uniform suspension in water under agitation. The fiber mulch shall blend with the additives to form homogenous slurry. Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption and percolation and shall cover and hold grass seed in contact with the soil. The fiber mulch shall be dyed with biodegradable dye and not inhibit plant growth.

e. The rate of application of the mulch/tackifier shall be a minimum 2,000 lbs. per acre. This application rate may vary according to soil type and slope as noted in the plans.

f. Alternate hydro-mulch/tackifier products and applications are acceptable if specified on the plans or with prior written approval by the LANDSCAPE ARCHITECT or ENGINEER.

1012.2.3.2 Native Grass Hay and Straw Mulch

a. Hay Mulch: Perennial native or introduced grasses of fine-stemmed varieties shall be used unless otherwise specified on the plans or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER. At least 50 percent of the herbage by weight of each bale of hay shall be 10 inches in length or longer. Hay with noxious seed or plants will not be acceptable. Rotted, brittle, or moldy hay will not be acceptable. Marsh grass or prairie hay composed of native grass species to be seeded will be acceptable. Marsh grass hay shall be composed of mid and tall native, usually tough and wiry grass and grass-like plants found in the lowland areas within the Rocky Mountain region. Tall wheat

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grass, Timothy grass, intermediate wheat grass, switch grass, or orchard hay will be acceptable only upon prior written approval of the LANDSCAPE ARCHITECT or ENGINEER and then only if cut prior to seed formation. Hay shall be properly cured prior to use. Hay which is brittle, short fibered or improperly cured is not acceptable.

b. Straw Mulch: Small grain straw such as wheat, barley, rye or oats will not be allowed except by prior written approval of the LANDSCAPE ARCHITECT or ENGINEER and with the concurrence of the Air Division of the Environmental Health Department. Other materials, such as alfalfa, are not acceptable. Material which is brittle, shorter than 10 inches or which breaks or fragments during the crimping operation will not be acceptable.

1012.2.3.3 Germination/Erosion Control Mats

a. Erosion-Control Blankets: As specified in the plans. Maximum 1-inch thick biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long, or 11 ga. 6" pins with washers.

b. Other products as specified on the plans or within the Supplemental Technical Specifications, or as approved by the LANDSCAPE ARCHITECT or ENGINEER.

1012.2.3.4 Aggregate Mulch: Sloped areas steeper than 3:1

a. Aggregate mulch shall consist of 3/4 inch to 1.5 inch depth maximum size crushed or angular material and will only be allowed with prior written approval of the LANDSCAPE ARCHITECT or ENGINEER. Install aggregate mulch at a depth equal to material size. Aggregate mulch shall be installed at a density not greater than 75% of the surface area.

1012.2.4 SOIL AMENDMENT

1012.2.4.1 Fertilizer: Fertilizer and Soil Amendments: Unless otherwise specified on the plans or in the Supplemental Technical Specification, no fertilizer or other soil amendments are required on areas specified to receive native seeding. If fertilizer and/or other soil amendments are required they shall be in accordance with Section 1011.2.2 of these specifications. If fertilizer and soil amendments are required CONTRACTOR shall perform a soils test in accordance with Section 1011.1.6.1 of these specifications.

1012.3 EXECUTION

1012.3.1 EXAMINATION

1012.3.1.1 Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

a. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

b. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

c. Uniformly moisten excessively dry soil that is not workable or which is dusty.

1012.3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

1012.3.1.3 If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the LANDSCAPE ARCHITECT or ENGINEER and replace with new planting soil at no additional cost to the OWNER.

1012.3.2 PREPARATION

1012.3.2.1 Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by seeding operations.

a. Protect grade stakes set by others until directed to remove them.

1012.3.2.2 Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Reference project NEPA and/or SWPPP requirements if applicable.

1012.3.3 SEED BED PREPARATION

1012.3.3.1 Prior to the starting of any seed bed preparation the final grades of all earthwork shall be inspected and approved by the LANDSCAPE ARCHITECT or ENGINEER.

1012.3.3.2 No preparation shall be performed when the surface is wet or muddy or when the soil moisture content is such that the soil is not fully loosened by the disking operation.

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1012.3.3.3 The extent of seed bed preparation shall not exceed the area on which seeding, mulching and crimping operations can be completed prior to crusting or wind or water erosion of the prepared surface. If erosion, crusting or re-compaction occurs, the affected area shall be re-worked beginning with seed bed preparation. Depth of preparation must be approved by the LANDSCAPE ARCHITECT or ENGINEER prior to the seeding and mulching operations.

1012.3.3.4 Mechanical Preparation: Seed bed shall be prepared to a minimum depth of 4 inches, tilling with a disc, harrow or chiseling tools. Seed bed preparation shall be confined to disturbed areas unless otherwise specifically directed by the LANDSCAPE ARCHITECT or ENGINEER. Area of heavy or compacted soil may require additional preparation such as chiseling or ripping if disking alone does not result in specified depth. All competitive vegetation shall be uprooted during seed bed preparation and the soil shall be uniformly worked to a smooth, firm surface free of clods, stones or other foreign materials, 4 inches or larger, that would interfere with seeding or crimping equipment operations and germination. Tilling shall not occur when the steady wind speed is over 15 mph and is causing a dust problem to adjoining areas. No work shall be done when the moisture content of the soil is unfavorable or the ground is otherwise in an un-tillable condition.

1012.3.3.5 Hand preparation: Areas which cannot be prepared with mechanized equipment because of small size or irregular shape, slope angle, or significant existing vegetation which is to remain, may be loosened to a minimum depth of 2 inches using hand tools or small mechanized equipment. Any such areas will be specified on the plans or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER.

1012.3.4 PREPARATION FOR GERMINATION / EROSION-CONTROL MATERIALS

1012.3.4.1 For erosion-control mats, provide seed bed preparation and seeding prior to installation as specified within this section. Install erosion-control germination materials and fasten as recommended by material manufacturer.

1012.3.4.2 For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

1012.3.4.3 Moisten prepared area after planting if surface is dry. Water thoroughly without creating

erosion or run-off.

1012.3.5 SEEDING

1012.3.5.1 General: Seed types and rates shall be as shown on plans or as directed by the LANDSCAPE ARCHITECT or ENGINEER. Three specific seed mixes have been specified for distinct areas of the city. Seeded areas shall be drilled seeded and mulched where slopes are flatter than 3:1 unless otherwise directed by the LANDSCAPE ARCHITECT or ENGINEER. Slopes steeper than 3:1 shall be broadcast seeded and hydro-mulched, aggregate mulched or erosion control blankets applied as per plans or as directed by the LANDSCAPE ARCHITECT or ENGINEER.

a. Seeding shall not start until the seed bed preparation has been inspected and approved by the LANDSCAPE ARCHITECT or ENGINEER.

b. CONTRACTOR'S vehicles and other equipment shall not travel over the prepared areas. If, as determined by the LANDSCAPE ARCHITECT or ENGINEER, that rain or some other factor has impacted prepared surfaces so that it is not possible to seed to the proper depth, the CONTRACTOR shall again prepare the seed bed without additional compensation.

c. No more area may be seeded than can be stabilized (i.e. covered with mulch and crimped, covered with gravel mulch or erosion control mats, hydro-mulched) by the end of the work day. No seeding operations may be conducted when steady wind speeds exceed 15 mph. If steady winds exceed 15 mph, seeding operations will be halted and any areas seeded shall be mulched.

d. Weather Limitations: Proceed with seeding operations only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to this specification.

1012.3.5.2 Drill Seeding: Drill seeding is required for reclamation areas unless otherwise specified in the plans or in the Supplemental Technical Specifications or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER. Seed shall be applied with a landscape seeder with double rollers, or "rangeland" type seed drill equipped with packer wheels. Seed shall be drilled to a maximum depth of 1/2 inch unless otherwise specified. Direction of seeding shall be in long sweeping and overlapping S-curves on flats and perpendicular to slopes and on the contour whenever possible.

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1012.3.5.3 Broadcast Seeding: Seed may be applied by hand or by utilizing a rotary spreader or a seeder box with a gear feed mechanism if mechanized seeding is not possible due to limited size, irregular shape, or slope angle exceeding 3:1. Rice hulls or other fillers shall be used to prevent uneven separation of lighter seed. Seed shall be evenly distributed and applied at a rate which is a minimum of twice that of drilled seed rate unless otherwise specified. Immediately following the seeding operation, the seed-bed shall be lightly raked to provide approximately 1/2 inch cover of soil over most of the seed.

1012.3.5.4 A hydro-mulch slurry blower may be used only with the prior written approval of the LANDSCAPE ARCHITECT or ENGINEER.

1012.3.6 MEADOW SEEDING

1012.3.6.1 Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 15 mph.

- a. Before sowing, mix seed with seed carrier at a ratio of not less than four parts seed carrier to one part seed.
- b. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
- c. Do not use wet seed or seed that is moldy or otherwise damaged.

1012.3.6.2 Broadcast, hand or hydro-seed as specified within this section. Brush or rake seed into top 1/16 inch of soil, roll lightly, and water with fine spray.

1012.3.6.3 On slopes steeper than 3:1, protect seeded areas from hot, dry weather or drying winds by applying erosion control/germination materials within same day after completing seeding operations.

1012.3.6.4 Water newly planted areas and keep moist until meadow is established.

1012.3.7 MULCHING FOR MISCELLANEOUS SEEDING

1012.3.7.1 General: All seeded areas shall be mulched unless otherwise specified on the plans or in the Supplemental Technical Specifications or approved in writing by the LANDSCAPE ARCHITECT or ENGINEER.

1012.3.7.2 On seeded areas that are level or have slopes 3:1 or flatter, fiber mulching or hydraulic mulching shall be utilized unless otherwise specified on the plans or in the Supplemental Technical

Specifications or with prior written approval of the LANDSCAPE ARCHITECT or ENGINEER. On seeded areas that have slopes steeper than 3:1, only hydro-mulch, gravel mulch, or erosion control mats may be used as specified on the plans and in the Supplemental Technical Specifications.

1012.3.7.3 Hay/Straw Mulching: Hay mulch shall be applied at a minimum rate of 2.5 tons per acre of air-dry hay. If approved, straw mulch shall be applied at a minimum rate of 2.5 tons per acre of air-dry straw.

a. Crimping: Hay and/or straw mulch shall be crimped into the soil. The mulch shall be spread uniformly over the area either by hand or with a mechanical mulch spreader. When spread by hand, the bales of mulch shall be torn apart and fluffed before spreading. Mulching will not be permitted when wind velocity exceeds 15 miles per hour. A heavy disc such as a mulch-tiller, with flat serrated discs at least 1/4 inch in thickness, having dull edges and the disc spaced up to 8 inches apart shall be used to crimp (or anchor) the mulch into the soil to a minimum depth of 2 inches or as specified on the plans or in the Supplemental Technical Specifications. The discs shall be of sufficient diameter to prevent the frame of the equipment from dragging the mulch.

b. The crimping operations shall be across the slope where practical but not be parallel to prevailing Westerly winds (270 degrees magnetic). Crimping shall be in a general north-south direction where practical, and with tight interlocking "S" curves to avoid straight crimp lines.

c. If small grain straw mulch is used it shall be crimped in two directions in a cross-hatch pattern.

1012.3.7.4 Hydro-mulching: Immediately following the drilling operation, all seeded areas shall receive hydro-mulch application with tackifier at the minimum rate of 2,000 lbs. per acre. The slurry shall be mixed in a tank with an agitation system and shall be sprayed, under pressure, uniformly to a depth of 1/8 inch over the soil surface. The hydraulic mulching equipment shall keep all materials in uniform suspension throughout the mixing and suspension cycle. The applicator shall use both horizontal and vertical movements to achieve an even application of the slurry material. All areas receiving insufficient coverage in the opinion of the LANDSCAPE ARCHITECT or ENGINEER shall receive additional slurry.

1012.3.7.5 Erosion Control, Germination Blankets, Mats, or Fabric

- a. The erosion control blankets shall be applied over

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seeded slope areas on the same day that seeding occurs without exception. Installation and anchoring of blankets shall occur as per approved manufacturer's specifications.

1012.3.7.6 Aggregate Mulch

a. If slope is accessible by appropriate equipment, steep slopes can be mulched with aggregate mulch with written approval of the LANDSCAPE ARCHITECT or ENGINEER. Immediately following seeding operation, all seeded areas shall receive aggregate mulch as noted in the plans. The mulch shall be placed in a layer approximately one stone deep over seeded areas. Seeding and mulch shall be completed simultaneously in strips from the top of the slope to the bottom so that seeded areas are not damaged by equipment use over seeded areas.

1012.3.8 MAINTENANCE AND PROTECTION

1012.3.8.1 The CONTRACTOR shall maintain the seeded areas regularly following installation until final acceptance.

1012.3.8.2 The CONTRACTOR shall be responsible for protecting and caring for seeded and mulched areas until final acceptance of the work and shall repair at his/her expense any damage to seeded and mulched areas caused by pedestrian or vehicular traffic or vandalism.

1012.3.9 MEADOW MAINTENANCE

1012.3.9.1 Maintain and establish areas designated as meadows by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, re-grade, and replant bare or eroded areas and re-mulch. Provide materials and installation the same as those used in the original installation.

a. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.

b. In areas where erosion control/germination materials have been disturbed by wind or maintenance operations, add new mats and anchor as required to prevent displacement.

1012.3.9.2 Watering:

a. Schedule watering to provide germination and establishment, prevent wilting, puddling, erosion, and displacement of seed or erosion control/germination materials.

1012.3.10 PEST AND WEED CONTROL

1012.3.10.1 Pest Control: Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with the LANDSCAPE ARCHITECT or ENGINEER and any others in proximity to the Work. Notify the LANDSCAPE ARCHITECT or ENGINEER before each application is performed. Pest control shall be implemented as necessary at no cost to the OWNER until final acceptance of the Project.

1012.3.10.2 CONTRACTOR shall control germination of weed species that are not included as part of the seed mix. Weed control may be mechanical or hand removal methods as determined by the CONTRACTOR with approval by the LANDSCAPE ARCHITECT or ENGINEER. Weed control shall be implemented as necessary at no cost to the OWNER until final acceptance of the Project.

1012.3.11 WARRANTY

1012.3.11.1 If at the end of one complete growing season, it has been determined by the LANDSCAPE ARCHITECT or ENGINEER that insufficient germination has occurred in meadow areas the CONTRACTOR shall reseed such areas with no additional cost to the OWNER.

1012.3.11.2 Where miscellaneous seeding is installed in areas without an irrigation system, no warranty shall be required after the date of final acceptance.

1012.3.11.3 CONTRACTOR shall provide a certificate to the OWNER prior to final acceptance that all requirements of this specification have been met.

1012.3.12 REVIEWS AND OBSERVATIONS

1012.3.12.1 The following shall be the minimum required reviews and observations during the course of construction. Additional reviews and observations can be made at any time at the discretion of the LANDSCAPE ARCHITECT or ENGINEER. It shall be the responsibility of the CONTRACTOR to notify the LANDSCAPE ARCHITECT or ENGINEER, in writing, 48 hours in advance of each required review or observation.

1012.3.12.2 The sequence of required reviews and observations shall not be changed from the sequence listed below. The CONTRACTOR shall not proceed with work of the next phase without written approval of the work of the previous phase by the LANDSCAPE

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ARCHITECT or ENGINEER. Payment will not be approved for items which have not been reviewed and approved in writing.

- a. Each phase of soil preparation shall be observed in process.
- b. Finish grade shall be reviewed.
- c. Implementation plan shall be approved prior to seeding.
- d. Seed shall be reviewed prior to seeding.
- e. Seeded area shall be reviewed after completion.
- f. Mulched areas shall be reviewed after completion.
- g. Final review and acceptance.
- h. Warranty review

1012.3.13 MEASUREMENT & PAYMENT

1012.3.13.1 Measurement: The measurement of native grass seeding shall be by the acre.

1012.3.13.2 Payment: Payment shall be made at the contract unit price per acre, of native grass seeding complete in place, which shall include the seed, fertilizer (if required), area preparation, seeding, soil amendments (if required), and mulching.

NM DOT Specifications

SECTION 509: PORTLAND CEMENT CONCRETE MIX DESIGNS

509.1 DESCRIPTION

This Work consists of developing, submitting and receiving approval to use Portland Cement Concrete (PCC) mix designs for use on Department Projects.

For the purposes of this Section, the following definitions are used:

1. Supplier: Any individual, partnership, company, firm, corporation, or joint venture that owns the Approved Concrete Mix Design, for concrete that is incorporated into a Department construction Project(s).
2. The terms "mix" and "mixture" are used interchangeably.

509.2 MATERIALS

All Materials shall be in accordance with AASHTO and ASTM methods or other test procedures designated by the Department. The State Materials Bureau is the final authority regarding the interpretation of test procedures.

The certifying laboratory or Private Testing Laboratory (PTL) performing the physical and chemical tests for the Supplier is required to participate in the Cement and Concrete Reference Laboratory (CCRL) proficiency sample and the pozzolan inspection programs.

509.2.1 Reserved

509.2.2 Cementitious Materials

Unless otherwise specified, the Supplier shall use; (1) a combination of Type II, III, or V Portland cement and supplemental cementitious Materials (SCM), (2) Blended cement, or (3) a combination of blended cement and SCM. Supplemental cementitious Materials used in blended cements shall not be used as a replacement of portland cement for mix design purposes.

509.2.2.1 Portland and Blended Cements

Portland cement shall comply with ASTM C150. Types II, III, and V portland cement shall have an alkali content less than 0.60% by mass of alkalis as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$ when determined under AASHTO T 105. Types III and V portland cements shall only be used if specified or authorized by the State Concrete Engineer.

Blended cements shall comply with Type IS (S) – portland blast-furnace slag cement, Type IP (MS) – portland-pozzolan cement, or Type IT – Ternary blended cement as specified in ASTM C595, except:

1. Portland cement used in blended cements shall comply with the requirements listed in 509.2.2.1;
2. Class C fly ash shall not be used in blended cements, unless otherwise approved by the State Concrete Engineer;
3. SCM used in blended cements shall meet the requirements of Section 509.2.2.2, "Supplementary Cementitious Materials;"
4. Maximum SCM content shall not exceed 50%; and
5. Blended cement shall be composed of Type II or V portland cement and SCM produced by one of the following methods:

- 5.1. Intergrinding of portland cement clinker and SCM;
- 5.2. Blending of portland cement and SCM; and
- 5.3. Combination of intergrinding and blending of portland cement and SCM.

509.2.2.2 Supplementary Cementitious Materials

Each SCM shall be in accordance with the following standards and as modified in Table 509.2.2.2:1, "Supplementary Cementitious Material Requirements:"

1. Portland cement used in blended cements shall comply with the requirements listed in Section 509.2.2.1, "Portland and Blended Cements;"
2. Class C and F fly ashes shall comply with the requirements of ASTM C618:
 - 2.1. Class C fly ash shall not be used in concrete exposed to sulfate environments or with "potentially reactive," or "reactive" aggregate;
3. Ultrafine fly ash (UFFA) shall comply with ASTM C618, Class F;
4. Natural or calcined natural pozzolans shall comply with ASTM C618, Class N;
5. Metakaolin shall comply with ASTM C618, Class N;
6. Ground granulated blast furnace slag (GGBFS) shall comply with ASTM C989, Grade 100 or 120; and
7. Silica fume shall comply with ASTM C1240.

