

HARLEY'S POND

BID AND CONTRACT DOCUMENTS VOLUME 2: TECHNICAL SPECIFICATIONS

SOUTHERN SANDOVAL COUNTY ARROYO FLOOD CONTROL AUTHORITY (SSCAFCA)

IFB # 2021-07

SSCAFCA PROJECT NUMBER: BL-P0019-04

FUNDING SOURCE - NMFA 5116-WPF

AUGUST 2021



NMAPWA

- 101 Portland Cement Concrete
- 102 Steel Reinforcement
- 105 Concrete Curing Compound
- 106 Cement Mortar and Grout
- 109 Riprap Stone
- 122 Plastic Liner Plate
- 123 Reinforced Concrete Pipe
- 161 Gray Iron Castings
- 201 Clear & Grub
- 204 Fill Construction
- 301 Subgrade Preparation
- 410 Fences
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- 501 Excavation and Backfill for Structures
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- 920 Sanitary and Storm Sewer Manholes Backfill for Major Structures
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- 1200 Temporary Traffic Control

NMDOT

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SOUTHERN SANDOVAL COUNTY ARROYO FLOOD CONTROL AUTHORITY (SSCAFCA) • HARLEY'S POND DESIGN & CONSTRUCTION RELATED SERVICES • BID AND CONTRACT DOCUMENTS



NMDOT

- 519 Shotcrete
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- 1503 Mobilization
- 1504 NPDES Compliance
- 1505 Control of Storm Water & Nuisance Flow
- 1506 Construction Staking
- 1507 Testing and Quality Assurance
- 1508 Project Record Documents
- 1511 Temporary Construction Fence

ADS

- SaniTite HP Pipe
- Water Stop Gasket

CONTECH

Storm Rack Installation Guide

Harley's Pond Geo technical Report

New Mexico Standard Specifications for Public Works Association

SECTION 101

PORTLAND CEMENT CONCRETE

101.1.1 GENERAL: Portland cement concrete, prestressed concrete, post tensioned concrete, shotcrete, gunite, and light weight structural concrete shall consist of a mixture of Portland cement, aggregates, water, and admixtures, proportioned, batched and delivered as specified herein. All materials and design mixes used in Portland cement concrete, either batched at or delivered to a project shall be certified in accordance with the requirements of these specifications. Each design mix submitted and authorized for use under this Specification shall be identified by a design mix number, unique to that design mix. If either a change in material(s) or material supplier(s) from that specified in the authorized design mix occurs during a project, authorized use of the job mix formula on the project may be canceled as directed by the ENGINEER. A concrete design mix shall not be used on a project without written authorization of the ENGINEER. A design mix, upon request by a concrete supplier, may be authorized by the OWNER for use on OWNER and OWNER-related projects for a period of 14 months from the date of sampling of reference aggregates in the design mix.

101.1.2 For construction and reconstruction projects requiring portland cement concrete continuous placement(s) equal or greater than either 100 cubic yards of concrete per day, the CONTRACTOR shall have a full time portland cement concrete construction supervisor on site to direct the construction operations. The supervisor shall be certified either as an ACI certified Concrete Field Testing Technician Grade I, or the equivalent National Institute for Certification of Engineering Technologies Technician, with Specialty Concrete Work Elements Level I 82001, 82002, and Level II 84002, 84003, 84004, The supervisor shall be identified by the 84010. CONTRACTOR at the preplacement conference and shall be the contact person for the ENGINEER during concrete construction.

101.1.3 Pre-Placement Conference

A Pre-Placement Conference shall be held by the CONTRACTOR, as directed by the ENGINEER, no later than seven (7) calendar days prior to the start of construction for concrete continuous placement(s) equal or greater than either 100 cubic yards of concrete per day. The following meeting agenda/assigned responsibilities shall be accomplished at the conference.

I. ENGINEER/OWNER

- A. Scope of the project.
- B. Identify construction management team and contact telephone numbers.
- C. Review CONTRACT requirements for construction.
- D. Review Quality Assurance Program.

II.CONTRACTOR

- A. Review construction schedules.
 - 1. Placement schedules.
- 2. Proposed construction schedule for duration of the project.
- B. Identify construction personnel and contact telephone numbers.
 - 1. Contractor Staff
 - 2.Sub-Contractor (s)
 - 3.Supplier (s)
 - 4. Safety Manger
- C. Present construction placement procedure plans. 1.Equipment Schedule
 - 2. Concrete Design Mix
 - 3. Construction methodology
 - 4. Concrete pumping plan
 - 5. Traffic Control Plan
 - 6. Quality Control Plan

III. DISCUSSION AND COMMENT

- 101.2 REFERENCES
- 101.2.1 American Society for Testing and Materials (Latest Edition) (ASTM)
- C31 Making & Curing of Concrete Test Specimens in the Field
- C33 Specification for Concrete Aggregates
- C39 Test for Compressive Strength of Cylindrical Concrete Specimens
- C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- C78 Test for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
- C94 Specification for Ready-Mixed Concrete
- C125 Definition of Terms Relating to Concrete and Concrete Aggregates
- C138 Air Content (Gravimetric), Unit Weight, and Yield of Concrete
- C143 Test for Slump of Portland Cement Concrete specification. If required, certification
- C150 Specification for Portland Cement
- C172 Sampling Fresh Concrete
- C173 Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C192 Making & Curing of Concrete Test Specimens in the Laboratory
- C227 Test for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar Bar Method)
- C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260 Specification for Air Entraining Admixtures for Concrete
- C330 Specification for Lightweight Aggregates for Structural Concrete
- C441 Test for Effectiveness of Mineral Admixtures in

Preventing Excessive Expansion of Concrete Due to Alkali-Aggregate Reaction

- C494 Specification for Chemical Admixtures in Concrete
- C567 Unit Weight of Structural Lightweight Concrete
- C617 Capping Cylindrical Concrete Specimens
- C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- C685 Specification for Concrete Made by Volumetric Batching & Continuous Mixing
- C803 Test for Penetration Resistance of Hardened Concrete
- C805 Test for Rebound Number of Hardened Concrete
- D2419 Sand Equivalent Value of Soils and Fine Aggregates
- 101.2.2 American Concrete Institute (Latest Editions)
- ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 211.2 Standard Practice for Selecting Proportions for Structural Lightweight Concrete
- ACI 318-89 Building Code Requirements for Reinforced Concrete
- 101.2.3 This Specification:
- SECTION 337 PORTLAND CEMENT CONCRETE PAVEMENT
- SECTION 340 PORTLAND CEMENT CONCRETE CURBS, GUTTERS, WALKS, DRIVEWAYS, ALLEYS, INTERSECTIONS, SLOPE PAVING, AND MEDIAN PAVING
- SECTION 346 TEXTURED CONCRETE
- SECTION 349 CONCRETE CURING
- SECTION 420 TRAFFIC SIGNAL AND STREET LIGHTING CONDUIT, FOUNDATIONS AND PULL BOXES
- SECTION 510 CONCRETE STRUCTURES
- SECTION 512 PRECAST PRESTRESSED MEMBERS
- SECTION 602 PORTLAND CEMENT CONCRETE FOR CHANNEL LINING AND DIKE AND DAM SURFACING
- SECTION 701 TRENCHING, EXCAVATION AND BACKFILL
- SECTION 800 INSTALLATION OF WATER TRANSMISSION, COLLECTOR AND DISTRIBUTION LINES
- SECTION 900 SANITARY AND STORM SEWER FACILITIES
- SECTION 915 STORM DRAINAGE APPURTENANCES SECTION 1500 MONUMENTS
- 101.3 PORTLAND CEMENT
- 101.3.1 Portland cement to be used or furnished under

this Specification shall comply either with the requirements of ASTM C150, Types I LA, II LA, III LA, and V LA, cements, or as specified herein, in the Supplementary Technical Specifications, Drawings, or as approved by the ENGINEER. The CONTRACTOR shall submit certification of compliance signed by the cement manufacturer, identifying the cement type and source (plant location), stating the Portland cement furnished to the project, and or used in the concrete delivered to the project complies with this Specification. If required, certification of the Portland cement used for each day's concrete placement shall be submitted to the ENGINEER for each type of cement and each design mix used on the project.

101.3.2 Portland cement specified in an authorized design mix shall be of the same source and type for all concrete batched at and/or delivered to a project under the authorized design mix identification number.

101.3.3 When suitable facilities (such as those recommended by the Concrete Plant Manufacturer's Bureau and/or approved by the ENGINEER) are available for handling and weighing bulk cement, such facilities shall be used. Otherwise, the cement shall be delivered in original unopened bags of the Manufacturer and the type of cement plainly marked thereon, each bag to contain 94 pounds (42.6 kg) of cement.

101.3.4 Cement shall be stored in such a manner as to permit ready access for the purpose of inspection and be suitably protected against damage by contamination or moisture. Should any lot of bulk cement delivered to the site show evidence of contamination, the ENGINEER may require that such lot be removed from the site.

101.3.5 Portland cement shall be measured by weight, lbs, (mass, kg) for concrete produced in accordance with the requirements of ASTM C94 and by volume for concrete produced accordance with the requirements of ASTM C685.