**Table 509.2.2.2:1
Supplementary Cementitious Material Requirements**

SCM Type	Material Standard	Properties	Limits		
Coal Fly Ash, and Raw or Calcined Natural Pozzolans	ASTM C618	Class	N	F	C
		Sum of Al_2O_3 , SiO_2 , and Fe_2O_4 , min	75%	85%	50%
		Loss on ignition, max	5.0%	3.0%	3.0%
		Magnesium Oxide (MgO), max	5.0%	5.0%	5.0%
		Sulfur Trioxide (SO_3), max	3.0%	3.0%	3.0%
		Available alkalis as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$, max	1.50%	1.50%	1.50%
		Calcium Oxide (CaO), max	As Approved	8.0%	50%

Table 509.2.2.2:1
Supplementary Cementitious Material Requirements

SCM Type	Material Standard	Properties	Limits
Ultra Fine Fly Ash in addition to the requirements for Class F fly ash	AASHTO M 321	Accelerated Pozzolonic Activity Index,	
		7 day 28 day	85% 100%
		Particle size distribution	
		- less than 2.25 μm - less than 8.50 μm	50% 90%
		Fineness, retained on 45 μm wet sieve, max	5.0%
		Moisture content, max	1.0%
Metakaolin	ASTM C618	Silicon dioxide (SiO_2) + aluminum oxide (Al_2O_3), min	92%
		Calcium oxide (CaO), max	1.0%
		Sulfur trioxide (SO_3) max	1.0%
		Loss on ignition, max	1.2%
		Available alkalis as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$, max)	1.5%
		Accelerated Pozzolonic Activity	

**Table 509.2.2.2:1
Supplementary Cementitious Material Requirements**

SCM Type	Material Standard	Properties	Limits
		Index, • 7 day • 28 day Fineness, retained on 45 μ m wet sieve, max	85% 95% 5.0%
Silica Fume	ASTM 1240	Reduction in mortar bar expansion when used with cement in the proposed mix design, min	80%

509.2.2.3 Cementitious Materials Source Approval and Acceptance

The Department will approve individual cementitious Materials based upon compliance with the respective ASTM or AASHTO Standard Specifications and the requirements listed in this Section. The following information shall be included with each cementitious Material approval request submittal:

1. Supplier name and address;
2. Manufacturer name and address;
3. Production facility physical address;
4. Material type;
5. Material source/origin;
6. Raw Material source(s);
7. Production procedures;
8. Description of storage facilities;
9. Quality Control program documentation including the following:
 - 9.1. Certifying Laboratory's accreditation and current participation in the ASTM Cement and Concrete Reference Laboratory Program (CCRL);
 - 9.2. Routine sampling and testing frequency; and
 - 9.3. QC program test reports (mill certs) for each lot tested from the previous six (6) months shall be provided upon request from the Department;
10. Cementitious Materials shall be tested and certified for conformance with the respective Material Specifications below:
 - 10.1. Portland cements: ASTM C150 – Standard Specification for Portland Cement; and

- 10.2. Blended cements: ASTM C595 – Standard Specification for Blended Hydraulic Cements;
 - 10.2.1. Portland cements used in manufacturing blended cements: ASTM C150 – Standard Specification for Portland Cement; and
 - 10.2.2. SCM used in manufacturing blended cements: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; and
- 11. Supplementary Cementitious Materials shall be tested and certified monthly for conformance with the respective Material Specifications listed below:
 - 11.1. Pozzolans: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete;
 - 11.2. Metakaolins: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete;
 - 11.3. GGBFS: ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars; and
 - 11.4. Silica fume: ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

509.2.2.4 Withdrawal of Source Approval

The State Materials Bureau may withdraw cementitious Material source approval for any of the following reasons:

- 1. A change in Material source or production procedure from that on the original request for approval;
- 2. Failure to comply with Specification requirements;
- 3. The source becomes inactive for a period of three (3) months; or
- 4. The appropriate cementitious Material mill certificates are not received monthly.

509.2.2.5 Packaging

Cementitious Materials shall be packaged with the name brand, the source manufacturing facility, Material type, date of production and lot number. The Supplier shall provide the same information, as well as quantities, on the shipping documents for bulk cementitious Materials deliveries.

509.2.2.6 Storage

Different brands of SCM or cements from different production facilities shall be stored in separate, identifiable storage units provided at the production facilities. Each cementitious Material shall be stored separately.

509.2.3 Aggregates

509.2.3.1 Aggregates Testing

Coarse and fine aggregate shall be tested in accordance with the methods shown in Table 509.2.3.1:1, "Aggregates Test Methods." Concrete mix design approval involving a designated source will remain in effect as long as annual test results for specific gravity, absorption, gradation, and sand equivalent (for fine aggregate only) and annual tests for other requirements (except ASR) demonstrate Material compliance.

**Table 509.2.3.1:1
Aggregates Test Methods**

Method	Aggregate test	Coarse	
		Aggregates	Fine Aggregates
AASHTO T 2	Sampling	Note ^A	Note ^A
AASHTO T 112	Clay lumps, max	2.5%	3.0%
	Soft fragments, max	2.0%	2.0%
	Coal & lignite, max	0.25%	1.0%
AASHTO T 27	Sieve analysis	Note ^B	Note ^{C, D}
AASHTO T 11	Passing No. 200, max	2.0% ^E	3.0% ^E
AASHTO M 6	Fineness modulus	NA	2.3 to 3.1 ^F
AASHTO T 85	Coarse aggregate absorption & specific gravity	Report	NA
AASHTO T 84	Absorption & Specific Gravity of Fine Aggregate	NA	Report
AASHTO T 104	Magnesium sulfate soundness, max	15%	12%
ASTM C131	L.A. Abrasion	40%	NA
ASTM D3744	Aggregate Index, min	25	NA
ASTM D4791 TTCP Modified	Flat and elongated pieces, max	15% ^G	NA
ASTM D5821	Fractured faces, min	Report	NA
AASHTO T 176	Sand equivalent, min	NA	75
ASTM C295	Petrographic analysis	Report	Report
AASHTO T303 or ASTM C1293	Alkali-Silica Reactivity	Report	Report

Notes:

1. Coarse and fine aggregates shall be sampled in accordance with AASTO T 2.
2. See Table 509.2.3.2.3:1 – Coarse Aggregate Gradation Requirements.
3. See Table 509.2.3.3.3:1 – Fine Aggregate Gradation Requirements.
4. The Department will not approve fine aggregate that has more than 45% passing any sieve and retained on the next finer sieve.
5. The Department may Accept coarse and fine aggregates with more than the maximum percent passing the No. 200 sieve if the combined gradation of the coarse and fine aggregate percent passing the No. 200 sieve does not exceed three percent (3.0%).
6. Ensure that Material larger than 3/8 inch contains no more than 15% flat or elongated particles with a 3:1 or greater dimensional ratio in accordance with TTCP. Add the percentage of flat pieces to the percentage of elongated pieces to determine specification compliance. Count pieces that are both flat and elongated only once.

509.2.3.2 Coarse Aggregate

Coarse aggregate shall consist of clean crushed stone, crushed gravel, or natural washed gravel free of trash, debris, organics, and other Deleterious Materials.

509.2.3.2.1 Coarse Aggregate Gradation Requirements

When using the combined gradation procedure in Section 509.2.7.5.1, "Combined Gradation;" coarse aggregate gradation requirements are not required with the exception of tolerance for Material passing the No. 200 sieve found in Table 509.2.3.2.1:1, "Coarse Aggregate Gradation Requirements." Coarse aggregate gradations shall be in accordance with Table 509.2.3.2.1:1, "Coarse Aggregate Gradation Requirements."

**Table 509.2.3.2.1:1
Coarse Aggregate Gradation Requirements**

Sieve size	% of aggregate passing sieve			
	1.5 in	1.0 in	3/4 in ^A	1/2 in
2.0 inch	100	—	—	—
1.5 inch	95–100	100	—	—
1.0 inch	—	95–100	100	—
3/4 inch	35–70	—	90–100	100
1/2 inch	—	25–60	—	90–100
3/8 inch	10–30	—	20–55	40–70
No. 4	0–5	0–10	0–10	0–15
No. 8	—	0–5	0–5	0–5
No. 200	0.0–2.0	0.0–2.0	0.0–2.0	0.0–2.0

A. Required for Class G gradation.

509.2.3.3 Fine Aggregate

Fine aggregate shall consist of clean and well-graded natural sand, manufactured sand, or combination of both, and free of trash, debris, organics, and other Deleterious Materials.

509.2.3.3.1 Fine Aggregate

When using the combined gradation procedure detailed in Section 509.2.7.5.1, "Combined Gradation;" fine aggregate gradation requirements are not required except for the amount of Material passing the No. 200 sieve which shall be within the tolerance listed within Table 509.2.3.3.1:1, "Fine Aggregate Gradation Requirements."

Fine aggregate shall meet the gradation requirements listed in Table 509.2.3.3.1:1, "Fine Aggregate Gradation Requirements." The gradation requirements represent the limits that the Department will use to determine source Acceptability.

The Supplier shall use a fineness modulus, calculated in accordance with AASHTO M 6, to determine the degree of uniformity between representative samples. If the combined gradation procedure has not been chosen, the Department may reject fine aggregate from designated sources with variation in fineness modulus greater than 0.20 above or below the fineness modulus shown on the approved concrete mix designs. Variations in excess of these tolerances may be cause for rejection.

Table 509.2.3.3.1:1
Fine Aggregate Gradation Requirements

Sieve size	% Passing
3/8 inch	100
No. 4	90–100
No. 8	70–95
No. 16	45–80
No. 30	25–60
No. 50	5–30
No. 100	0–8
No. 200	0.0–3.0

509.2.3.4 Aggregate Alkali-Silica Reactivity

The Supplier shall perform the initial proof-of-reactivity-potential test using standard GCC Type I-II low alkali cement from the GCC Cement plant located at Tijeras, New Mexico. The Department considers aggregates with mean mortar bar expansions of greater than 0.10% at 14 Days when tested in accordance with AASHTO T 303 or ASTM C1260 potentially reactive and those less than 0.10% as non-reactive. Expansions greater than 0.20% are considered "Reactive." If tested using ASTM C1293, the Department will consider aggregate non-reactive if the average expansion at the end of one (1) year is less than 0.04%. Once the State Materials Bureau approved a particular aggregate source is non-reactive, it will not require the source to reevaluate for five (5) years unless concerns arise from possible aggregate source changes.

509.2.3.4.1 ASR Mitigation Evaluation Criteria

If the results of the initial proof-of-potential-reactivity test show the aggregate to be "potentially reactive" or "reactive," the Contractor shall repeat the test procedure using the actual cement, and, if desired, any of the ASR inhibiting SCM and admixtures listed in Table 509.2.3.4.1:1, "Option 2 Mix Designs - ASR Mitigation Requirements." The Department will consider an admixture effective if the mean mortar bar expansion at 14 Days is less than or equal to 0.10%, when tested in accordance with AASHTO T 303 (modified to include SCM) or ASTM C1567. The Supplier shall retest aggregates classified as "potential reactive" or "reactive" for ASR mitigation each time the comprehensive mix evaluation is performed. The Contractor shall report the minimum amount of Class F fly ash, and the minimum amount of ASR inhibiting admixture required to provide a maximum expansion at 14 Days that is less than 0.10%. The SCM required for mitigation shall be reported as a percentage of the cement weight. For Option 2 mix designs, the Contractor shall use ASR inhibiting SCMs or admixtures in accordance with Table 509.2.3.4:1, "Option 2 Mix Designs - ASR Mitigation Requirements," unless it is determined that larger dosages are required to control the expansion.

Table 509.2.3.4:1
Option 2 Mix Designs - ASR Mitigation Requirements

SCM	Minimum SCM Content^{A, B}
Class F	
Binary Blends	20%
Ternary Blends ^C	12%
Blended cement	20%
GGBFS	20%
Silica fume	10%
Lithium nitrate	0.55 gal/yd ³ of solution for each pound of cement sodium equivalent

Table 509.2.3.4:1
Option 2 Mix Designs - ASR Mitigation Requirements

Notes:

1. By total cementitious content.
 2. Or minimum amount required to mitigate ASR expansion, whichever is greater.
 3. 20% combined SCM content or minimum amount required to mitigate ASR expansion, whichever is greater.
-

509.2.4 Admixtures

Admixtures types and brands are required to be on the Department's APL at the time of mix design submission. Air entraining, and chemical, and lithium nitrate admixtures shall not contain more than 0.1% of soluble and insoluble chlorides. Individual admixtures shall be compatible with each other when multiple admixtures are used in a concrete mixture. Admixtures shall be used in compliance with the manufacturer's written instructions.

509.2.4.1 Air Entraining Admixtures

Air-entraining admixtures shall be provided in accordance with ASTM C260.

509.2.4.2 Chemical Admixtures

Any of the following chemical admixtures types as defined by and meeting the requirements of ASTM C494 may be used to facilitate concrete mix design:

1. Type A – Water Reducing;
2. Type B – Retarding;
3. Type D – Water Reducing and Retarding;
4. Type F – Water Reducing, High Range; or
5. Type G – Water Reducing, High Range, and Retarding.

The following admixtures may be used if approved by the State Concrete Engineer:

1. Type C – Accelerating;
2. Type E – Water Reducing and Accelerating; or
3. Type S – Specific Performance.

Any of the following chemical admixtures types as defined by and meeting the requirements of ASTM C1017 may be used to facilitate concrete mix design:

1. Type I – Plasticizing; or
2. Type 2 – Plasticizing and Retarding.

509.2.4.3 Lithium Nitrate Chemical Admixture

Lithium nitrate shall be in an aqueous solution meeting the following:

1. Lithium nitrate as LiNO_3 shall be 30% by weight;
2. Sulfate as SO_4 shall be less than 0.1% (1,000 PPM); and
3. Alkalis as $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$ shall be less than 0.1%.

509.2.4.4 Pigment Admixtures for Integrally Colored Concrete

Pigments shall conform to ASTM C979. Pigments shall be lightfast, alkali-resistant, weather resistant, and formulated to give long lasting color to concrete.

509.2.5 Water

Water shall conform to ASTM C1602. Water shall have a pH between 6.0 and 8.5; sulfate or chloride contents shall not exceed 1,000 ppm, and shall be free of oil, silt, clay, organic matter, or other Deleterious Material.

509.2.6 Fiber Reinforcement

If specified, steel fibers shall conform to ASTM A820, and synthetic fibers conform to ASTM C1116.

509.2.7 Portland Cement Concrete Mix Design

Concrete mixtures shall be designed in a PTL approved by the Department, by a Professional Engineer registered in the State of New Mexico with a minimum of three (3) year of experience in testing, proportioning and designing of concrete and is directly responsible for all test results used for design purposes. The laboratory mix design shall only be developed using the proposed Materials.

Only technicians who are currently certified by TTCP - Concrete or ACI Concrete Field Technician, Level I shall determine concrete fresh properties in accordance with the appropriate AASHTO procedures. Laboratories approved by the Department's State Materials Bureau shall determine hardened properties. Technicians performing tests on aggregates and aggregate gradations shall be certified by TTCP or ACI Concrete Laboratory Level I. Those technicians performing strength tests on hardened concrete must be certified as an ACI Level I Laboratory Technician or by TTCP for Compressive Strength Testing of Concrete.

509.2.7.1 Concrete Classifications

The concrete classes listed below shall be used when specified in the Contract:

1. Class A: Structural, cast-in-place sidewalks, curb/gutter, concrete wall barrier, Bridge Substructures;
2. Class AA: Structural, used for cast-in-place structural, Bridge Superstructure, approach slabs, abutments;
3. Class HPD: Structural, used for Bridge decks, concrete paving, concrete paving repair. Additional requirements: combined gradation protocol, shrinkage ASTM C157 less than 0.04% at 28 days;
4. Class F: Slip formed concrete wall barrier, curb/gutter; compressive strength measured at 14 days;
5. Class G: Below grade applications, caissons, drilled piers (part of Bridge Substructure);
6. Class HES (formerly rapid set): High early strength concrete used for rapid repair applications. Early compressive strengths will be determined on a per Project basis. Cement content will be determined by lab trials. Allowable cements: Type II, III and rapid strength cements;
7. Class P (formerly class F-LS): Concrete paving. Mix design shall include compressive strengths in addition to flexural beams in order to develop a correlation curve. Other additional requirements: combined gradation protocol, shrinkage

ASTM C157 less than 0.04% at 28 days; and

8. Special: The Contract Requirements for the individual Project will address mix design and testing requirements.

509.2.7.2 Concrete Class Requirements

Option 1 or Option 2 may be used for mix design development of the Concrete Classes listed in Table 509.2.7.2:1, "Option 1: Concrete Requirements." Mix designs developed using Option 1 shall be approved by the State Concrete Engineer for estimated Project quantities less than those provided in the table below. The Department may consider requests to increase the maximum estimated quantity on a Project specific basis. Mix designs developed using Option 1 do not require ASTM C666 testing, and ASTM C457 hardened air void characteristics.

For Projects with anticipated concrete quantities of 150 CY or less of an individual concrete class, a written request may be submitted to the State Concrete Engineer to issue the a mix design under Section 509.2.7.6.12, "Mixture Design Submittals," bullet 13.3, "Incidental Concrete."

Table 509.2.7.2:1
Option 1: Concrete Requirements

Class	Strength ^A , psi	W:CM Ratio, max	Minimum Cementitious Content, lbs/CY	Maximum Estimated Project, Quantity	Slump ^B , Inches	Air Content ^C , %
A	3,000	0.45	560	1,000 CY	3 - 5"	-
F	3,000 ^D	0.45	575		0.5 - 2"	-
G	3,000	0.44	611		6 - 9"	< 3% ^G
HES	4,000 ^F	0.40	NA	500 CY	Note H	-
P	3,000 ^D and 650 ^E flex	0.35	600	10,000 SY	0.5 - 2"	-
Special	The Contract Requirements for the individual Project will address special mix requirements.					
Notes: 1. Specified strength shall be achieved by 28 days unless otherwise noted. 2. As determined by AASHTO T 119. 3. Project risk zone requirements apply; see Section 509.2.7.4, "Freeze-Thaw Risk Zones." 4. Specified strength shall be achieved by 14 days. 5. Specified flexural strength shall be achieved by 28 days. 6. Specified strength shall be achieved in 24 hours, and 75% of the specified strength shall be achieved in five (5) hours, unless otherwise stated in the Contract. 7. Air entraining admixtures are not allowed. 8. Mix design specific for Project specific requirements.						

For Option 1 mix design development, the minimum SCM in concrete shall comply with one of the following:

- Any combination of cement and a minimum of one (1) SCM satisfying Equation 1:

Equation 1:

$$\frac{(25 \times UF) + (12 \times FA) + (6 \times SL)}{MC} \geq X$$

Where:

- UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, lb/CY.
 FA = Class N natural pozzolan, or Class F fly ash including quantity in blended cement, lb/CY.
 SL = GGBFS, including the quantity in blended cement, lb/CY.
 MC = minimum cementitious content, lb/CY.
 X = 1.8 innocuous aggregate, 3.0 for reactive or potentially reactive aggregates.
- Or
- 25 % Class F fly ash by total weight of cementitious Material.

Option 2 mix designs are required for Project quantities in excess of the maximum quantities provided in Table 509.2.7.2:2, "Option 2: Concrete Requirements."

Table 509.2.7.2:2
Option 2: Concrete Requirements

Class	Compressive Strength ^A , psi	Slump ^B , Inches	Air Content ^C , %
A	3,000	4.5" – 5.5"	-
AA	4,000	4.5" – 5.5"	-
F	3,000 ^D	0.5 - 2"	-
HES	4,000 ^F	-	-
HPD	4,000	4.5" – 5.5"	-
P	3,000 ^D and 650 ^E flex	0.5 - 2"	-
G	3,000	6-9"	< 3% ^G
Special	The Contract Requirements for the individual Project will address special mix requirements.		
Notes:			
1. Min specified strength shall be achieved by 28 days unless otherwise noted.			
2. As determined by AASHTO T 119.			
3. Project risk zone requirements apply; see Section 509.2.7.4, "Freeze-Thaw Risk Zones."			
4. Min specified strength shall be achieved by 14 days.			
5. Min specified average flexural strength shall be achieved by 28 days when tested in accordance with AASHTO T 97.			
6. Min specified strength shall be achieved in 24 hours, and 75% of the specified strength shall be achieved in five (5) hours, unless otherwise stated in the Contract.			
7. Air entraining admixtures are not allowed.			

For both Options 1 and 2, Class G concrete shall have the following characteristics:

1. Minimum cementitious content of at least 611 lb;
2. Maximum water/cementitious ratio no greater than 0.44;
3. Combined gradation;
4. Maximum sized aggregate no greater than 0.75 in;
5. Class G mix designs using aggregates with fractured faces shall include a viscosity modifying admixture.
6. Sand/aggregate ratio between 40% and 42% by total aggregate volume;
7. Maximum air content no greater than three percent (3.0%);
8. No air entrainment agent;
9. Slump range of seven (7.0) inches $\pm$ one (1.0) inch, except when placing under a drilling fluid;
10. Slump range of eight (8.0) inches $\pm$ one (1.0) inch for placement under a drilling fluid; and
11. Adjust admixtures for the job site conditions encountered so that the concrete remains workable and plastic for the two (2) h placement limit.

509.2.7.3 Details for Tables 509.2.7.2:1 & 2, "Concrete Classes for Laboratory Design of Concrete Mixtures"

Tables 509.2.7.2:1 & 2, "Concrete Classes for Laboratory Design of Concrete Mixtures" shall be used for designing concrete mixes. Section 510.3.1.4, "Plastic Properties" shall be used to evaluate concrete delivered to Department Projects.

The Contractor shall use the minimum air content shown below in the Laboratory mix:

1. High Risk Zones: 7.0%
2. Medium Risk Zones: 6.5%
3. Low Risk Zones: 6.0%

All new mix designs shall have a minimum over-design compressive strength of 1,200 psi greater than the specified compressive strength. For Class F and Class P the minimum over-design compressive strength shall be 800 psi greater than the specified design strength unless a lower value is calculated using the greater value from either Equation (1) or Equation (2). Class P over-design flexural strength shall be 15% greater than the specified flexural design strength. For Class P, the minimum average flexural strength for three (3) beams cast in the Laboratory shall be 650 psi at 28 Days, when tested in accordance with AASHTO T 97. Option 1 mix designs shall not be adjust based compressive strength statistical analysis.

For Option 2 mix designs, annually the Supplier shall determine the minimum allowable average compressive strength for approved mix designs with 15 or more compressive strength tests, or for similar mix designs mixing from the same facility with the similar air content and compressive strength, and 15 or more compressive strength tests using one (1) of the following equations. The equation that produces the largest value shall be used to determine the minimum allowable compressive strength.

$$f'_{cr} = f'_c + (1.34 \times k \times s) \quad (1)$$

$$f'_{cr} = f'_c + (2.33 \times k \times s) - 500 \quad (2)$$

Where,

- f'_{cr} Minimum Laboratory compressive strength at the specified age.
- f'_c Specified compressive strength.
- k KK-factor from Table 509.2.7.3:1, "k-Factor for Increasing Standard Deviation," for standard deviation increase if the total number of tests is less than 30, but equal to or greater than 15.
- S Standard deviation for the compressive strength tests submitted of the same specified strength.

Table 509.2.7.3:1
k-Factor for Increasing Standard Deviation

Total number of tests	k-Factor
15	1.16
20	1.08
25	1.03
≥30	1.00

The Department will allow linear interpolation for an intermediate number of tests. A mix that was developed from a history of 15 or more test results from the preceding 24 month period is considered an existing mix. A mix developed without historical test results is considered a new mix.

509.2.7.4 Freeze-Thaw Risk Zones

The concrete mixture shall be designed for use in the freeze-thaw zone in which the Project is located. One (1) freeze/thaw cycle is defined as a Day in which the lowest recorded temperature is equal to or less than 25 °F as recorded on the Western Regional Climate Center database. The web address is www.wrcc.dri.edu. The risk levels are defined as follows:

1. **Low-Risk.** The annual average number of freeze/thaw cycles is equal to or less than 30 cycles per year;
2. **Medium-Risk.** The annual average number of freeze/thaw cycles is greater than 30 but less than or equal to 130 cycles per year; and
3. **High-Risk.** The annual average number of freeze/thaw cycles is greater than 130 cycles per year.

Table 509.2.7.4:1, "Statewide Concrete Risk Zones," shall be used to determine the required risk zone.

Table 509.2.7.4:1
Statewide Concrete Risk Zones

District no.	County name	Station name	Concrete risk zone
1	Dona Ana	(County wide)	Low
1	Grant	(County wide)	Low
1	Hidalgo	(County wide)	Low
1	Luna	(County wide)	Low
1	Sierra	(County wide)	Low
1	Socorro	(County wide)	Medium
2	Chaves	(County wide)	Low

**Table 509.2.7.4:1
Statewide Concrete Risk Zones**

District no.	County name	Station name	Concrete risk zone
2	Curry	(County wide)	Medium
2	De Baca	(County wide)	Medium
2	Eddy	(County wide)	Low
2	Lea	(County wide)	Low
2	Lincoln	(County wide) ^a	Medium
2	Lincoln	Ruidoso	High
2	Otero	(County wide)	Medium
2	Roosevelt	(County wide)	Medium
3	Bernalillo	(County wide) ^a	Medium
3	Bernalillo	Sandia Crest	High
3	Sandoval	(County wide)	Medium
3	Valencia	(County wide)	Medium
4	Colfax	(County wide)	High
4	Guadalupe	(County wide)	Medium
4	Harding	(County wide)	Medium
4	Mora	(County wide)	High
4	Quay	(County wide)	Medium
4	San Miguel	(County wide)	Medium
4	Union	(County wide)	Medium
5	Los Alamos	(County wide)	Medium
5	Rio Arriba	(County wide)	High
5	San Juan	(County wide)	Medium
5	Santa Fe	(County wide)	Medium
5	Taos	(County wide)	High
5	Torrance	(County wide)	Medium
6	Catron	(County wide)	High
6	Cibola	(County wide)	High
6	McKinley	(County wide) ^a	High
6	Sandoval	(County wide)	High

^aExcept as otherwise listed

The minimum allowable air content for mix design submittal purposes is:

1. Six percent (6.0%) for low-risk zones;
2. 6.5% for medium-risk zones; and
3. Seven percent (7.0%) for high-risk zones.

The air content shall be confirmed by the pressure method and the volumetric method in accordance with Section 509.2.7.6, "Mix Design Submittal."

509.2.7.5 PCC Mixture Development

509.2.7.5.1 Combined Gradation

The combined gradation procedure is required for Class F, Class P and Class HPD, and is optional for all other concrete mixes. The aggregates shall be evaluated for concrete mixtures prepared for the combined gradation procedures in accordance with the following:

1. **Coarseness Factor.** Determine the Coarseness Factor in accordance with the following equation:

$$CF = \frac{Q}{Q+I} \times 100 \quad (3)$$

Where,

CF Coarseness Factor.

Q Weight of the aggregate retained on or above the 3/8-inch sieve.

I Weight of the aggregate passing the 3/8 inch sieve, but retained on the No. 8 sieve

2. **Workability Factor.** The weight of the aggregate passing the No. 8 sieve divided by the weight of the combined gradation, represented as a percent.
3. **Mortar Factor.** The volume of the cement, SCMSCM, water, air, other pozzolans, and aggregate passing the No. 8 sieve divided by the volume of the entire concrete mixture, represented as a percent.
4. **Paste Factor.** The volume of the cement, fly ash, water, air, and other pozzolans divided by the volume of the entire concrete mixture, represented as a percent.

When using the combined gradation protocol, aggregates shall be proportioned using a 0.45 power curve to achieve a dense and uniform gradation. Coarse and fine aggregate gradation requirements do not apply. The suggested targets for the Coarseness and Workability Factors for concrete mixtures designed using combined gradation are provided in Table 509.2.7.5.1:1, "Recommended Workability Factor and Coarseness Factor Targets."

Table 509.2.7.5.1:1 Recommended Workability Factor and Coarseness Factor Targets		
Nominal Maximum Aggregate Size	Workability Factor	Coarseness Factor
3/4 inch	32 - 36	65 - 75
1/2 inch	40-42	10-20

509.2.7.5.2 Concrete Mix Design Requirements

The concrete mix design shall be proportioned and designed to meet the following requirements:

1. All concrete mix design submittals shall include compressive strengths for the following specified ages:
 - 1.1 3 days;
 - 1.2 7 days;
 - 1.3 14 days; and
 - 1.4 28 days;
2. For concrete classes developed using Option 2, when examined in accordance with

the ASTM C457 linear traverse method, hardened air void system characteristics with the exception of Class G and Class HES, shall meet the following criteria:

- 2.1 A minimum air content of five percent (5.0%);
- 2.2 A specific surface greater than 600 inches⁻¹; and
- 2.3 A spacing factor less than 0.008 inch;
3. Ensure that concrete complies with Section 509.2.3.4, "Alkali-Silica Reactivity," and Section 509.2.3.4.1, "ASR Mitigation Evaluation Criteria," as determined by the State Materials Bureau;
4. For all concrete classes, chloride ion permeability at 28 Days tested in accordance with ASTM C1202 shall meet the following:
 - 4.1 Less than or equal to 3,000 coulombs for Low-Risk Zones;
 - 4.2 Less than 2,500 coulombs for Medium-Risk Zones; or
 - 4.3 Less than 2,000 coulombs for High-Risk Zones;
5. For structural concrete classes developed using Option 2, the durability index shall be determined from at least one (1) prism tested at 28 Days for 300 cycles, in accordance with ASTM C666, Method A. The mix designs shall have a minimum durability index of:
 - 5.1 80 for Low-Risk Zones;
 - 5.2 85 for Medium-Risk Zones; and
 - 5.3 90 for High-Risk Zones;
6. Cure prisms tested for durability index and chloride ion permeability by bathing in lime saturated water at a temperature of 73.3 °F ± 3.0 °F for the first seven (7) Days followed by 21 Days in lime saturated water at a temperature of 100.0 °F ± 3.0 °F; and
7. The maximum shrinkage value for Class P and HPD concrete mixtures is 0.04% at 28 Days when tested with three (3) inch x four (4) inch x 16 inch prism or three (3) inch x three (3) inch x ten (10) inch prism and cured in a standard cure for the first seven (7) Days. Following the seven (7) Day initial cure, cure in a relative humidity of 50% and test in accordance with AASHTO T 160. The results shall be reported in the "comments" field of the mix design submittal form.

509.2.7.6 Mixture Design Submittals

For standard concrete mix designs, complete electronic copy of the NMDOT *Concrete Mix Design Submittal Form* shall be submitted to the Concrete Unit of the State Materials Bureau for review and approval. Special mix designs and mix designs with Project specific shall be submitted to the Project Manager for review and approval by the State Concrete Engineer.

The following information shall be included in the mix design submittal:

1. Mix design Option;
2. Supplier name;
3. Production facility physical address, telephone number and e-mail address;
4. Production facility NRMCA Certification # and expiration date;
5. PTL's name;
6. The New Mexico registration number of the professional Engineer who is responsible for the concrete mixture design Work;
7. A comprehensive Materials list and the properties of each component, including:

- 7.1. Aggregates:
 - 7.1.1. Source names;
 - 7.1.2. Specific source locations;
 - 7.1.3. For new aggregate sources, a complete ASTM C295 "Petrographic Examination of Aggregates for Concrete" and an ASTM C294, *Constituents of Natural Mineral Aggregates* for both the coarse and fine aggregates after completing processing and manufacturing procedures and the aggregate is ready for use shall be submitted. Include the geologic origin of the Material; perform and certify the analysis using a petrographer previously approved by the Department;
 - 7.1.4. AASHTO T 11 - Soundness loss;
 - 7.1.5. AASHTO T 335 - Percent of Fractured Faces for the coarse aggregate;
 - 7.1.6. Gradations, including AASHTO T 11;
 - 7.1.7. AASHTO T 85 - Bulk saturated surface dry specific gravities;
 - 7.1.8. AASHTO T 96 - Los Angeles wear abrasion;
 - 7.1.9. AASHTO M 6 - Fineness modulus;
 - 7.1.10. AASHTO T 84 - Aggregate absorption;
 - 7.1.11. AASHTO T 152 - Aggregate correction factor;
 - 7.1.12. AASHTO T 176 - Sand equivalent of fine aggregate;
 - 7.1.13. AASHTO T 112 - Clay lumps content; and
 - 7.1.14. AASHTO T 21 - Organic impurity content, including soft fragments, coal and lignite, flat or elongated pieces, and other Deleterious substances;
- 7.2. Cement:
 - 7.2.1. Supplier name;
 - 7.2.2. Specific source name; and
 - 7.2.3. Specific cement type;
- 7.3. SCMSCM:
 - 7.3.1. Supplier name;
 - 7.3.2. Specific source name; and
 - 7.3.3. Specific SCM type;
- 7.4. Blended Cement:
 - 7.4.1. Cement supplier name;
 - 7.4.2. Specific cement source name;
 - 7.4.3. Cement type;
 - 7.4.4. SCM supplier name if different than the cement supplier name;
 - 7.4.5. Specific SCM source name;
 - 7.4.6. Specific SCM type; and
 - 7.4.7. Percent SCM;
8. Concrete mixture proportions; state clearly if submitting request under the combined gradation provisions;
9. Water/cementitious ratios;
10. Type and amount of admixtures; use admixtures on the Department's *Approved Products List*;
11. Water source and location; include pH, available alkalis, and a full chemical

- analysis, if the water source is not a certified NMED public potable water supply;
12. Plastic Concrete Properties:
 - 12.1. Air temperature;
 - 12.2. Concrete temperature;
 - 12.3. Slump; when using super-plasticizer, document the slump before and after addition of the super-plasticizer;
 - 12.4. Unit weight;
 - 12.5. Air content measured in accordance with AASHTO T 152 or AASHTO T 121; and
 - 12.6. When using super-plasticizer, document the measured air content before and after adding the super-plasticizer);
 13. Hardened Concrete Properties:
 - 13.1. New Concrete Mixtures:
 - 13.1.1. Compressive strength tests (the average of three (3) cylinders tested at three (3) Days, seven (7) Days, 14 Days and 28 Days);
 - 13.1.2. Type of fracture of each cylinder;
 - 13.1.3. Flexural strength test results for Class P (average of three (3) beams)
 - 13.1.4. Durability index (for structural mixes only);
 - 13.1.5. Hardened air void analysis (for structural mixes only);
 - 13.1.6. Rapid Chloride Permeability (for structural mixes only); and
 - 13.1.7. Expansion data from AASHTO T 303 or ASTM C1260 or C1567;
 - 13.2. Existing Concrete Mixtures:
 - 13.2.1. Resubmit original mix design, updated aggregate properties, and compressive strength statistical data when available in accordance with Section 509.2.7.6, "Mixture Design Submittals;"
 - 13.3. Incidental Concrete Mix Designs (Only for specific Projects) are concrete mixes intended for Projects that anticipate less than 150 CY of each concrete class. Incidental Mix Designs shall be proportioned in accordance with the Section and shall be approved based on the following:
 - 13.3.1. Compressive strength data (field performance data if using the mix within the previous 24 months, or Laboratory mix performance data not using it in the field); and
 - 13.3.2. Air content, as measured by the pressure method or the volumetric method; when using superplasticizer, show the air content before and after adding superplasticizer.

509.2.7.7 Mixture Design Approval

The Department will require 14 Days to review the submittal packages after receipt by the State Materials Bureau of all required information.

The Department will approve Option 1 mix designs for a period of one (1) year from the date of issuance upon verification of compliance with all requirements. Option 1 designs are required to be fully renewed each year prior to use on NMDOT Projects, or may be resubmitted under Option 2 with the additional testing required for Option 2.

The Department will approve Option 2 mix designs for a period of one (1) year from the date of issuance upon verification of compliance with all requirements. A minimum of 30 Days

before the one (1) year approval expires, the Supplier may request that the mix design be reissued. The Supplier shall provide test reports showing that the mix design met specification requirements during the issue period. Option 2 mix designs may be re-approved for no more than four (4) additional years.

At the discretion of the State Concrete Engineer, a mixture can be adjusted without re-batching by using "cement efficiency" calculations to determine the amount of change to the cement and the total cementitious content that is necessary to achieve the desired level of performance. When this procedure is allowed, the ratio of SCM to cement ratio will remain unchanged, the water content will remain unchanged, and the aggregates will be adjusted without changing the overall gradation to accommodate the changes in volume from changes made to the cement. All changes made by this method shall be approved by the State Concrete Engineer before being implemented in the field.

The approved mix design's constituent Materials shall not be changed without the State Concrete Engineer's written approval. The approved mix design's constituent Materials shall not be changed without the State Concrete Engineer's written approval.

509.2.7.8 Suspension and Revocation of Mix Design Approval

Mix design approval may be suspended by the State Concrete Engineer at any time during the approval period for any of the following reasons:

1. Unauthorized changes to the constituent Materials or proportions;
2. Conditions of the Supplier's Equipment or Quality Control adversely affects the strength or other properties of the concrete;
3. Drop in the statistical averages of the concrete below the minimums required for Acceptance in accordance with Section 510.3.5, "Acceptance;" and
4. Test cores indicate the mix is not performing as designed or is not meeting the specified design strength as determined in accordance with Section 510.3.5.4.1, "Testing Cores."

If a mix design approval is suspended or revoked, it shall not be Accepted for use on any Department construction Project.

In the event that a mix design approval is suspended for reasons 1 or 2, all of the Supplier's mix designs approvals may be suspended until such time that is demonstrated that the root cause for the suspension has been corrected.

The State Concrete Engineer will only consider a request to reinstate an approval after the Contractor has submitted and implemented a comprehensive "Corrective Action Plan" to address and correct the reason(s) for the suspension.

If the "Corrective Action Plan" fails to adequately address and correct the reason(s) for the suspension, the approval may be permanently revoked by the State Concrete Engineer. The mix design will then be required to be resubmitted in its entirety as a new mix design with updated comprehensive testing.

509.3 CONSTRUCTION REQUIREMENTS

Concrete or concrete items shall be constructed in accordance with the section of these Standard Specifications for which the concrete is used.

509.4 METHOD OF MEASUREMENT

The Department will measure concrete or concrete items in accordance with the section of these Standard Specifications for which the concrete is used.

509.5 BASIS OF PAYMENT

The Department will pay for concrete or concrete items in accordance with the section of these Standard Specifications for which the concrete is used.

SECTION 511: CONCRETE STRUCTURES

511.1 DESCRIPTION

This Work consists of constructing concrete box Culverts, headwalls, retaining walls, abutments, bents, piers, slabs, girders, and Incidental Structures requiring the use of concrete, except pre-stressed members.

511.2 MATERIALS

When waterproofing is required by the Contract but a type is not specified, either fluid-applied waterproofing or sheet membrane waterproofing shall be used.

511.2.1 Portland Cement Concrete

The Contractor shall use concrete mixes that have been designed in accordance with Section 509, "Portland Cement Concrete Mix Designs" and approved for use on NMDOT Projects by the State Materials Bureau for the freeze/thaw risk zone in which the Project is located. A higher risk zone concrete may be substituted.

511.2.1.1 Concrete Surface Finishing Materials

For Class 2 Surface Finish, the Contractor may use a thin mortar composed of one (1) part cement and four (4) parts sand passing the No. 16 sieve. The cement used in the thin mortar shall be of the same type and source as that used in freshly placed concrete.

Alternatively, the Contractor may use a prepackaged, polymer modified mortar, designed specifically for concrete surface finishing with a minimum 28 day compressive strength of 2,000 psi per ASTM C109.

511.2.2 Steel Reinforcing

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

511.2.3 Bonding Agent

The Contractor shall use a bonding agent that meets the requirements of ASTM C1059, Type II or C-881 Type V.

511.2.4 Form Release Agent

The Contractor may use form release agents at their discretion. Compatibility must be confirmed in a letter from the Manufacturer of subsequent surface treatments including but not limited to penetrating water repellent treatment, stains, and/or paints. If compatibility cannot be confirmed, form release residue shall be removed per the surface preparation recommendations of the manufacturer of the subsequent product.

When integrally colored concrete is used, the Contractor shall use form release agents that are non-staining and minimize surface imperfections of concrete.

511.2.5 Liquid Applied Evaporation Reducers

Unless otherwise specified in the Contract documents, the Contractor may utilize liquid-applied evaporation reducers to reduce the effects of excessive rate of evaporation at the

surface of plastic concrete. Evaporation reducers shall be commercially available water-based compounds that are specifically designed to form a thin monomolecular film to reduce rapid moisture loss from the concrete surface prior to curing. The product shall be certified to have no adverse effects on the cement hydration process or the concrete and that it reduces surface moisture evaporation from the concrete when performing concrete operations in direct sun, wind, high temperatures, and/or low relative humidity.

511.2.6 Curing Materials

511.2.6.1 Liquid Membrane Forming Compounds

The Contractor shall use Type 1-D or Type 2 liquid membrane-forming concrete curing compounds that comply with ASTM C 309.

When integrally colored concrete is used, the Contractor shall use only curing compounds specifically recommended for use with colored concrete and in accordance with ASTM C309 Type 1.

511.2.6.2 Linseed Oil Emulsion

The Contractor shall not use linseed oil emulsion-curing agent.