101.4 AGGREGATES:

101.4.1 Aggregates shall comply with the requirements of ASTM C33 and as amended herein, or as specified in the Supplementary Technical Specifications and Drawings, or as approved by the ENGINEER. Aggregates shall be certified to comply with the requirements of this Specification and authorized for use by the ENGINEER before the materials may be incorporated in the construction. Prior to delivery of the aggregates or material containing the aggregates, The CONTRACTOR may be required to furnish samples of the aggregates to the ENGINEER for testing. The CONTRACTOR's daily production aggregate gradations used in concrete shall be submitted to the ENGINEER upon request. Aggregates specified in an authorized design mix shall be of the same source and type for all concrete batched and delivered under the authorized design mix identification number.

101.4.2 In placing materials in storage or in moving them from storage to the mixer, no method shall be employed which may cause the segregation, degradation, or the combining of materials of different grading which will result in any stockpile not meeting specified requirements.

101.4.3.1 Aggregates supplied under this Specification shall be assumed to be "alkali-silica reactive", ASR. Variance from this position for a particular aggregate source may be authorized by The ENGINEER. Application for a variance may be made to The ENGINEER.

101.4.3.2 An aggregate may be classified non-alkali-silica reactive if, when tested in accordance with ASTM C227, using low alkali cement demonstrates an expansion at one (1) year not greater than 0.05%, and the rate of expansion is negative decreasing, based on test measurements at 1 month, 3 months, 6 months, 9 months, and 15 months, as authorized by the ENGINEER.

101.4.3.3 Portland cement concrete design mixes using non alkali-silica reactive aggregates complying with 101.4.3.2 will not be required to be proportioned with Class F fly ash.

101.4.4.1 Coarse aggregates shall meet the gradation limits as specified in Table 2 of ASTM C33. Fine aggregates shall comply with the gradation requirements of ASTM C33, Section 4, Grading. The sand equivalent of fine aggregate, when tested in accordance with ASTM D2419, Sand Equivalent Value of Soils and Fine Aggregates, shall be greater than 75.

101.4.4.2 The maximum size aggregate shall comply with either these specifications, or the requirements of Table 101.A, or the Supplementary Technical Specifications, or the recommendations of ACI 318-89, paragraph 3.3.2, or as required by the ENGINEER.

101.4.5 Aggregates shall be measured by weight (mass) for concrete batched under the requirements of ASTM C94 and by volume for concrete batched in accordance with the requirements of ASTM C685.

TABLE 101.A
MAXIMUM SIZE AGGREGATE

	Application	Size, in
I.	Pavement, Sidewalk, Curb and Gutter, Drive Pads, Wheel Chair Ramps, Slab on grade, Foundations, and Structures,	1
п	Channels, minimum 5% retained on	L1/2

II. Channels, minimum 5% retained on I-1/2 the 1 in sieve

- III. High Early Release Concrete, 3/4 minimum 5% retained on the ½ in sieve
- IV. Stamped, Patterned, Stairs and 1/2 Steps, minimum 5% retained on the 3/8 in sieve
- V. Formed Concrete
- A. 1/5 the narrowest dimension between sides of forms,
- B. 1/3 the depth of slab,
- C. 3/4 of the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts, or reinforcing and forms.

101.5 WATER

Water used in Portland cement concrete shall be clean and free from injurious amounts of oil, acids, alkalis, salts, organic materials, or other substances that may be deleterious to the concrete or reinforcement. Non-potable water shall not be used unless the requirements of ACI 318.3.4.3.2 are met. Water shall be measured by weight or volume for concrete batched under the requirements of ASTM C94 and by volume for concrete batched in accordance with the requirements of ASTM C685.

101.6 ADMIXTURES:

101.6.1 Admixtures shall comply with the requirements of this specification. The CONTRACTOR shall submit a certification of compliance signed by the admixture manufacturer, identifying the admixture and its source (plant location), stating the admixture furnished to the project and/or used in the concrete delivered to the project complies with this Specification. Certification laboratory testing of an admixture shall be submitted by the CONTRACTOR to the ENGINEER upon request. Admixtures specified in an authorized design mix shall be of the same source and type for all concrete batched and delivered as defined under a design mix identification number. Admixtures shall be measured accurately by mechanical means into each batch by equipment and in a method approved by the ENGINEER. An admixture shall not be used on a project without authorization by the ENGINEER.

101.6.2 Air-entraining agent, conforming to ASTM C260, shall be measured accurately by mechanical means into each batch by equipment and in a method approved by the ENGINEER. The air-entraining agent used shall not contain more than 0.035% chloride by weight. Air-entrainment content shall comply with the requirements Table 101.B., the Supplementary Technical Specifications, or the recommendations of ACI 318, latest

edition.