511.2.6.3 Sheet Materials for Curing Concrete

The Contractor shall use concrete curing sheet Materials in accordance with AASHTO M 171. The Department will only allow the white reflective type.

511.2.7 Joint Materials

The Contractor shall provide joint filler Material in accordance with AASHTO M213 or AASHTO M153 Type I or IV (no cork).

The Contractor shall provide liquid-applied joint sealant in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints" at non-Bridge joint locations.

511.2.8 Extruded Polystyrene

The Contractor shall provide extruded polystyrene that complies with ASTM C578 Types X or XII (15 psi), Type IV (25 psi), or Type VII (60 psi). If strength is not shown in the contract, the Contractor shall use Type IV (25 psi). Extruded or expanded polystyrene may be used interchangeably.

511.2.9 Tear-Web Waterstop

Waterstop at the joint between abutment cap and abutment diaphragm shall be tear-web waterstop. The Contractor shall provide a product that meets the requirements of Table 511.2.9:1, "Tear-Web Waterstop Requirements."

**TABLE 511.2.9:1
Tear-Web Waterstop Requirements**

Typical Properties	ASTM Method	Minimum Value

TABLE 511.2.9:1
Tear-Web Waterstop Requirements

Typical Properties	ASTM Method	Minimum Value
Water Absorption	D-570	0.10%
Tear Resistance, lb/in	D-624	225
Specific Gravity, (+/-0.05)	D-792	1.38
Hardness, Shore A (+/-5, 10 sec. delay)	D-2240	80
Tensile, psi	D-638, Type IV	2000
Elongation %	D-638, Type IV	350
Low Temperature Brittleness @ - 35° F	D-746	No Failure
Stiffness in Flexure, psi	D-747	600
Accelerated Extraction, USACE CRD-C572		
Tensile, psi	D-638, Type IV	1600
Elongation, %	D-638, Type IV	300
Effect of Alkali, USACE CRD-C572		
Weight Change, %	-----	+0.25%, -0.10%
Change in Hardness, Shore A	D-2240	+/-5 points

511.2.10 Sheet Membrane Waterproofing

When specified in the Contract documents, the Contractor shall install waterproof membrane Materials. For this application, the Contractor shall provide flexible, sheet membrane waterproofing Material that is a minimum 50 mil thickness. Compatible surface primers, adhesives and flashings shall be used as recommended by the manufacturer's application instruction. The Material shall meet the requirements of Table 511.2.10:1, "Sheet Membrane Waterproofing Requirements."

TABLE 511.2.10:1
Sheet Membrane Waterproofing Requirements

Typical Properties	ASTM Method	Value
Water Vapor Permeance	ASTM E96	0.05 perms max
Elongation	ASTM D412	300% min
Tensile Strength	ASTM D412	300 psi min
Peel Strength	ASTM D903	8 lbs/in min
Puncture Resistance	ASTM E154	45 lbf min

511.2.11 Fluid-Applied Waterproofing

When specified in the Contract documents, the Contractor shall install cold, fluid-applied waterproof membrane Materials on concrete walls prior to backfill. For this application, the Contractor shall provide seamless rubberized asphalt membrane at a minimum thickness of 30 mils. Compatible surface primers, and joint, crack, and corner treatments shall be used as recommended by the manufacturer's application instruction. The Material shall meet the

requirements of Table 511.2.11:1, "Fluid-Applied Waterproofing Requirements."

TABLE 511.2.11:1
Fluid-Applied Waterproofing Requirements

Typical Properties	ASTM Method	Value
Solids by Weight	ASTM D1644	60% min
Elongation	ASTM D412	300% min
Water Vapor Permeance	ASTM E96	0.1 perms max
Hardness	ASTM C661	60 max

511.2.12 Swellable Hydrophilic Waterstop

Swellable hydrophilic waterstop shall meet the requirements of ASTM D-71, ASTM D-6, and ASTM D-217. The following properties will apply:

1. Specific gravity — ASTM D71: 1.35;
2. Hydrocarbon content — ASTM D4: 47%;
3. Volatile matter — ASTM D6: one percent (1%);
4. Penetration cone in accordance with ASTM D217 at 77 degrees F (25 degrees C): 40 mm; and
5. Service temperature range: -30 to 180 degrees F (-34 to 82 degrees C).

511.3 CONSTRUCTION REQUIREMENTS

511.3.1 Concrete Placement

Concrete shall be placed and tested for compliance with the Project Specifications in accordance with Section 510, "Portland Cement Concrete."

511.3.2 Temporary Works and Falsework

511.3.2.1 Temporary Works

The Contractor shall perform temporary Works in accordance with the current edition of the AASHTO Guide Design Specification for Bridge Temporary Works and the AASHTO Construction Handbook for Bridge Temporary Works.

Although the document contains "Guide Design Specifications," the Contractor shall consider them to have the same importance and standing as a code or a Specification. If the content of the collaboration documents appears permissive with words such as "should," "could," "may," etc., the Contractor shall consider the content to be a requirement unless otherwise approved by the State Bridge Engineer.

In the event of a conflict between a referenced code and this Specification, this Specification will take precedence.

511.3.2.2 Falsework and Falsework Foundations

The Contractor shall construct Structure in accordance with Section 511, "Concrete Structures," and Section 512, "Superstructure Concrete", as applicable.

The Contractor shall design, construct, and maintain falsework and falsework foundation to provide the required strength and rigidity, and to support loads without settlement. The Contractor shall have a professional Engineer licensed in the State of New Mexico design the falsework and its foundation. The design of the falsework and foundation will be required if one (1) or more of the following conditions apply:

1. If the height of the Structure is greater than ten (10) ft (excluding concrete Culverts with bottom slabs);
2. Where the supported span is greater than 15 ft; or
3. Where traffic, other than workmen involved in constructing the Structure, will travel under the falsework.

The Contractor shall place the falsework on an adequate foundation. The maximum foundation bearing pressure is 2,000 pounds per square foot unless a Geotechnical investigation indicates a higher value can be used. The Contractor shall provide methods for measuring settlement or movement of falsework and forms under load. If falsework shows settlement greater than 3/8 inch at the vertical supports, the Contractor shall stop the Work and correct the settlement or movement.

If pilings are used for falsework, the Contractor shall pull or cut off falsework pilings. The Contractor shall ensure the cut-off elevations are one (1) ft below the low water level, natural ground, or bottom of proposed channel.

If required, the Contractor shall submit Plans for falsework to the State Bridge Engineer for approval. The Contractor shall submit proposed changes to existing Structures required for maintenance of traffic to the Project Manager for approval. 30 Days shall be allowed for the initial review. 15 additional Days shall be allowed for each resubmittal.

511.3.3 Form Construction

The Contractor shall make forms mortar tight and sufficiently rigid to prevent deformation due to the pressure of the concrete and other loads incidental to the construction operations, including vibration. The Contractor shall construct and maintain forms to prevent the joints from opening. The Contractor shall construct and maintain forms used on surfaces in public view such that the finished concrete surface will be smooth and of uniform color and texture.

The Contractor shall remove loose dirt, laitance, and miscellaneous debris from the bottom of the forms before placing concrete.

The Contractor shall fillet forms and chamfer them 3/4 inch, unless required otherwise in the Contract, and give them a bevel or draft for easy removal of projections such as girders and copings.

511.3.3.1 Form Lumber

The Contractor shall use lumber that is planed on at least one (1) side and the two (2) edges for exposed concrete surfaces. The Contractor shall place the planed face so that it will be the formed surface for the concrete being placed.

511.3.3.2 Metal Ties

The Contractor shall construct metal ties and anchorages within the forms to permit the removal of a portion of the tie connections without damaging the concrete, and provide at least 1/2 inch depth of cover from the concrete surface.

511.3.3.3 Surface Treatment of Forms

The Contractor shall ensure that forms have been properly wetted before placing concrete.

The Contractor shall use form release agents at their discretion before placing reinforcing steel. The Contractor shall not use form release agents that adhere to or discolor the concrete.

511.3.3.4 Metal Forms

The Contractor shall provide metal forms thick enough to prevent bending and maintain their shape. The Contractor shall use countersunk bolts and rivet heads. The Contractor shall use clamps, pins, and other connecting devices designed to hold forms rigidly together and for removal without damaging the concrete. The Contractor shall use metal forms that have a smooth surface and line up properly.

The Contractor may use metal forms that remain part of the Structure in accordance with the Contract or as approved by the State Bridge Engineer. The Contractor shall use permanent steel Bridge deck forms in accordance with Section 512.3.4.1, "Permanent Steel Deck Forms."

511.3.3.5 Reuse of Forms

The Contractor shall continuously maintain the shape, strength, rigidity, water tightness, and surface smoothness of reused forms. The Contractor shall resize warped or bulged lumber before reusing it.

511.3.4 Temperature and Weather Limitations

The Contractor shall keep the concrete mixture temperature between 50 °F to 90 °F at the time of placement.

511.3.4.1 Cold Weather Concrete

The Contractor shall place cold weather concrete in accordance with ACI 306, "*Cold Weather Concreting*."

If air temperatures are likely to fall below 40 °F during the placement or curing periods, the Contractor shall submit a cold weather concreting and curing plan to the Project Manager for approval by the State Concrete Engineer before concrete placement. The Contractor shall allow 14 Days for review. The Contractor shall ensure that the Plan details the methods and Equipment to maintain the required concrete temperatures over the entire concrete pour area.

Information submitted will include, but not be limited to:

1. Whether or not outside heating sources will be used (and how the exhaust will be vented away from the fresh concrete);
2. Whether or not the rate of surface evaporation is expected to exceed the limitations detailed in Section 511.3.4.3, "Rate of Evaporation Limitations" and measures to be taken;
3. What the target mix temperature will be;
4. How the concrete will be protected from the ambient conditions;
5. Curing methods to be used during and following the protection period;

6. How soon after the placement the protection from the ambient conditions will be implemented;
7. Who will be responsible for insuring that the proper protection from the environment is properly implemented;
8. How the actual temperature of the concrete will be monitored;
 - a. How often will this be checked;
 - b. Who will do the checking;
9. What actions will be taken if the temperatures fall below the target points;
10. Who will be responsible for taking the necessary actions; and
11. Who the contact will be if Department Personnel need to transmit notices or information about the cold weather conditions.

Review and Acceptance of the Cold Weather Concreting and Curing Plan shall not relieve the Contractor from its obligation to perform the Work and provide Materials in strict conformance with the Contract.

The Contractor shall not place concrete directly onto any surface that is less than 40 °F unless otherwise approved by the Project Manager. The Contractor shall not place concrete on frozen ground.

If placing concrete at or below air temperatures of 35 °F, the Contractor shall provide suitable enclosures and heating devices. The Contractor shall vent exhaust from combustion type heating devices outside the placing area so that the exhaust fumes cannot come in contact with the freshly placed concrete.

The Contractor shall ensure the concrete surface temperatures never fall below 45 °F during placement and the first three (3) Days after placing. The Contractor shall not let the surface temperature fall below 40 °F during the next four (4) Days after the initial three (3) Day curing period, or until the in-place strength determined by the *Maturity Method*, in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements" indicates that 75% of the design strength is achieved.

The Contractor shall monitor the minimum concrete temperatures at various locations including edges and corners of slabs or other Structures, and check immediately before placing insulating Material over the concrete.

If heating the aggregates or water, the Contractor shall use heating methods and Equipment that can heat the Material uniformly. The Contractor shall not heat the Materials to more than 110 °F. During the heating or mixing process, the Contractor shall not add cement to water and aggregate combinations that are hotter than 90 °F.

511.3.4.2 Hot Weather Concrete

The Contractor shall place hot weather concrete in accordance with ACI 305, "*Hot Weather Concreting*."

Hot weather is any combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration or otherwise causing detrimental results: high ambient temperature; high concrete temperature; low relative humidity; wind speed; or solar radiation.

The Contractor shall estimate the rate of evaporation at the surface of the concrete per

Section 511.3.4.3, "Rate of Evaporation Limitations." If the rate of evaporation is anticipated to be greater than 0.2 lb per sq ft per hour, the Contractor shall submit a hot weather concreting and curing Plan to the Project Manager for approval by the State Concrete Engineer before concrete placement. The Contractor shall allow 14 Days for review.

The Contractor's Hot Weather Concreting and Curing Plan shall include measures that shall be taken by the Contractor at their expense and maintained to the satisfaction of the Project Manager to reduce the rate of evaporation during initial cure to within the specified rate. The methods can include but not be limited to following:

1. Erect windbreaks to reduce the wind velocity over the concrete surface;
2. Place concrete during nighttime or early morning hours;
3. Use cool aggregate and mixing water to lower the fresh concrete temperature;
4. Increase the relative humidity at the site with a fog spray; and/or
5. Apply a liquid-applied evaporation reducer.

Review and Acceptance of the Hot Weather Concreting and Curing Plan shall not relieve the Contractor from its obligation to perform the Work and provide Materials in strict conformance with the Contract.

511.3.4.3 Rate of Evaporation Limitations

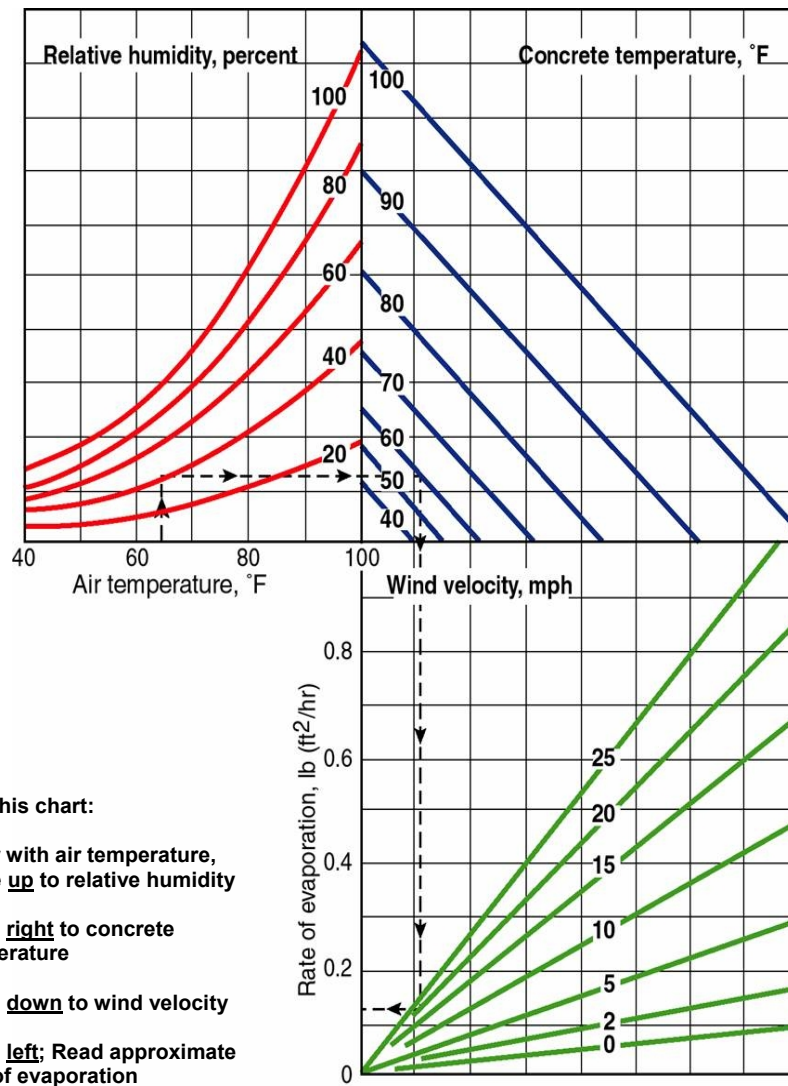
The "Rate of Evaporation Limitations" are detailed in ACI 305 – Hot Weather Concrete. These procedures lessen the potential of plastic-shrinkage cracking in concrete. The "Rate of Evaporation Limitations" apply to Bridge decks, approach slabs, CBC (top and bottom slabs), slipped formed concrete Structures, all PCCP and structural shotcrete. ACI 308 – Guide to Curing Concrete emphasizes that the rate of evaporation limitations can be exceeded in both cold and hot weather and must be addressed in both conditions.

The Contractor shall determine the anticipated rate of evaporation of surface moisture from the concrete by utilizing Figure 511.3.4.3:1, "Surface Evaporation from Concrete." The Contractor shall not place concrete if the anticipated rate of evaporation exceeds 0.20 lb per square foot per hour at the site over any ten (10) minute period, unless measures are taken to prevent excessive moisture loss from the surface of the concrete during initial curing. See Section 511.3.4.2, "Hot Weather Concrete" for Acceptable measures. These measures must be detailed in the Cold Weather Concrete Plan per Section 511.3.4.1, "Cold Weather Concrete" or the Hot Weather Concrete Plan per Section 511.3.4.2, "Hot Weather Concrete."

During the concrete placement, the wind speed, relative humidity and ambient air temperature shall be collected via a computerized weather station that shall be provided and retained by the Contractor. The weather station shall be an automated system that does not require any human support or effort after its initial set-up. The Contractor shall record readings at minimum five (5) minute intervals until the final curing system has been physically applied. Copies of these readings shall be submitted to the Project Manager within 24 hours of the placement. Measurements to determine the Surface Evaporation from the Concrete shall be taken at a height of approximately five (5) feet above the deck for relative humidity and ambient air temperature, and between a height of 20 inches and five (5) feet for wind speed.

For concrete placements that are smaller than ten (10) cubic yards, a handheld anemometer may be used in lieu of a weather station. The handheld anemometer shall be capable of measuring wind speed, humidity and air temperature; and shall be supplied and retained by the Contractor.

Figure 511.3.4.3:1
Surface Evaporation from Concrete (reference ACI 305)



To use this chart:

1. Enter with air temperature, move up to relative humidity
2. Move right to concrete temperature
3. Move down to wind velocity
4. Move left; Read approximate rate of evaporation

511.3.4.3.1 Wind Break

If a wind break is used, the wind break shall be a minimum height of eight (8) ft - zero (0) inches protecting the Bridge deck, approach slabs, sleeper footings and/or transition slabs (if applicable). All areas of the freshly placed concrete must be protected by the wind break. The nature and type of windbreak to be used shall be approved by the Project Manager prior to placement of any Superstructure concrete.

511.3.4.3.2 Fogging System

If a fogging system is used, a water fog shall be continuously applied over the surface of the freshly placed concrete in such a manner that the entire surface is kept at a relative humidity of 90% or greater and the surface of concrete is kept at an evaporation potential of 0.15 pound/square foot/hour or less, as determined from Figure 511.3.4.3:1, "Surface Evaporation from Concrete." The evaporation potential shall be determined prior to fogging and outside the wind protection, and continuously monitored with evaporation potential measurements taken and recorded at least once every five (5) min throughout the entire placement, and continuing until the concrete curing system has been completely installed. If a wind break and/or fogging are being used, the Contractor shall obtain these readings from the protected area at a height of approximately five (5) feet above the protected concrete.

The area to be fogged shall be the entire area of the freshly placed concrete, which has not had the final finish applied. This fog shall be delivered through a network of nozzles, which are properly spaced to provide a uniform fog at the surface of the concrete. The nozzles used shall be of the type, which atomizes the water so that there are no visually discernible droplets of water. The area of coverage from each nozzle shall overlap all adjacent nozzle coverage by at least one (1) ft. It shall be demonstrated prior to the placement of the concrete that the intended system is capable of delivering the required fogging environment for at least twice the anticipated required time. The Contractor shall not finish or otherwise mix any of the fogging water into the fresh concrete.

The intended system must be properly field tested, and approved by the State Materials Bureau before being used on any Superstructure concrete. Fogging shall continue until the surface is treated with an approved curing method.

511.3.4.3.3 Liquid Applied Evaporation Reducers

If a liquid-applied evaporation reducer is used, it shall be selected from the Departments Approved Products list and must be applied in strict accordance with manufacturer's application instructions.

Liquid applied evaporation reducers are not curing compounds and are not finishing aids. Liquid applied evaporation reducers are to be used to reduce surface evaporation during the initial cure of concrete. Initial cure of concrete typically occurs up to and including bull-floating. Multiple applications of liquid applied evaporation reducer may be required, reference manufacturer's application instructions.

Upon commencing surface finishing (beyond bull-floating), further application of liquid evaporation reducers shall not be allowed (liquid evaporation reducers cannot be used as finishing-aids). The Contractor shall cure concrete after surface finishing in accordance with Section 511.3.9, "Curing."

511.3.5 Concrete Placement

Concrete shall be placed and tested for compliance with the Project Specifications in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall not place concrete until the Project Manager approves the reinforcing steel and forms. The Contractor shall ensure that forms are clean and free of rust, grease, and other Deleterious Material immediately before placing the concrete. The Contractor shall remove wooden form spacers immediately before placing concrete in that area.

The Contractor shall vibrate the concrete during placement to force the coarse aggregate from external surfaces and to bring mortar against the forms to produce a smooth finish significantly free of water, air pockets, and honeycombs.

The Contractor shall place concrete in girders, walls, and other similar Structures in horizontal layers. The Contractor shall ensure that the concrete is not too thick for the vibrator to consolidate and merge it with the previous layer. The Contractor shall not pour concrete layers deeper than two (2) ft.

The Contractor shall not place concrete faster than the rate used for the design of the forms. The Contractor shall adjust the rate for the temperature of the concrete being placed.

511.3.5.1 Chutes and Troughs

The Contractor shall avoid segregation of the Materials and the displacement of the reinforcement when placing the concrete. The Contractor shall use metal or metal-lined open troughs and chutes; the Contractor shall not use aluminum. All tools used for the moving and/or spreading of the concrete shall be square pointed tools. The Contractor shall not use round nose shovels and spreading tools.

Where the Contract requires steep slopes, the Contractor shall equip the chutes with baffle boards or use short lengths that reverse the direction of movement.

The Contractor shall keep chutes, troughs, and pipes clean and free of hardened concrete by thoroughly flushing with water after each pour. The Contractor shall discharge the water used for flushing away from the placed concrete.

The Contractor shall not allow concrete to free fall for more than three (3) ft. For CBC walls and retaining walls that are less than or equal to ten (10) inches thick, maximum free fall heights shall not apply. For CBC walls and retaining walls greater than ten (10) inch thick, concrete may have a free fall of less than nine (9) ft.

The Contractor shall fill each part of the form by placing the concrete as close to the final position as possible. The Contractor shall vibrate the concrete during placement to force the coarse aggregate back from the forms and around the reinforcement without displacing the bars. After the concrete's initial set, the Contractor shall not jar the forms or place strain on the ends of projecting reinforcement.

511.3.5.2 Concrete Pumping

If placing concrete by pumping, the Contractor shall install pumping Equipment so that vibrations resulting from the operation do not damage the concrete being placed. The Contractor shall obtain Project Manager approval before using concrete pumping Equipment.

Before placing the concrete, the Contractor shall clean the Equipment thoroughly. The Contractor shall operate the Equipment so that it pumps a continuous flow of concrete without air pockets and without an appreciable loss of slump or entrained air.

The Contractor shall control the loss of entrained air by one (1) or more of the following methods:

1. Tie the end of the pump hose so that the discharge end is pointing upward, forming a "J" at the end of the hose;
2. Install a series of four (4) consecutive elbows to form a 360° loop;

3. Reduce the diameter of the end of the pump line; or
4. Limit the enclosed angle of the boom arms to an angle of 135° or more.

The Contractor shall make sure that the discharge of the concrete from the pump is as close as possible to the bottom of the structure being placed, but in no case shall it be allowed to drop a distance greater than four (4) feet with the exception of CBC walls where the walls equal to or less than ten (10) inch thick, concrete may have a free fall of less than nine (9) ft.

The Contractor shall not use aluminum pipe. The Contractor shall not add water to the concrete during pumping. If water is added at the pump hopper to clear a clogged pump, the Contractor shall dispose of the concrete in the hopper and the line.

511.3.5.3 Conveyers and Belts

The Contractor may use conveyor belts to transport the concrete from the point of delivery to the point of placement. If using multiple belts, the Contractor shall ensure that the drop from one (1) belt to the next is no greater than 18 inches. At the end of the last belt, the Contractor shall not allow the concrete to free-fall more than four (4) ft. The Contractor shall ensure that the concrete coming off the end of any belt is not being segregated. If segregation occurs, the Contractor shall slow down the speed of the belt until segregation no longer occurs.

511.3.5.4 Placing Concrete Under Water

If placing concrete under water, the Contractor shall submit a mix design and procedure plan to the Project Manager. The Project Manager may require up to 30 Days to approve them. The Contractor shall allow time in the schedule to accommodate this approval process.

511.3.5.5 Vibrating/Consolidation

Unless otherwise directed by the Project Manager, and excluding drilled shafts, the Contractor shall consolidate concrete with suitable mechanical vibrators operating within the concrete. During concrete placement, the Contractor shall keep enough personnel, vibrators, and other tools available to assure adequate consolidation. If necessary, the Contractor shall supplement vibrating with hand spading with suitable tools to assure proper consolidation. If using vibrators, the Contractor shall use procedures in accordance with ACI 309 – Consolidation of Concrete.

The Contractor shall not use a "jitterbug" or any other flat tool that could cause concrete segregation.

The Contractor shall use vibrators that have each been certified within the last 90 Days to provide 8,500 to 12,500 Vpm.

The Contractor shall operate vibrators to consolidate the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The Contractor shall not use vibrators to make concrete flow or run. The Contractor shall vibrate long enough to accomplish consolidation, but do not vibrate so long to cause segregation or air bubbles. The Contractor shall insert the vibrators vertically into the concrete, and immediately withdraw upward along the same line with the opposite motion. The Contractor shall not drag the vibrator horizontally across the placing area.

When operating vibrators, the Contractor shall avoid contact with reinforcing bars, particularly epoxy coated reinforcing bars or bars that extend into concrete that has taken an

initial set. If vibrating concrete in areas reinforced with epoxy-coated bars, the Contractor shall cover the vibrators with nonmetallic sleeves to prevent damage to the epoxy coating.

511.3.5.6 Sequence of Placement and Application of Load

The Contractor shall not place superimposed loads on or against load carrying members, floor slabs, or retaining walls until the concrete reaches 75% of specified design compressive strength but no less than 2,500 psi, determined in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements." Concrete Box Culverts and CBC wingwalls shall not be backfilled until specified design compressive strength has been achieved.

The Contractor shall submit a concrete placement schedule to the Project Manager upon request. The Contractor shall plan and schedule concrete placement to prevent damage to previously placed concrete or to the curing or protection systems of previously placed concrete.

The following applies to concrete placement scheduling:

1. The Contractor may erect reinforcement and formwork for walls, columns, and pier caps 24 h after placement of footings or floor slab concrete. Unless otherwise provided, the Contractor may place concrete columns, walls, and pier caps, 48 h after placement of footing or floor slab concrete;
2. The Contractor shall not set beams or girders, or place Superstructure concrete until Substructure forms have been stripped sufficiently to determine the quality of the concrete;
3. The Contractor shall not place the load of the Superstructure on the Substructure until the Substructure concrete has been in place for at least 14 Days or until in-place strength measured by the Maturity Method indicates that the concrete has attained 75% of the design strength;
4. The Contractor shall ensure that the concrete has achieved sufficient strength as determined by the Maturity Method in accordance with the form design before placing concrete for integral horizontal members, such as pier caps or top slabs;
5. The Contractor shall place the vertical members at least seven (7) Days before mounting friction collars or falsework brackets that will support the weight of horizontal members. The Contractor shall ensure that the vertical members have attained the specified strength before applying loads, unless the Department approves otherwise;
6. The Contractor shall limit monolithic casting of walls and deck slabs of concrete box Culverts to Culverts that are six (6) ft high or less. The Contractor shall construct box Culvert walls higher than six (6) ft in accordance with this subsection; and
7. If the concrete is not gaining strength as expected, the Assistant District Engineer of Construction may extend the waiting periods. The Contractor shall conduct construction operations in a manner that does not damage the previously placed concrete.

511.3.5.7 Supplementary Lighting

The Contractor shall not mix, place, or finish concrete when the natural light is insufficient without using an adequate artificial lighting system, approved by the Project Manager. The Contractor shall test the lighting system at least one (1) Day before placing the concrete to assure that the system will provide sufficient light, without shadows or dark areas for placing, testing and finishing concrete. The Contractor shall ensure that the lights do not create a hazard for traffic on adjacent Roadways or Detours.

511.3.6 Removal of Forms

The Contractor shall not remove the forms until the concrete is strong enough to avoid damage by removing the forms.

If in-place strength tests in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements," are not used to control field operations, the Contractor shall remove forms in accordance with Table 511.3.6:1, "Timetable for Removal of Forms," not counting those Days when the temperature is below 40 °F.

**Table 511.3.6:1
Timetable for Removal of Forms**

Structural component	Minimum time for removal
Bottom of beams	14 Days
Bridge decks ^a	seven (7) Days
Floor slabs	seven (7) Days
CBC Floors	seven (7) Days
CBC Top Slab	seven (7) Days
Walls	24 h
Columns	48 h
Sides of beams	24 h
All other parts	24 h

^aAdditional requirements of Section 512, "Superstructure Concrete," shall apply.

If one (1) of the test methods in Section 510.3.5.2, "In-Place Concrete Strength Measurements," is used to control the field operations, the Contractor may remove forms from the bottom of beams and floor slabs when the concrete reaches 75% of the design compressive strength.

511.3.7 Joints

The Contractor shall make construction joints in concrete Structures in accordance with the Plans, unless otherwise directed or approved by the Project Manager.

If the concrete placement is interrupted and additional construction joints are required, the Contractor shall place the additional joints in planes perpendicular to the principal lines of stress, and at points of minimum shear, as approved by the Project Manager.

511.3.7.1 Keyed Joints

The Contractor shall mechanically bond construction joints with keys formed by beveled strips embedded in the surface of the concrete. The Contractor shall make the keys from 1 3/8 inch to 1 1/2 inch deep. The Contractor shall place the keys centrally within the thickness of the joint. The Contractor shall ensure that the keys have a width that is one-third (1/3) of the depth of the smallest dimension of the joint. The keys do not need to exceed the clear distance between reinforcing mats, or be greater than eight (8) inches. The Contractor shall provide raised keys in accordance with the Plans.

511.3.7.2 Bonding New Concrete to Existing

If bonding new and existing concrete, the Contractor shall retighten the forms before

depositing new concrete on or against the hardened concrete. The Contractor shall roughen the surface of the hardened concrete without loosening the aggregate or damaging the concrete on the surface. The Contractor shall thoroughly clean the surface of foreign matter and laitance.

The Contractor shall utilize a bonding method at the interface between the hardened and fresh concrete. It is Acceptable to utilize an enriched mortar or a bonding agent. When using enriched mortar, the Contractor shall saturate the surface of the concrete and scrub the enriched mortar onto the entire surface with a nylon bristled brush. The Contractor shall place the new concrete before the enriched mortar reaches an initial set. If using a bonding agent, the Contractor shall follow the manufacturer's application instructions. The Contractor shall place the concrete continuously from joint to joint, and finish the face edges of exposed joints in accordance with the Plans.

511.3.7.3 Water Stops and Flashings

The Contractor shall provide and place water stops, and flashings per the Contract documents. The Contractor shall splice or solder water stops and flashings to form continuous watertight joints.

Swellable hydrophilic waterstop shall be installed with two (2) inch minimum concrete cover. Materials shall be installed per manufacturer's installation instructions.

511.3.7.4 Joint Sealing Materials

The Contractor shall install joint sealers in accordance with the manufacturer's recommendations, including surface preparation and the use of primers and backer-rod as required.

511.3.8 Miscellaneous Construction

511.3.8.1 Setting of Bearings

The Contractor shall ensure the surfaces on which metal masonry plates and elastomeric bearing pads will rest are flat and on level planes. If using elastomeric bearing pads, the Contractor shall finish the Bridge seats slightly high and grind to the correct elevation.

If it is necessary to adjust the elevation of a bearing upward, the Contractor shall make the adjustment by placing full size shim plates. If it is necessary to adjust the elevation of a bearing downward, the Contractor shall make the adjustment by diamond grinding to a level plane-bearing surface. The Contractor shall not use grout to level or adjust elevation.

If placing a bearing surface below the level of adjacent concrete, the Contractor shall ensure water drains away from the masonry plate or elastomeric bearing pad.

The Contractor shall finish sections of Bridge seats on abutments or piers on both sides of bearing assemblies to drain, with a slope of from 1/16 inch to 1/8 inch per foot. The Contractor shall correct depressions that retain water.

511.3.8.2 Waterproofing

If required in the Contract, the Contractor shall protect the backsides of abutment backwalls and wingwalls by waterproofing. The Contract shall define the vertical and horizontal limits of the waterproofing. The Material shall be installed in conformance with the manufacturer's application instructions.

511.3.9 Finishing

The Contractor shall perform finishing after removing forms in accordance with the Contract.

511.3.9.1 Exposed Surfaces

The Department considers "exposed surfaces" as surfaces that are not buried in the ground or permanently covered by the fill, or against which the fill is not permanently placed. However, the Department does not consider the inside surfaces of concrete box drainage Culverts and concrete box girders, and the bottom side of concrete Bridge decks as "exposed surfaces."

511.3.9.2 Class 1, Ordinary Surface Finish

The Contractor shall apply a Class 1 finish to exposed surfaces as a final finish or before a Class 2, Rubbed Surface Finish, or a Class 4, Special Surface Finish.

A Class 1 finish includes the removal of rods, bolts, or other form ties to at least 1/2 inch deep from the face of the concrete. The Contractor shall fill tie holes and honeycombs with mortar composed of one (1) part cement and two (2) parts sand; the Contractor shall use the same brand and type of cement as used in the concrete.

The Contractor shall remove objectionable fins, bulges, and projections by rubbing with carborundum bricks or by other methods approved by the Project Manager. If necessary, the Contractor shall clean the entire surface. The Contractor shall keep such surfaces in an Acceptable condition until Final Acceptance of the Work.

The Contractor shall apply a Class 1 finish to surfaces buried in the ground or permanently against the fill, except that form ties may be cut off even with the concrete surface, and fins, minor bulges, projections, stains, and discolorations do not need to be removed.

Unless specified otherwise in the Contract, the Contractor shall apply a Class 1 finish to the front faces of backwalls of abutments, the top surfaces of Bridge seats on piers and abutments, and concrete curtain walls between pier pilings.

The Contractor shall apply a Class 1 finish to the inside surfaces of concrete box drainage Culverts, except as noted in Section 511.3.8.3, "Class 2, Rubbed Surface Finish."

511.3.9.3 Class 2, Rubbed Surface Finish

The Contractor shall apply a Class 2 finish to concrete surfaces generally exposed to public view.

The Contract may specify a Class 4, Special Surface Finish with selected colors, for various components or parts of components. If the Contract specifies a Class 4, Special Surface Finish, the Contractor shall apply a Class 2 finish first, unless otherwise approved by the Project Manager.

A Class 2 finish consists of a Class 1 finish, then thoroughly wetting the surface and applying a mortar.

The Contractor shall apply a thin mortar, in accordance with Section 511.2.1.1, "Concrete

Surface Finishing Materials,” and rub it into holes and pockets in the surface of the concrete. The Contractor shall allow the mortar to remain until it has set sufficiently to prevent removal by subsequent rubbing operations. The Contractor shall rub the surface with a No. 25 to No. 30 carborundum brick, then, rub with burlap to remove excess mortar. If the completed rubbed surface does not look uniform, the Contractor shall make a final finish by wet rubbing with a No. 30 carborundum brick.

The Contractor shall apply Class 2 finish to the following:

1. Outside vertical surfaces of Bridge decks;
2. Outside surfaces of exterior girders, curb and rail posts seen in elevation view;
3. Curb tops, post tops, inside faces of curbs, and faces of hand rails;
4. Exposed surfaces of pier columns and caps;
5. Abutment wingwalls and Bridge seats one (1) ft below final grade;
6. Bridge rehabilitation Projects with existing slope paving;
7. Top surface of slope paving (tops of Bridge seats require only a Class 1 finish);
8. Exposed surfaces of barrier railings on Bridges or concrete box Culverts;
9. Exposed surfaces of miscellaneous concrete Structures extending above Shoulder line grade and inside walls of concrete underpass Structures;
10. Concrete box Culverts used for drainage, on the soffit and streamside faces of headwalls and wingwalls, and for six (6) inches down the back side of wingwalls; and
11. The interiors of sidewalls to one (1) ft back from the face of the Culvert at the tops of the sidewalls, and extending on a 45° line downward and inward.

511.3.9.4 Class 3, Float Finish

The Contractor shall apply a Class 3 finish to upper surfaces not formed, such as tops of walls, headwall, tops of slabs and bottom slabs of box Culverts, copings and Bridge seats, except tops of Bridge decks, Sidewalks, or curbs.

A Class 3 finish consists of placing an excess amount of concrete in the forms and striking off this excess concrete with a template, forcing the coarse aggregate below the surface. After striking off the concrete, the Contractor shall thoroughly work the surface with a wooden, cork, or canvas float without adding water or cement. Before the final finish has set, the Contractor shall use a fine brush to remove surface film and to produce a fine grain, smooth, sanded texture.

511.3.9.5 Class 4, Special Surface Finish

When specified in the Contract documents, the Contractor shall apply a Class 4, Special Surface Finish. The Class 4, Special Surface Finish shall be applied in accordance with Specification Section 548, “Coating of Concrete.”

The Contractor shall apply the Class 4 finish over the Class 2 finish, unless directed otherwise by the Project Manager.

The Contractor shall apply the Class 4 finish consistent with the location requirements of Section 511.3.8.3, “Class 2, Rubbed Surface Finish.” If repairing existing Structures, apply a Class 4 finish to the entire surface of the repaired components.

511.3.10 Curing

The Contractor shall cure all concrete in accordance with ACI 308 – Guide to Curing Concrete. All concrete shall receive a minimum of seven (7) Days of curing treatment. The Contractor shall use curing methods in accordance with Table 511.3.10:1, "Curing of Concrete Structures," unless the Contract specifies otherwise.

If the Department allows the Contractor to choose the curing method, the Contractor shall obtain the approval of the Project Manager before beginning curing operations.

Table 511.3.10:1
Curing of Concrete Structures

Method designation		Curing method description
Method 1		Water curing
Method 2		Curing compound
Method 3		Form curing
Method 4		Combination of Method 1 and Method 2
Structure description		Curing methods
<u>Top surfaces of:</u>		
Bridge decks ^a		4
Approach slabs		4
Concrete curbs, gutters and	Sidewalks	1 or 2
Pier caps, abutment Bridge seats		1 or 2
Wingwalls and parapet walls		1 or 2
All vertical concrete surfaces that begin in contact with form Materials, including but not limited to:		3
Barrier walls, barrier railing, wingwalls, parapet walls, abutments, box culverts, decks, slabs, curbs, gutters, sidewalks, construction joints		
Elevated horizontal surfaces on the underside of structural elements that begin in contact with temporary form Materials including but not limited to:		3
pier caps, girders, structural slabs		
Slip Formed Concrete elements including but not limited to:		2
Concrete wall barriers, curb, gutter		
All other concrete ^b		1, 2, or 3

^aSee Section 512.3.10.1, "Curing," for additional curing requirements for Bridge decks.

^bUnless the Contract specifies otherwise.

511.3.10.1 Method 1, Water Curing

The Contractor shall keep the concrete thoroughly and continuously wet and covered for at least seven (7) Days. The Contractor shall place and anchor covers, mats, and sheeting to ensure continuous contact with the concrete surfaces.

The Contractor shall cover concrete slabs as soon as possible with a double layer of clean, wet burlap or cotton mats, or other moisture retaining Material approved by the Project

Manager. The Contractor shall ensure that the moisture retaining Materials lay flat with no wrinkles and that adjacent strips of moisture retaining Materials overlap at least 12 inches. After installation, the Contractor shall soak the moisture retaining Material and add moisture as required to ensure that it is not allowed to become dry for the duration of the specified curing period. The Project Manager will determine the suitability of the moisture retaining Material for reuse, based on the cleanliness and absorptive ability of the Materials.

In addition to the moisture absorptive Material, the Contractor shall install plastic sheeting over the moisture absorptive Material. If the slabs are on grade, the Contractor shall extend the cover Materials at least twice the slab's thickness beyond the edges of the slab, and make sure that the entire exposed surface of the concrete is protected. If the slab is a Bridge deck, the Contractor shall place the cover Materials to fully protect exposed edges and unformed surfaces of the concrete.

The Contractor may temporarily remove the cover from surfaces that require a rubbed finish for finishing, but shall restore the cover as soon as possible.

511.3.10.2 Method 2, Curing Compound

Application of curing compound shall be in accordance with manufacturer's application recommendations.

For slabs, Bridge decks and other flatwork, the Contractor shall apply the curing compound to the fresh concrete as soon after finishing as allowed by the manufacturer.

The Contractor shall thoroughly mix the membrane forming curing compound per the manufacturer's recommendations.

The Contractor shall not apply the curing compound in rainy conditions. The Contractor shall adhere to the thermal limitations as specified by the manufacturer – typically, the product when stored should not be allowed to freeze and should not be applied when the air or concrete temperature is less than 40 degrees Fahrenheit.

The Contractor shall apply the curing compound under pressure with an atomizing-type spray nozzle. The Contractor shall uniformly cover the entire surface area at the rate recommended by the manufacturer or at a rate of at least one (1) gal per 175 ft² whichever rate is greater. The Contractor shall use spray Equipment with enough pressure to force the curing compound to leave the nozzle as a fine mist. If the nozzle becomes plugged, the Contractor shall immediately clear the nozzle before continuing the application. The Contractor shall not continue to spray curing compound through a nozzle that has become plugged or obstructed.

The Contractor shall apply the curing compound by first spraying back and forth in one (1) direction until a uniform covering has been achieved. Then, the Contractor shall spray back and forth in a direction perpendicular to the first application until a second, uniform covering has been achieved. The Contractor shall ensure that the entire curing surface has been uniformly covered with two (2) coatings of curing compound. The Contractor shall not apply the curing compound to exposed reinforcing steel.

The Contractor shall protect all surfaces covered with curing compound for seven (7) Days after application. The Contractor shall provide walkways and mats for workmen, Material, and Equipment.

The Contractor shall not use a curing compound that exhibits separation, segregation, or skimming.

The Contractor shall not apply curing compound to surfaces that will receive a Class 2 or Class 4 finish, unless the Contractor thoroughly cleans the surfaces per the recommendations of the manufacturer of the Class 2 or Class 4 finish product.

511.3.10.3 Method 3, Form Curing

The Contractor shall leave forms in place in accordance with Section 511.3.6, "Removal of Forms." The Contractor shall keep wood forms moist during the curing period and replenish the system with water to maintain a continuously moist condition. The Contractor shall cure exposed surfaces with Methods 1 or 2.

Form removal shall be in accordance with Section 511.3.6, "Removal of Forms." Should forms be removed prior to the specified seven (7) day curing period, the Contractor shall immediately resume curing by Method 2.

For Structures with formed surfaces that require the application of a finish per Section 511.3.8, "Finishing" such as barrier walls, barrier railings on Bridges, wingwalls, or parapets on Bridges or box Culverts, the Contractor shall remove the forms in accordance with Section 511.3.6, "Form Removal," finish the concrete in accordance with Section 511.3.8, "Finishing," and resume curing with Method 2 for the duration of the curing period. The Contractor shall not pause curing for more than two (2) hours.

511.3.10.4 Method 4, Combination of Curing Compound and Water Curing

The Contractor shall apply Method 2 curing compound as soon after finishing as is allowed by the manufacturer.

When the concrete is hard enough that placement loads and burlap or cotton mats can be applied without marring the concrete surface or deformation of structural elements, the Contractor shall apply Method 1 curing directly over the curing compound coated surface.

511.3.10.5 Equipment and Personnel Readiness

The Contractor shall show the Project Manager that curing Material and Equipment (including backup sprayers and mixers) are in working order, at least one (1) Day before concrete placement.

511.3.10.6 Temperature Requirements for Storage and Application

The Contractor shall store curing compounds in protected areas away from weather and extreme temperatures and per the manufacturer's recommendations. The Contractor shall dispose of compounds that have been frozen in storage. The Contractor shall apply curing compounds when the temperature of the compound is between 50 °F and 95 °F.

511.3.10.7 Penetrating Water Repellent Treatment Solution

The Contractor shall saturate the exposed surfaces of the following concrete Structures with a penetrating water repellent treatment in accordance with Section 532, "Penetrating Water Repellent Treatment" for:

1. Bridge wingwalls;
2. Front and side faces of abutment Bridge seats;
3. Front faces of abutments, backwalls and diaphragms;

4. Top surfaces of Bridge seats on piers and abutments;
5. Pier columns, stem walls and vertical surfaces of pier caps;
6. Top and vertical side surfaces of Bridge decks, except in the areas where using epoxy Bridge deck overlays;
7. Top surfaces of concrete approach slabs;
8. Concrete barrier railings;
9. Concrete wall barriers; and
10. Sidewalks, curbs and gutters on Structures.

The Contractor shall extend treatment to at least one (1) ft below the final groundline.

The Contractor shall not treat the underside of pier caps, or side and end surfaces of concrete approach slabs.

511.4 METHOD OF MEASUREMENT

The Department will measure all pay items using the dimensions shown in the Contract or approved modifications.

511.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Structural Concrete, Class _____</i>	Cubic Yard
<i>Structural Concrete, Class _____, _____ inch</i>	Square Yard
<i>Substructure Concrete, Class _____</i>	Cubic Yard

511.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Waterstops and flashings;
2. Waterproofing;
3. Premolded and preformed joint fillers;
4. Concrete required to fill overbreakage in excavation when footings or walls are cast against vertical or horizontal faces of excavation;
5. Installation of drains and weep holes;
6. Extruded polystyrene; and
7. Means and methods associated with placement of concrete in hot and cold weather conditions, including but not limited to wind break, fogging systems, and temporary heat.

SECTION 602: SLOPE AND EROSION PROTECTION STRUCTURES

602.1 DESCRIPTION

This Work consists of providing and placing riprap, gabions, revetment mattresses, sacked concrete revetment, concrete block revetment, wrapped rock faces, and other systems on the Embankment slopes and the sides and bottoms of channels, drain outlets, ditches, and other such locations.

602.2 MATERIALS

Unless otherwise specified in the Contract, the Contractor shall provide slope protection Structures as follows:

1. Hexagonal double-twisted wire mesh riprap, gabions, and revetment mattresses; or
2. Welded wire mesh gabions, revetment mattresses, and wrapped rock faces.

The Contractor shall provide galvanized slope protection items in accordance with ASTM A 641. If specified in the Contract, the Contractor shall coat galvanized items with PVC in accordance with Section 602.2.2.9, "PVC Coating."

The Contractor shall provide double-twisted riprap, gabions, and revetment mattresses in accordance with ASTM A 975. The Contractor shall provide welded wire mesh gabions, revetment mattresses, and wrapped rock faces in accordance with ASTM A 974.

602.2.1 Classifications

The Department will classify riprap and gabions in accordance with Table 602.2.1:1, "Riprap Classifications and Gabion Requirements."

The Contractor shall provide riprap with at least 80% of the stones meeting the specified size requirements. The Contractor shall use stones less than the minimum dimensions to fill voids. For riprap Class A, wrapped rock faces, and gabions, the Contractor shall not use stones smaller than the mesh openings.

The Department will classify riprap and gabions in accordance with Table 602.2.1:1 "Riprap Classifications and Gabion Requirements" with the exception of Class D, Derrick Stone. Class D, Derrick Stone will follow the gradation requirements in Table 602.2.1:2 "Gradation Requirements for Class D, Derrick Stone" shown below.

Table 602.2.1:1
Riprap Classifications and Gabion Requirements

Class	Description	Stone volume (ft ³)		Minimum dimension (in) ^a
		Minimum	Maximum	
A	Wire enclosed riprap	1/6	2/3	4
B ^b	Non-enclosed riprap	1	2	6
C ^b	Non-enclosed riprap	2	4	9
E	Grouted riprap	1/3	1	3
F	Grouted riprap	1	2	6
G	Rock plating	—	—	4–8 ^c

Table 602.2.1:1
Riprap Classifications and Gabion Requirements

Class	Description	Stone volume (ft ³)		Minimum dimension (in) ^a
		Minimum	Maximum	
N/A	Wrapped rockfacing	—	—	1
N/A	Gabions	—	—	4–8 ^c

^aMinimum size in the least dimension.

^bClass B and C stone — at least two (2) Fractured Faces.

^c70% to 80% of the stone — at least four (4) inches but not more than eight (8) inches in the smallest dimension. 30 to 20% of the stone — no larger than four (4) inches in any dimension.

Table 602.2.1:2
Gradation Requirements for Class D, Derrick Stone

Class, Description	Percent of Rock Equal or Smaller By Count, D _x	Range of Intermediate Dimension ¹ , (inches)	Range of Rock Weight ² , (pounds)
D, Derrick Stone ³	100	30	5000
	70	24 – 18	1780 – 2500
	40	11 – 14	360 – 500
	20	6 – 8	70 - 100
¹ Intermediate dimension measured as the shortest straight-line distance from one side of the rock or rock particle to the other on the maximum projection plane (plane of rock or rock particle with the largest projected surface area). ² Weights based on a specific gravity of 2.65. ³ Include spalls and rock fragments to provide a stable dense mass.			

602.2.2 Riprap, Gabions, and Revetment Mattresses

602.2.2.1 Stone for Riprap, Gabions, Revetment Mattresses, and Rock Faces

Except for Class G riprap, the Contractor shall provide rocks or rough quarry stone with no more than 60% wear, in accordance with AASHTO T 96. The Contractor shall provide stone with a soundness loss of no more than 21, in accordance with AASHTO T 104 using a magnesium sulfate solution with a five (5)-cycle test duration.

The Contractor shall provide stone for riprap, gabions, revetment mattresses, and rockfaces in accordance with Section 602.2.1, "Classifications."

602.2.2.2 Wire Mesh

The Contractor shall provide non-raveling, double-twisted wire mesh forming hexagons for riprap, gabions, and revetment mattresses in accordance with Section 602.2.2.3, "Pull-Apart Test." The Contractor shall provide non-raveling welded wire mesh for gabions, wrapped rock faces, and revetment mattresses forming squares or rectangles in accordance with ASTM A 974, Section 7, *Material Properties*, except that the strength requirement for mattress joints is 900 lb per foot instead of 600 lb per foot.

602.2.2.2.1 Wire

The Contractor shall provide soft temper wire with a Class 3 zinc coating for constructing wire mesh in accordance with ASTM A 641. The Contractor shall provide 0.120-inch diameter wire for gabions and riprap and 0.087-inch diameter wire for revetment mattresses and wrapped rock faces.

602.2.2.2.2 Mesh Openings

The Contractor shall ensure that mesh openings are uniform and hexagonal. The Contractor shall make mesh openings for riprap and double-twisted gabions approximately 3 1/4 inch × 4 3/4 inch, and for double-twisted revetment mattresses approximately 2 1/2 inch × 3 1/4 inch. The Contractor shall make mesh openings for welded wire mesh gabions approximately three (3) inch × three (3) inch, and for welded wire mesh revetment mattresses and wrapped rock faces approximately 1 1/2 inch × three (3) inch.

602.2.2.2.3 Selvedges

The Contractor shall mechanically selvedge the edges of double-twisted gabions, revetment mattresses, and wrapped rock face, including, end panels and diaphragms. The Contractor shall use a selvedge wire with a diameter of at least 0.150 inch.

602.2.2.2.4 Lacing and Tie Wire

The Contractor shall provide lacing wire for double-twisted gabions, revetment mattresses, and wrapped rock faces with a diameter of at least 0.087 inch. The Contractor shall provide tie wire for double-twisted gabions and revetment mattresses with a diameter of at least 0.087 inch. The Contractor shall provide tie wire for riprap with a diameter of at least 0.120 inch. The Contractor shall provide lacing and tie wire with the same tensile strength and coating as the mesh wire.

602.2.2.2.5 Spiral Binders

The Contractor shall provide spiral binders for welded wire mesh gabions, revetment mattresses, and wrapped rock faces, of the same wire quality as the mesh wire with a diameter of at least 0.106 inch. Unless otherwise approved, the Contractor shall provide spiral binders with a maximum inside diameter of 2 1/2 inches and with a maximum pitch of three (3) inches.

602.2.2.2.6 Alternate Fasteners

The Contractor may use alternative fasteners, such as ring fasteners, with double-twisted wire mesh, and welded wire mesh riprap, gabions, revetment mattresses, and wrapped rock faces, if approved by the Project Manager. The Contractor shall provide wire for alternative fasteners in accordance with Section 602.2.2.2.5, "Spiral Binders."

602.2.2.2.7 Minimum Strength of Fasteners

The Contractor shall use fasteners that provide a minimum strength of 1,400 lb per foot for gabion baskets, and 900 lb per foot for revetment mattresses and wrapped rock faces.

602.2.2.2.8 Approval of Alternative Fasteners

The Contractor shall use a certified Laboratory to test alternative fasteners in accordance with Section 602.2.2.3, "Pull-Apart Test." At least 60 Days before using alternative fasteners, the Contractor shall submit CTRs to the Project Manager verifying that the fasteners meet the pull-apart test requirements.

The Contractor shall provide a description of the fastener, with drawings and photographs showing the number of fasteners required, details of the fasteners, and load capacities. In addition the Contractor shall:

1. Lock and close each interlocking fastener. For gabions, use fasteners in every other opening. For revetment mattresses and wrapped rock faces, use fasteners in every opening; and
2. Close each overlapping ring fastener and overlap ends a minimum of one (1) inch. Provide one (1) ring for each opening.

The Department will allow this fastener for forming individual baskets, but not for interconnecting baskets.

602.2.2.2.9 PVC Coating

The Contractor shall provide PVC coating with an average thickness of 0.0216 inch and a minimum thickness of 0.0150 inch per side. The Contractor shall apply PVC coating over the galvanizing.

The Contractor shall coat the galvanized wire with extruded or fusion bonded PVC Material. Unless otherwise specified, the Contractor shall use a gray or green colored coating. The Contractor shall use a PVC coating that meets the following requirements:

1. Specific gravity of from 1.20 to 1.40, if tested in accordance with ASTM D 792;
2. Abrasion resistance of less than 12% weight loss, if tested in accordance with ASTM D 1242-95A, Method B at 200 cycles, CSI-A Abrader Recording, 80 grit;
3. Brittleness temperature no higher than 15° F, if tested in accordance with ASTM D 746;
4. Tensile strength no less than 2,980 psi for extruded coating, if tested in accordance with ASTM D 412; and no less than 2,275 psi for fusion bonded coating, if tested in accordance with ASTM D 638;
5. Modulus of elasticity no less than 2,700 psi at 100% strain for extruded coating, if tested in accordance with ASTM D 412; and no less than 1,980 psi at 100% strain for fusion bonded coating, if tested in accordance with ASTM D 638;
6. Ultraviolet light exposure for a test period of no less than 3,000 h, using apparatus Type E at 145 °F, if tested in accordance with ASTM G 152; and
7. Salt spray test for a test period of no less than 3,000 h, if tested in accordance with ASTM B 117.

602.2.2.3 Pull-Apart Test

602.2.2.3.1 Sample Preparation

The Contractor shall prepare two (2) identical rectangular panels along a selvedge wire, each about 10 1/2 mesh-openings wide. The Contractor shall attach the two (2) panels along the two (2) selvedge wires using the proposed fastener system. If the Contractor uses alternative fasteners to join two (2) individual gabion baskets, the Contractor shall include two (2) additional selvedge wires (each mechanically wrapped with mesh wires) so that each fastener contains two (2) selvedges and two (2) mesh wires.

602.2.2.3.2 Test Procedures

The Contractor shall mount the joined test panels in a loading machine with grips or

clamps that secure the panels uniformly along the full width. The Contractor shall use grips or clamps designed to transmit only tension forces. The Contractor shall apply the load at a uniform rate of 50.7 lb per second until failure occurs. The Department will define failure as a drop in strength under continuous loading or, when an opening between two (2) joined selvedge wires exceeds two (2) inch. The minimum allowable strength at failure is 1,400 lb per foot for joined gabions; and 900 lb per foot for joined revetment mattresses and wrapped rock face panels.

602.2.2.4 Certification

The Contractor shall submit a certificate, to the Project Manager, stating that the following proposed items meet the requirements of this Specification before their use:

1. Wire mesh;
2. Gabion baskets;
3. Lacing wire;
4. Tie wire; and
5. Approved alternative fastener systems.

602.2.2.5 Stakes

The Contractor shall use steel railroad rails, standard weight galvanized steel pipe, or steel angles for riprap stakes. The Contractor shall use railroad rails with a unit weight of at least 30 lb per yard. The Contractor shall use standard weight galvanized steel pipe with a minimum outside diameter of four (4) inches. The Contractor shall use steel angles that are at least four (4) × four (4) × 3/8 inch.

602.2.2.6 Grout

The Contractor shall provide portland cement, aggregate, and water for grout in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.2.7 Material

The Contractor shall provide geotextile (filter fabric) Class one (1) as per Section 604, "Soil and Drainage Geotextiles."

602.2.3 Sacked Concrete Revetment

The Contractor shall provide sacked concrete revetment from a vendor on the Department's *Approved Products List*. The Contractor shall provide bags of concrete that weigh from 60 lb to 80 lb each, dry weight, and contain from 0.018 yd³ to 0.025 yd³ of concrete. The Contractor shall ensure each bag contains one (1) of the following mixes:

1. One (1) part cement to three (3) parts sand;
2. A mix design in accordance with the Contract; or
3. A mix design approved by the State Materials Bureau.

The Contractor shall provide a concrete mix capable of attaining a minimum compressive strength of 3,500 psi after 28 Days, unless otherwise specified in the Contract. The Contractor shall keep the sacked concrete in dry storage until application.

602.2.3.1 Packaging

The Contractor shall use permeable, biodegradable sacks made of jute, cotton, or scrim-reinforced paper that are capable of holding the sand-cement mix without significant leakage and allowing sufficient water to hydrate the concrete mix.

The Contractor shall provide non-asphaltic, three (3)-layer laminated, polyester-fiber-scrim-reinforced paper sacks. The Contractor shall perforate each of the three (3) layers and offset the perforations to prevent cement leakage.

The Contractor shall use only one (1) type and size of sack throughout the Project, unless otherwise specified in the Contract.

602.2.3.2 Portland Cement

The Contractor shall provide portland cement in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.3.3 Aggregate

The Contractor shall provide fine aggregate in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.3.4 Steel Anchorage

The Contractor shall provide steel staples in accordance with Section 540, "Steel Reinforcement." The Contractor shall use steel staples either epoxy coated in accordance with AASHTO M 284, or galvanized in accordance with ASTM A 153.

602.2.4 Concrete Block Revetment

The Contractor shall provide concrete block revetment products from the Department's *Approved Products List*. The Contractor shall provide concrete block units compatible with the geotextiles being used and with a minimum compressive strength of 3,000 psi, unless otherwise specified in the Contract.

602.3 CONSTRUCTION REQUIREMENTS

602.3.1 General Placement Requirements

The Contractor shall place riprap stones forming a continuous blanket in accordance with the Contract. Unless otherwise specified, the Contractor shall construct rock plating using riprap Class G to minimum thickness of 12 inches. The Contractor shall place stones with the long axis parallel to the toe of the slope, with a stable bearing upon the underlying soil or stones.

The Contractor shall place large stones as close together as possible. The Contractor shall use smaller stones to fill the areas between the larger stones, except when the Contract requires Class E or F (grouted) riprap.

The Contractor shall ensure that the finished riprap surface varies no more than three (3) inches from the specified slope; and derrick stone riprap varies no more than eight (8) inches from the specified slope.

Unless otherwise specified, the Contractor shall place the riprap foundation course in a trench excavated to 24 inches below the toe of the slope of the Embankment or side of channel.

The Contractor shall place a layer of Class 1 geotextile filter fabric between the slope and erosion protection Structures, and the backfill Material.

602.3.1.1 Grouted Riprap Placement

The Contractor shall fill riprap voids with grout to the full riprap thickness. After placing grout, the Contractor shall sweep the riprap surface with a stiff broom.

The Contractor shall protect grout from freezing for at least four (4) Days after placement.

The Contractor shall cure grouted riprap placed in hot, dry weather in accordance with Section 511.3.9, "Curing."

602.3.1.2 Proportioning and Mixing Grout

The Contractor shall use grout that consists of one (1) part portland cement and three (3) parts fine aggregate (by volume). The Contractor shall mix with water to a workable consistency.

602.3.1.3 Class A Riprap Placement

The Contractor shall enclose Class A riprap with wire mesh drawn tightly on all sides. The Contractor may connect wire mesh using approved fasteners or lacing wire. The Contractor shall weave adjacent edges at least once with double loops of lacing wire that is as strong and flexible as the mesh.

The Contractor shall provide continuous lacing as far as possible that passes through each mesh opening. Where splicing is necessary, the Contractor shall overlap the lacing at least 12 inches.

The Contractor shall space galvanized wire ties connecting top and bottom mesh layers approximately 24 inches on centers. The Contractor shall anchor the ties to the bottom wire-fabric layer. The Contractor shall extend the ties through the rock layer and secure to the top wire-fabric layer. The Contractor shall anchor wire-enclosed riprap to slopes with steel stakes driven into the Embankment. The Contractor shall space stakes in accordance with the Contract.

602.3.1.4 Placement of Geotextile

The Contractor shall place Class 1 non-woven geotextile (filter fabric) between the riprap or revetment mattresses and the supporting soil. The Contractor shall ensure that the fabric is in accordance with Section 604, "Soil and Drainage Geotextiles."

602.3.2 Sacked Concrete Revetment Placement

The Contractor shall place sacked concrete revetment within ± 0.2 ft of the specified grade and slope, or as directed by the Project Manager.

The Contractor shall place the foundation course in a trench excavated to 24 inches below the toe of the slope of the Embankment or side of channel. The Contractor shall stagger the sack ends and steel staple anchors of succeeding courses.

The Contractor shall tamp each row of sacks, round out the bags, eliminate wrinkles, minimize voids, and prepare an even surface for the next row.

The Contractor shall obtain the Project Manager's approval of the compaction method prior to backfill and compact soil behind each row of sacks before placing the next row. The Contractor shall not place large stones and jagged objects adjacent to the bags.

The Contractor shall anchor the sacks with steel staples without damaging the sacks.

After placing the sacks, the Contractor shall wet thoroughly and keep moist for at least three (3) Days.

602.3.3 Concrete Block Revetment Placement

The Contractor shall construct concrete block revetment systems in accordance with the manufacturer's recommendations and the Contract.

The Contractor shall remove slope obstructions, and fill voids with approved Material or grade slopes before placing concrete blocks.

602.3.4 Gabions

The Contractor shall supply gabions within $\pm$ five percent (5%) of the manufacturer's stated sizes.

602.3.4.1 Assembly of Gabion Baskets

The Contractor shall fabricate gabions for individual assembly at the construction site.

If a gabion is greater than 1 1/2 times as long as it is wide, the Contractor shall divide the gabion into cells using diaphragms of the same wire mesh as the body of the gabion. The Contractor shall create cells that are no longer than the gabion is wide and anchor diaphragms to the base section of the gabion. The Contractor shall selvages or bind perimeter edges so the joints are as strong as the gabion body. The Contractor shall assemble perimeter edges using approved fasteners or lacing wire. The Contractor shall place fasteners in each mesh opening. The Contractor shall secure lacing wire by double looping through every other mesh opening. The Contractor shall assemble gabions using one (1) of the following:

1. Double looped lacing twice; or
2. Connect with approved fasteners and double looped lacing once.

602.3.4.2 Foundation Preparation

The Contractor shall level and compact the top six (6) in of the gabion foundation to at least 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), and to field densities in accordance with AASHTO T 310.

602.3.4.3 Placement of Gabion Baskets

The Contractor shall set assembled, empty baskets into the specified positions and wire each unit to adjacent units along the top and vertical edges before placing stone.

602.3.4.4 Placement of Gabion Stone

The Contractor shall place stone in equal layers of from nine (9) inch to 12 inch. The Contractor shall minimize local deformations by not filling a gabion more than 12 inches higher than an adjacent gabion. The Contractor shall hand place stone at exposed surfaces.

The Contractor shall provide cross-connecting wires on gabions with cells 18 inches or higher. The Contractor shall place cross connecting wires directly above each layer of stone. The Contractor shall equally space and tightly tie two (2) connecting wires in each direction for each layer through two (2) mesh openings at opposite faces of each gabion cell.

The Contractor shall maintain alignment while filling gabions (minimizing voids and bulges, and finishing to a neat square appearance).

After filling, the Contractor shall bend the lid over and tightly bind to the perimeters and diaphragms in accordance with Section 602.3.4.1, "Assembly of Gabion Baskets."

602.3.4.5 Gabion Marking

The Contractor shall mark each gabion in an identifiable manner that clearly indicates its size.

602.3.4.6 Placement of Geotextile

The Contractor shall install Class 1 non-woven geotextile (filter fabric) between gabion baskets and supporting soil, and between gabion baskets and backfill.

602.3.5 Placement of Wrapped Rock Faces

The Contractor shall place wrapped rock faces within ± 0.2 ft of the specified grade and slope.

The Contractor shall place the foundation course 18 inches below the toe of the slope of the Embankment or side of channel.

The Contractor shall place each level of welded wire forms with biaxial geogrid embedded in the rock face in accordance with the Contract, and tensioned with anchor pins to remove slack. The Contractor shall lap the geogrid a minimum of 12 inches at the edges of adjacent panels. The Contractor shall tamp the welded wire form face to eliminate wrinkles, minimize voids, and finish to an even surface.

The Contractor shall backfill and compact behind each welded wire form level before placing the next row. The Contractor shall obtain the Project Manager's approval of the compaction method.

602.4 METHOD OF MEASUREMENT

The Department will measure *Riprap Class*___ and *Sacked Concrete Revetment* based on the specified thickness and Accepted surface area.

The Department will measure *Concrete Block Revetment* and *Wrapped Rockfacing* based on the Accepted surface area.

The Department will measure *Gabions* and *Revetment Mattresses* based on the specified basket dimensions.

602.5 BASIS OF PAYMENT

Pay Item

Pay Unit

<i>Riprap Class ____</i>	Cubic Yard
<i>Riprap Class G</i>	Square Yard
<i>Sacked Concrete Revetment</i>	Cubic Yard
<i>Concrete Block Revetment</i>	Square Yard
<i>Gabions</i>	Cubic Yard
<i>Revetment Mattresses</i>	Cubic Yard
<i>Wrapped Rockfacing</i>	Square Yard

602.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Excavation, backfilling and disposal of Material required for the placement of slope and erosion protection Structures;
2. Dewatering; and
3. Stakes and steel staples, drainage geotextile(s).

SECTION 604: SOIL AND DRAINAGE GEOTEXTILES

604.1 DESCRIPTION

This Work consists of providing and installing geotextiles.

604.2 MATERIALS – RESERVED

604.2.1 Classifications

The Contractor shall use the class of geotextile in accordance with Table 604.2.1:1, "Cross Reference of Old Classes to New Classes of Geotextiles."

Table 604.2.1:1 Cross Reference of Old Classes to New Classes of Geotextiles		
Geotextile	Old class	New class
Subsurface drainage	A or B	2 or 3
Sediment control	B	2
Erosion control	C or D	1 or 2
Separation	C or D	2 or 3
Stabilization	None	1

The Department specifies Class 1 for more severe or harsh installation conditions where there is a great potential for geotextile damage and specifies Class 2 and 3 for less severe conditions.

604.2.2 Subsurface Drainage Geotextiles

The Department prohibits the use of woven slit film geotextiles or geotextiles made from yarns of a flat, recording-like character.

The Contractor shall provide Class 2 geotextiles for drain system installations that require use of very coarse, sharp angular aggregate with a one (1) inch diameter or greater, or require a depth of trench greater than six (6) ft.

The Contractor shall provide Class 3 geotextiles for general underdrain installations that require smooth graded surfaces having no sharp angular projections and fine aggregate.

604.2.3 Erosion Control Geotextiles

The Department prohibits the use of woven slit film geotextiles or geotextiles made from yarns of a flat recording-like character. If the Contractor uses a woven monofilament geotextile, the Contractor shall provide a Class 2 geotextile; otherwise the Contractor shall provide a Class 1 geotextile.

604.2.4 Separation Geotextiles

The Contractor shall provide separation geotextiles that are of woven or non-woven Material.

The Contractor shall use a Class 2 separator for Pavement Structures constructed over soils with an R-value greater than 20 to separate dissimilar Materials where water seepage is

allowable. The Contractor shall use Class 2 geotextiles where installation requires a depth of trench greater than ten (10) ft, where stone drop height is to be more than zero (0), or where there is no sand cushion protection. The Department requires field trials where stone drop height exceeds three (3) ft or where individual stone weight exceeds 250 lb.

The Contractor shall use Class 3 geotextiles to prevent mixing of a Subgrade soil and an aggregate cover Material (Subbase, base, select Embankment, etc.), to separate dissimilar Materials where water seepage is allowable. The Contractor shall not use Class 3 geotextiles under pavement. The Contractor may also use Class 3 geotextiles in Structures or under conditions where the geotextile is protected by a sand cushion or by "zero (0) drop height" placement of stone.

The Contractor shall use Table 604.2.4:1, "Required Class of Separator Geotextile and Cover Thickness for R-values Greater Than or Equal to 20," to determine the class of separator geotextile and the required minimum thickness.

Table 604.2.4:1
Required Class of Separator Geotextile and Cover Thickness for R-values Greater Than or Equal to 20

Required minimum cover thickness, compacted	Required class of geotextile
6 inch.	2
12 inch.	3

The Contractor shall not use aggregate larger than one (1) inch.

604.2.5 Stabilization Geotextiles

The Contractor shall provide stabilization geotextile in wet, saturated conditions to provide separation, filtration, and also reinforcement. The Contractor shall use stabilization geotextiles for Pavement Structures constructed over soils with R-values from ten (10) to 20. The Contractor may provide stabilization geotextiles made of woven or non-woven Material.

The Contractor may use stabilization geotextiles in applications that require a design by a licensed professional Engineer. The Contractor shall obtain Department approval of these designs.

604.2.6 Certification

For each class of geotextile fabric, the Contractor shall provide a certificate from the manufacturer stating that the geotextile meets the physical and chemical requirements in accordance with AASHTO M 288, and that geotextile fabric meets R-value requirements for the respective application.

The Contractor shall include in the certification the product name, chemical composition of the filaments or yarns, or other relevant information to fully describe the geotextile.

The Contractor shall submit the certification to the Project Manager before geotextile placement.

R-values corresponding to California bearing ratio (CBR) used in AASHTO M 288 are presented in Table 604.2.6:1, "CBR Values Used in AASHTO M 288 and Corresponding R-values."

Table 604.2.6:1
CBR Values Used in AASHTO M 288 and Corresponding R-values

Soil strength (CBR)	Corresponding R-value
1	10
2	15
3	20

604.3 CONSTRUCTION REQUIREMENTS

604.3.1 Geotextile Packaging, Storage, and Handling

The Contractor shall use geotextile rolls wrapped with a Material to protect the geotextile, including the ends of the roll, from damage.

The Contractor shall cover and elevate geotextile rolls during storage to protect them from the following:

1. Site construction damage (tearing, excessive mud, wet cement, or epoxy);
2. Precipitation;
3. Extended ultraviolet radiation including direct sunlight;
4. Chemicals that are strong acids or strong bases;
5. Flames including welding sparks; and
6. Temperatures above 160 °F and below -22 °F.

604.3.2 Geotextile Exposure After Placement

The Contractor shall not expose geotextiles to the elements after placement for more than 14 Days, unless otherwise directed by the Project Manager.

604.3.3 Site Preparation

The Contractor shall prepare the installation site by clearing and grading the area and preparing a firm, smooth surface on which to place the geotextiles. The Contractor shall remove sharp objects and large stones and cut trees and shrubs flush with the smooth surface.

The Contractor shall ensure correct orientation (roll direction). The Contractor shall place geotextiles as smoothly as possible on the prepared surface; pull tight, align, and anchor such that the geotextile is free of wrinkles and does not show evidence of holes, tears, or rips before placing cover Material on the geotextile. Before placing cover Material, the Contractor shall hold geotextiles in place by pins, staples, or piles of fill or rock as required by fill placement procedures. On curves, the Contractor shall fold or cut geotextiles to conform to the curve.

The Department will not allow vehicles directly on the geotextile, but will allow vehicles after the Contractor places at least six (6) inches of cover Material on the geotextile. The Contractor shall not allow vehicles to turn on the cover Material until at least two (2) lifts of cover Material have been placed.

604.3.4 Backfill

The Contractor shall obtain approval from the Project Manager before beginning backfill operations. The Contractor shall not end dump backfill directly onto exposed geotextile. The

Contractor shall backfill by end dumping onto previously spread backfill and then pushing the dumped backfill over the exposed geotextile. On Subgrades having an R-value less than ten (10), the Contractor shall dump and spread the Material placed on the geotextile to minimize the potential of a localized Subgrade failure.

The Contractor shall backfill in layers from six (6) inches to eight (8) inches deep (uncompacted) unless otherwise specified in the Contract. After placement, the Contractor shall compact each lift to 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Contractor shall compact the top lift in accordance with Section 207, "Subgrade Preparation." The Contractor may use vibratory compaction Equipment on initial layers of Material, if approved by the Project Manager.

The Contractor shall repair ruts occurring during construction by filling with additional Material and compacting to the specified density to maintain an even backfill surface and the minimum lift thickness over the geotextile.

The Contractor shall obtain the Project Manager's approval of geotextile placement before covering.

604.3.5 Subsurface Drainage Geotextiles

The Contractor shall place geotextiles in accordance with Section 605, "Drains," where specified.

The Contractor shall use subsurface drainage geotextiles against soil in an underground drainage system or in an edgedrain to allow for long-term passage of water into a subsurface drain system while retaining the in-situ soil. The primary function of the geotextile in subsurface drainage applications is filtration.

The Contractor shall provide one (1) soil sample to the Department for testing to confirm the applicable apparent opening size based on the percent of in-situ soil passing the No. 200 sieve and cohesiveness (PI).

The Contractor shall compact the aggregate with vibratory Equipment to a minimum compaction of 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). If a higher compactive effort is necessary, the Contractor shall substitute a geotextile suited for more severe installation conditions.

604.3.6 Sediment Control Geotextiles

The Contractor shall place geotextiles in accordance with Section 603, "Temporary Erosion and Sediment Control," where necessary.

The Contractor shall place and maintain sediment control geotextiles as a temporary control measure to prevent eroded soil from being transported off the construction site to rivers, streams, and impoundments and to prevent damage to private property from storm water runoff.

604.3.7 Erosion Control Geotextiles

The Contractor shall place geotextiles in accordance with Section 602, "Slope and Erosion Protection Structures," where necessary.

The Contractor shall use erosion control geotextiles between erosion control Structures (rip-rap and gabions) and the in-situ soil to prevent soil loss resulting in excessive scour and to

mitigate hydraulic uplift pressures that may cause instability of an erosion control Structure.

604.3.8 Separation/Stabilization Geotextiles

The Contractor shall use separation/stabilization geotextiles as a semi-permeable separator to prevent mixing of a Subgrade soil and sub-base or base Material.

The Contractor shall fold, overlap, sew, or join adjacent geotextile rolls in accordance with Table 604.3.8:1, "Minimum Overlap Requirements for Separation/Stabilization Geotextiles," unless manufacturer's recommendations or the Contract are more stringent.

Table 604.3.8:1 Minimum Overlap Requirements for Separation/Stabilization Geotextiles		
Soil strength R-value	Un-sewn seams overlap (inch)	Sewn seams overlap (inch)
<10	—	9
10–15	40	8
15–20	30	3
>20	24	—

The Contractor shall ensure that both factory and field sewn or sealed seams meet or exceed the strength requirements as required by the manufacturer.

604.3.9 Repair of Damaged Geotextiles

To repair subsurface drainage, erosion control, and sediment control geotextiles, the Contractor shall clear the damaged area and repair in accordance with the manufacturer's recommendations. The Contractor shall obtain the Project Manager's approval of repairs.

To repair separation/stabilization geotextiles, the Contractor shall clear the damaged area plus an additional three (3) ft around the damaged area and repair in accordance with Table 604.3.8:1, "Minimum Overlap Requirements for Separation/Stabilization Geotextiles," unless manufacturer's recommendations or the Contract are more stringent. The Contractor shall replace removed cover Material and compact to the specified density.

604.4 METHOD OF MEASUREMENT

The Department will only measure the area of one (1) layer at geotextile overlaps.

604.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Geotextile Class	Square Yard

Payment for achieving Subgrade preparation in accordance with Section 207, "Subgrade Preparation" will be paid as Subgrade Preparation.

604.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Repair of damaged geotextile fabric as a result of the Contractor's negligence, improper shipping, handling, packaging, or storing;

2. Geotextile packaging, storage and handling; and
3. Overlaps, anchoring, splicing and seam assemblies.

SECTION 607: FENCE

607.1 DESCRIPTION

This Work consists of constructing fence and gates.

607.2 MATERIALS

607.2.1 Certification

The Contractor shall submit independent testing Laboratory certification to the Project Manager that indicates the fencing Materials meet these Specifications. The Department may inspect the manufacturing methods at manufacturing plants and may obtain Material samples for testing and may base Acceptance on the quality of manufacturing lots.

607.2.2 Barbed Wire and Woven Wire Fence

607.2.2.1 Wire

The Contractor shall provide wire and wire components with at least a Class 1 zinc coating in accordance with ASTM A 121 or ASTM A 116, unless otherwise specified in the Contract. Instead of Class 1 coating, the Contractor may coat the wire with aluminum alloy covering at least 0.3 oz per square foot of wire surface.

607.2.2.1.1 Barbed Wire

The Contractor shall provide barbed wire and barbs in accordance with ASTM A 121. The Contractor shall provide composite barbed wire strands that consist of two (2) coated wires with diameters of 0.099 inch. The Contractor shall provide round barbs that have a coated diameter of 0.08 inch, with either two (2)-point barbs spaced four (4) inches apart or four (4)-point barbs spaced five (5) inches apart. The Contractor shall provide stays for barbed wire fences in accordance with ASTM A 116, with a coated diameter of at least 0.142 inch and with lengths and spacing in accordance with the Contract.

607.2.2.1.2 Woven Wire

The Contractor shall provide woven wire in accordance with ASTM A 116, Design Number 832-6-11, unless otherwise specified in the Contract.

607.2.2.1.3 Post Fasteners

The Contractor shall provide coated staples with a diameter of at least 0.148 inch and a length of at least 1 1/2 inch; use for fastening fence wire to wood posts.

607.2.2.1.4 Brace Wire

The Contractor shall provide coated brace wire with a diameter of at least 0.148 inch; use for constructing braces and intermediate braces with wood posts.

607.2.2.1.5 Tie Wire

The Contractor shall provide coated tie wire for fastening barbed or woven wire to steel posts with a diameter of at least 0.099 inch. The Contractor may use wire fasteners or metal clamps with thicknesses of 0.12 inch or greater instead of tie wires, if approved by the Project Manager.

607.2.2.2 Posts

The Contractor shall provide metal or wood corner, brace, intermediate brace gate, and line posts of the specified type, size, and length in accordance with the Contract. The Contractor shall permanently cap all vertical metal pipes on fence and gate supports. The Contractor shall ensure that the top coating and color of the pipe is maintained.

607.2.2.2.1 Metal Posts

The Contractor shall provide metal posts and braces of rail, billet, or commercial-grade steel in accordance with ASTM A 702 or ASTM F 1083 for galvanized, standard weight pipe. The Contractor shall provide C-section posts in accordance with ASTM A 1011.

The Contractor shall galvanize steel posts in accordance with AASHTO M 181 for Grade 1 steel and provide a top coating specified for Grade 2 steel, or an equivalent or better coating, from the Department's *Approved Products List*. The Contractor shall coat edges and damaged areas of posts in accordance with ASTM A 780. The Contractor shall use posts of the same coating and color.

The Contractor shall provide posts that weigh no less than 95% of the specified weight; and are of the specified length + two (2) inch, - one (1) inch.

The Contractor shall provide line posts with a minimum weight of 1.33 lb per foot, not including anchor plates. The Contractor may provide I-beam, T-beam, U-beam, Y-bar, or C-section line posts. The Contractor shall provide line posts with corrugations, lugs, ribs, or notches spaced one (1) inch on centers to attach fence wire. The Department will not Accept posts with punched tabs used for crimping around the wire.

The Contractor shall provide anchor plates with an area of at least 18 inch² and that weigh at least 0.67 lb. The Contractor shall clamp, weld, or rivet anchor plates to the post section to prevent displacement when driving the posts.

607.2.2.2.2 Wood Posts

The Contractor shall provide wood posts cut from live southern yellow pine, lodge pole pine, or ponderosa pine trees. The Contractor shall provide straight posts that are free of decay and other defects, bark-free, trimmed smooth of knots and projections, and with both ends sawed off perpendicular to the centerline.

The Contractor shall provide an average nominal diameter at the top of each post of at least six (6) inches. The Contractor shall ensure the circumference of corner, brace, intermediate brace, and gate posts is at least 19 inches, measured six (6) inches below the top of the post.

The Contractor may provide line posts with a slight crook in one (1) direction, but the post may not vary more than 1 1/2 inch from a straight line connecting both ends of the post. The Contractor shall ensure the average nominal diameter of the top of each line post is at least three (3) inches. The Contractor shall ensure the circumference of line posts is at least nine (9) inches, measured six (6) inches below the top of the post.

The Contractor shall provide coast region douglas fir or New Mexico red spruce or fir braces for wood posts.

607.2.2.2.2.1 Preservative Treatment of Wood Posts

The Contractor shall provide wood posts pressure treated with pentachlorophenol in accordance with Section 550.2.2, "Preservatives and Treatment Methods," treated according to AASHTO M-133, all in accordance with AWPA Standard U1 and Commodity Standard B: Posts and AWPA Standards P8 and P9.

607.2.2.3 Gates

The Contractor shall provide two (2)-inch 16-gauge tubular gates meeting the requirements of ASTM A513 with a wall thickness of .065 inches and a tolerance of plus (+0.003) or minus (-0.011) unless otherwise specified in the Contract.

Gates shall be coated in accordance with Section 607.2.2.2.1, "Metal Posts," or coat in accordance with Section 545, "Protective Coating for Miscellaneous Structural Steel." The Contractor shall use "Interstate Green" as the finished color coating, except for galvanized gates and unless otherwise shown in the Contract.

607.2.2.4 Fittings

The Contractor shall provide fittings, hardware, and appurtenances for fences and gates that are of commercial-quality steel, malleable iron, or wrought iron, and galvanized in accordance with ASTM A 153.

607.2.3 Chain Link Fence

607.2.3.1 Posts

The Contractor shall provide posts that are tubular steel, H-column, or C-section (for line posts). The Contractor shall provide either Grade 1 or Grade 2 steel posts in accordance with AASHTO M 181. The Contractor shall provide Grade 1 tubular posts, braces, and top rails in accordance with ASTM F 1083 for galvanized, standard weight pipe. The Contractor shall provide Grade 2 steel posts in accordance with ASTM A 1011 or ASTM A 653.

The Contractor shall provide C-section line posts in accordance with ASTM A 1011. The Contractor shall provide H-column posts in accordance with ASTM A 36.

The Contractor shall provide pipe with minimum wall thickness as specified in the Contract. The Contractor shall ensure that the product of the yield strength and section modulus of the pipe is in accordance with ASTM F 1083.

The Contractor shall provide posts that securely hold tension wires in position without vertical movement.

607.2.3.2 Fittings

The Contractor shall provide fittings in accordance with Section 607.2.2.4, "Fittings."

The Contractor shall provide stainless steel straps and seals in accordance with ASTM A 176.

The Contractor shall provide coated tension wires that are galvanized coil spring steel wire of commercial quality with a diameter of 0.148 inch. The Contractor shall provide galvanized ferrules for tension take-up in accordance with ASTM A 1011.

The Contractor shall provide pull cable and tension truss rods with diameters of at least

3/8 inch, with drop forged turnbuckles or other approved tension devices.

The Contractor shall provide pull cable and tension wires with a minimum zinc coating of 0.8 oz per square foot of uncoated individual wire surface, tested in accordance with ASTM A 90.

The Project Manager will determine the uniformity of the coating by visual inspection. The Project Manager may reject coating with excessive roughness, blisters, discoloration spots, bruises, and flaking. The Department may make other inspections and tests at the manufacturer's plant, before shipment.

607.2.3.3 Tie Wires and Fasteners

The Contractor shall provide galvanized, coated tie wires for fastening chain link fabric to posts and rails with a diameter of at least 0.148 inch. The Contractor may provide galvanized steel or non-corrosive metal bands or fasteners instead of tie wires, as recommended by the manufacturer.

607.2.3.4 Compression Braces

The Contractor shall provide compression braces that meet the same requirements as top rails in accordance with Section 607.2.3.1, "Posts."

607.2.3.5 Chain Link Fabric

The Contractor shall provide chain link fabric in accordance with AASHTO M 181, with a Class C coating or better. The Contractor shall provide chain link fabric full height. The Contractor shall provide galvanized, coated wire with a diameter of 0.148 inch. The Contractor shall provide two (2) inch mesh fabric. The Contractor shall measure the mesh size as the distance between the wires forming parallel sides of the mesh.

607.2.3.6 Gates

The Contractor shall provide double drive, single drive, or single walk gates. The Contractor shall provide galvanized steel pipe gate frames in accordance with ASTM F 1083 and ASTM A 123.

607.2.3.7 Vinyl-Coated Chain Link Fence

The Contractor shall provide vinyl-coated chain link fences in accordance with Section 607.2.3, "Chain Link Fence," except as modified in this subsection.

If providing PVC coated chain link fabric, the Contractor shall use vinyl-coated fabric, posts, and hardware in accordance with AASHTO M 181 for Class A PVC coating. The Contractor shall continuously bond the vinyl coating (do not spray or dip) over the galvanized steel wire by the extrusion bonding process under pressure.

The Contractor shall ensure the vinyl coating resists damage from prolonged exposure to dilute solutions of common mineral acids, sea water, and dilute solutions of salts and alkali.

The Contractor shall galvanize using the electrolytic process before coating with PVC.

The Contractor shall provide wire that was vinyl-coated before weaving and is free and flexible at the joints.

607.2.4 Post and Cable Access Fence

607.2.4.1 Cable

The Contractor shall provide wire cable in accordance with AASHTO M 30. The Contractor shall provide cable of Type I, Class A, 0.75 in diameter rope, unless otherwise specified in the Contract.

607.2.4.2 Hardware and Fittings

The Contractor shall provide galvanized or cadmium plated parts, hardware, and fittings. The Contractor shall galvanize in accordance with AASHTO M 232. The Contractor shall provide cadmium plating in accordance with ASTM B 766, for Class 12, Type III. The Contractor shall provide bolts in accordance with ASTM A 307 and nuts in accordance with ASTM A 563.

The Contractor shall provide externally threaded fittings such as end tie rods, anchor rods, and splicing rods that transmit direct tensile stress, having a minimum tensile strength of 75,000 psi.

The Contractor shall provide internally threaded fittings such as turnbuckles, cable sockets, and nuts capable of withstanding a proof load that is 85% of the proof load requirements for nuts, as specified in accordance with ASTM A 563, Table 3.

The Contractor shall provide cable splices and connections that withstand a proof load equal to the tensile strength required of the attached wire rope cable.

The Contractor shall provide steel rectangular plate washers and cable clamps with a minimum tensile strength of 60,000 psi. The Contractor shall provide plain washers of ferrous metal in accordance with ANSI B 18.22.1, Type A.

607.2.4.3 Wood Posts

The Contractor shall provide wood posts from one (1) of the following species:

1. Northern White Cedar;
2. White Pine;
3. Jack Pine;
4. Red (Norway) Pine;
5. Southern Yellow Pine; or
6. Ponderosa Pine.

The Contractor shall provide posts from live trees that are stacked and properly seasoned. The Contractor shall peel the entire length of each post, closely trim knots, saw both ends square, and shave the entire length of the post to the white.

The Contractor shall provide posts with a top diameter after shaving of four (4) inches; - 1/2 inch, +1 1/4 inch.

The Contractor shall ensure posts are free of sap rot, woodpecker holes, plugged holes, ant-eaten areas, and hollow knots extending to center of the post. The Contractor shall not allow butt rot to exceed five percent (5%) of the butt area. The Contractor shall provide posts with sound tops, however, the Department will allow one (1) pipe rot not exceeding a diameter of 3/8 inch on a cedar post. The Contractor shall provide posts that do not have excessive

checking. The Contractor shall ensure that the posts do not have short kinks or more than one (1) one-way sweep exceeding two (2) inches, however, the post may have a winding twist.

The Department will not allow posts exhibiting both the maximum crook and maximum butt rot, and will not allow more than ten percent (10%) of the posts specified in the Contract to contain the maximum crook or butt rot.

The Department may reject posts with other defects that give the post an unsightly appearance or impair its durability or strength. The Contractor shall complete debarking, trimming, and sizing operations before treatment.

607.2.4.4 Preservative Treatment of Posts for Post and Cable Barrier

The Contractor shall provide pressure treated wood posts with pentachlorophenol in accordance with Section 550.2.2, "Preservatives and Treatment Methods," treated according to AASHTO M-133, in all accordance with AWPA Standard U1 and Commodity Standard B: Posts and AWPA Standards P8 and P9.

607.2.5 Snow Fence

The Contractor shall provide snow fence of 1/2 inch × 1 1/2 inch wooden pickets spaced 3 1/2 inch on center and woven between five (5) cables. Each cable will consist of at least two (2) strands of galvanized steel wire with diameters of 0.099 in or larger.

The Contractor shall provide wooden pickets that are at least 48 inches long and treated or painted in accordance with the manufacturer's recommendations.

The Contractor shall provide wire, braces, attachments, and fittings in accordance with ASTM A 116 and applicable requirements of Section 607.2.2, "Barbed Wire and Woven Wire Fence."

607.2.6 Concrete

The Contractor shall provide Class A concrete bearing blocks and anchors in accordance with Section 510, "Portland Cement Concrete." The Contractor may provide a prepackaged, pre-blended cementitious Material to which the Contractor only adds water at the site.

607.3 CONSTRUCTION REQUIREMENTS

607.3.1 General

The Contractor shall clear the fence lines of trees, bush, stumps, logs, weeds, existing fences, and other obstructions that may interfere with fence construction, unless the Project Manager requires certain trees to remain in place. The Contractor shall dispose of removed Material in accordance with Section 601, "Removal of Structures and Obstructions."

If the Contractor is to embed posts, braces, or anchors in concrete, the Contractor shall install temporary guys or bracing to hold the posts in position until the concrete sets. Unless otherwise specified, the Contractor shall not install Materials on posts and do not strain posts, braces, or anchors set in concrete until seven (7) Days after concrete placement, or until the concrete has reached a compressive strength of 2,500 psi, whichever occurs first. The Contractor shall crown the concrete at the top of the foundation to shed water.

The Contractor shall only cut the tops of posts as approved by the Project Manager. The

Contractor shall apply protective coating to cut posts in accordance with Section 607.3.8, "Repair of Damaged Coating on Pull Cables and Tension Wires."

The Contractor shall firmly attach wire and fencing to the posts and braces. The Contractor shall tightly stretch wire and install it at the required elevations. The Contractor shall place fence wire on the field side of the posts, except on the inside of curves.

At each location where an electric transmission, distribution, or secondary line crosses new fence, the Contractor shall provide and install a ground connection in accordance with the NEC®.

The Contractor shall build new fences adjacent to existing fence before removing existing fences. When removing and rebuilding fences, the Contractor shall maintain the security of livestock and protect adjacent properties and the traveling public. The Contractor shall remove the existing fence or unused Materials and neatly roll it up in single strand rolls. The Contractor shall remove the fence posts without damaging them and place the posts with the rolls of wire within the Right of Way for property owners to salvage, unless otherwise directed by the Project Manager. If the property owners do not pick the fence up within the allotted time, the Contractor shall dispose of the fence as directed by the Project Manager.

607.3.2 Barbed Wire and Woven Wire Fence

The Contractor shall set posts plumb and in accordance with the Plans. The Contractor may drive metal line posts. The Contractor shall excavate for footings and anchors in accordance with the Plans or as directed by the Project Manager. The Contractor shall place post hole backfill in thin layers and compact each layer.

The Contractor shall attach Right of Way fences to Roadway Structures, in accordance with the Plans.

607.3.2.1 Fence Tensioning

The Contractor shall stretch fence wire with a mechanical stretcher or other similar device. The Contractor shall not allow the length between pull posts to exceed 990 ft for barbed wire, and 660 ft for woven wire.

607.3.2.2 Braces and Corner Posts

The Contractor shall place intermediate braces at intervals of 990 ft or less and at every fence grade-change, such as edges of arroyos, bottoms and tops of hills, and as directed by the Project Manager. The Contractor shall maintain the required distance between the bottom wire and the ground. The Contractor shall space intermediate braces evenly between corner and gateposts or cattle guards. The Contractor shall place a corner post and brace at the intersection of cross fences and the Right of Way fence. The Contractor shall stretch the wires and firmly attach them to the corner posts.

607.3.3 Chain Link Fence

The Contractor shall install braces, tension rods, cables, hardware, and appurtenances in accordance with the manufacturer's recommendations and the Contract.

The Contractor shall not attach chain link fabric to posts until the concrete footings have reached a compressive strength of 2,500 psi, or until three (3) Days after concrete placement, whichever occurs first.

After permanently positioning posts, setting anchorages firmly, and drawing tension wires and pull cables tight with turnbuckles or other approved tension devices, the Contractor shall secure the tension wires to the posts with tension bands and tie wires. The Contractor shall secure the chain link fabric at one end and stretch away from the secured end. The Contractor shall stretch the fabric with a mechanical stretcher or other device approved by the Project Manager.

607.3.3.1 Chain Link Fence Post Placement

The Contractor shall set posts plumb in concrete footings. The Contractor shall space chain link fence posts at intervals of ten (10) feet or less. The Contractor shall measure the intervals from center to center of posts. Pull posts are line posts braced to adjacent line posts. The Contractor shall position pull posts at intervals of 500 ft or less. The Contractor shall provide end posts with an outside diameter of at least 2.875 inch. The Contractor shall brace end posts in the same way as corner posts.

607.3.3.2 Chain Link Security Fence

The Contractor shall use chain link security fence in accordance with Section 607.3.3, "Chain Link Fence." The Contractor shall supply security appurtenances on gates for access.

607.3.4 Post and Cable Access Fence

607.3.4.1 Post Placement

The Department will allow a depth of post embedment that is greater than specified in the Contract if the finished top of the post meets the required elevation. The Contractor shall compact the bottom of the holes to provide a stable foundation. The Contractor shall set the posts plumb with the front faces in a neat uniform line and with full contact on the foundation surface. The Contractor shall backfill holes with granular Material and compact in layers so the posts maintain the specified position and alignment.

Instead of setting posts in previously dug holes and backfilling, the Contractor may drive the posts, except if the Contract specifies bearing blocks. The Contractor shall only drive if there is adequate lateral stability and as long as the Shoulders and adjacent slopes are not damaged from the driving operations.

The Contractor shall remove posts that do not meet the requirements or are damaged below cutoff during driving, and replace with sound posts. If upward vertical adjustment of posts is necessary, the Contractor shall remove and reinstall them.

The Contractor may cut off the tops of posts to the elevation specified in the Contract. The Contractor shall round the tops of round posts to an approximate domed hemispherical shape centered on the axis of the post. After cutting off treated posts, the Contractor shall apply two (2) coats of pentachlorophenol preservative to the cut surfaces.

607.3.4.2 Setting of Anchors, Cable, and Fittings for Post and Cable Access Fence

If a bolt projects more than one (1) inch from the nut, the Contractor shall cut off 1/2 inch and burr. The Contractor shall paint the ends of cut-off bolts with aluminum paint. The Contractor shall bore holes for cable supports after the posts are set. The Contractor shall place end and intermediate anchorages and bearing blocks in accordance with the Contract.

The Contractor shall excavate trenches for anchor blocks to their neat lines. The Contractor shall perform excavation for anchor rod installation without excessively disturbing

the earth between the block and the anchored posts. The Contractor shall excavate holes for bearing blocks to their neat lines, then place and level the block with anchor rods in place on undisturbed soil. The Contractor shall place backfill Material and compact in layers. The Contractor shall not apply final tension to the anchor assembly until after completing the backfilling.

After completing the anchor assemblies, the Contractor shall properly adjust and securely fasten the cables, draw the cables tight, then loosen them to meet Contract requirements for the applicable temperature range.

The Contractor shall use three (3) inch wide reflective sheeting in accordance with Section 701.2.2.1, "Retroreflective Sheeting," Silver White No. 2. The Contractor shall mount the sheeting on flexible aluminum alloy. The Contractor shall fix the sheeting to each end post and at maximum intervals of 100 ft on intermediate posts, with a minimum of three (3) strips per installation. The Contractor shall completely wrap the reflective strips around each post before installing the post plate washers.

607.3.5 Snow Fence

The Contractor shall construct snow fence in accordance with the manufacturer's recommendations and the Contract.

607.3.6 Pedestrian/Bicycle Railing

The Contractor shall construct pedestrian and bicycle railing in accordance with the Contract or as directed by the Project Manager.

607.3.7 Removing and Rebuilding Fence

The Contractor shall remove and rebuild existing fences in accordance with the Contract or as directed by the Project Manager. The Contractor shall construct new fences in the same or better condition than the original fence.

The Contractor shall salvage Materials from removed fences and incorporate into the rebuilt fences. If the Project Manager determines that some Materials are not reusable, the Contractor shall replace those Materials as necessary and in accordance with Section 109.5, "Payment for Changes, Differing Site Conditions, and Extra Work."

The Contractor shall firmly reset posts to the staked alignment. The Contractor shall use the same spacing of the posts and the same number of wires strung and stapled to the posts as the original fence. The Contractor shall use new staples to fasten the wires to the posts.

607.3.8 Repair of Damaged Coating on Pull Cables and Tension Wires

The Contractor may repair pull cables and tension wires that exhibit minor damage to the zinc coating by wire-brushing the damaged area and removing loose, cracked, or weld-burned zinc coating. The Contractor shall paint the cleaned area with two (2) coats of zinc oxide-zinc dust paint in accordance with Federal Specification TT-P-641 or Military Specification MIL-P-21035 or with an equivalent coating approved by the Project Manager. The Contractor shall make repairs and provide repair Materials at no additional cost to the Department.

607.3.9 Gates

The Contractor shall fabricate and construct gates, and stile and post wire traps in accordance with the Contract.

607.3.9.1 Remove and Reset Gate

The Contractor shall remove and reset existing gates in accordance with the Contract or as directed by the Project Manager.

607.4 METHOD OF MEASUREMENT

The Department will measure fences and watergap gates along the top from outside to outside of end posts for each continuous run of fence or watergap gate.

607.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Barbed Wire Fence ____ft</i>	Linear Foot
<i>Game Fence ____ft</i>	Linear Foot
<i>Woven Wire Fence ____ft</i>	Linear Foot
<i>Chain Link Fence ____ft</i>	Linear Foot
<i>Chain Link Security Fence ____ft</i>	Linear Foot
<i>Vinyl-Coated Chain Link Fence ____ft</i>	Linear Foot
<i>Snow Fence ____ft</i>	Linear Foot
<i>Pedestrian/Bicycle Railing ____ft</i>	Linear Foot
<i>Pedestrian Screening Fence Type ____ft</i>	Linear Foot
<i>Post and Cable Access Fence ____ft</i>	Linear Foot
<i>Remove and Rebuild (type) Fence</i>	Linear Foot
<i>Standard Gate ____ft</i>	Each
<i>Barbed Wire Gate, ____ft</i>	Each
<i>Chain Link Gate, ____ft Span</i>	Each
<i>Chain Link Gate, ____ft Span by ____ft Rise</i>	Each
<i>Pipe Gate ____ft</i>	Each
<i>Water Gap Gate</i>	Linear Foot
<i>Turnstile Gate ____ft</i>	Each
<i>Remove and Reset Gate</i>	Each
<i>Stile and Post Wire Trap</i>	Each
<i>Braces/Corner Posts</i>	Each

607.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Clearing and grubbing,
2. Grading,
3. Excavation,
4. Backfill,
5. Disposal of surplus Material,
6. Concrete, fasteners,

7. Galvanizing,
8. Coating repairs; and
9. All additional bracing required for grade changes.