Nominal Maximum Size Aggregate,	Air Conte (۹	nt Range, %)
in.	min	max
1/2	5.5	8.5
3/4	4.5	7.5
1	4.5	7.5

101.6.3 Chemical admixtures shall conform to either the requirements of ASTM C494, or as specified in the Supplementary Technical Specifications, or as specified by the ENGINEER. Chemical admixtures shall not contain more than 0.035% chloride by weight.

101.6.4.1 Mineral admixtures shall be class "F" fly ash complying with the requirements of ASTM C618 including the requirements of TABLE 4, UNIFORMITY REQUIREMENTS, and the requirements of this Specification.

101.6.4.2 Mineral admixtures, when tested in accordance with ASTM C441, shall conform to the following:

Reduction in expansion @ 14 days, % , min, 65.0 100% Reliability

Mortar expansion @ 14 days, max, % 0.20

Expansion must be less than control sample expansion.

101.6.4.3 The "Reactivity with Cement Alkalis" shall be determined using new Dow Corning glass rod base for aggregate. If a fly ash does not comply with the above requirement using the specified cement type, it may be authorized if the criteria is met using the low alkali Portland cement typically available to the Albuquerque area, as directed by the ENGINEER.

101.6.4.4 Mineral admixtures used or furnished under this Specification shall be certified quarterly, in a calendar year, to comply with this Specification by the supplier. Certification shall include test results and specifications, source and location.

101.6.4.5 Mineral admixtures shall be measured by weight (mass) for concrete batched under the requirements of ASTM C94 and by volume for concrete batched in accordance with the requirements of ASTM C685.

101.6.5 Accelerating admixtures may be used in Portland cement concrete batched and supplied under this Specification only when approved by the ENGINEER. The accelerating admixture used shall be a non-chloride type. A design mix proportioned with an accelerating admixture shall be submitted as specified in paragraph 101.8.8. and authorized by the ENGINEER, prior to use on a project.

101.7 PROPORTIONING

101.7.1 Portland cement concrete shall he proportioned in accordance with the requirements of ACI 318, latest edition, Chapter 5, either ACI 211.1 or ACI 211.2 (latest editions), and Table 101.C of this Specification, either field experience or trial mixtures, and the construction placement requirements selected by the CONTRACTOR. The CONTRACTOR shall be solely responsible for the portland cement concrete design mix proportions for concrete either batched at, or delivered to, placed and finished at the site. Certification of a design mix and all component materials, including all formulations of a mix and any and all admixtures which may be used under special construction conditions and environments with that mix to include high range water reducers (super-plasticizer), accelerating admixtures and retarders, and any other admixture, shall comply with the requirements of this Specification.

101.7.1.1 Design mix(es) shall be prepared in a laboratory accredited in accordance with the requirements of the New Mexico State Highway and Transportation Department "Procedure for Approval of Testing Laboratories to Perform Inspection, Testing, and Mix Design Services", April 13, 1998 Edition, and operated under the direct supervision of a New Mexico registered Professional Engineer.

101.7.1.2 The testing equipment used in the design development testing shall be calibrated annually with calibration standards traceable to the National Bureau of Standards. Certificates of calibration shall be maintained at the laboratory for review by the ENGINEER. A copy of the certifications shall be submitted to the ENGINEER upon request. A portland cement concrete design mix shall not be batched at and/or delivered to a job site without written authorization of the ENGINEER.

101.7.1.3 A design mix shall be prepared under the direct supervision of a New Mexico Registered Professional Engineer.

101.7.2 Portland cement shall be proportioned to comply with the requirements specified in Table 101.C, or as specified in the Supplemental Technical Specifications, or Plans, or as authorized by the ENGINEER.

101.7.3 The mineral admixture Class F fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4, not less than 20 per cent of the total cementitious material. Portland cement concrete submitted under this Specification shall be proportioned with Class F fly ash, unless a variance is authorized by the ENGINEER.

107.7.4 The water to total cementitious material ratio shall not be greater than specified in Table 101.C, or the maximum determined from a "trial mix" compressive strength vs. water to cementitious ration curve, defined in accordance with ACI 318, latest edition, Chapter 5. The trial mix compressive strength water to cementitious material ratio curve shall be developed with the target slump at design application maximum, ± 0.75 inches, and the target entrained air content at design application maximum, ± 0.5 per cent, using materials specified in the design submittal. The cementitious material shall be defined as the total weight of portland cement and Class F fly ash in design mix.

101.7.5.1 A design mix submittal shall include but not be limited to the following information, as directed by the ENGINEER.

A. Certification of compliance of the design mix with the requirements of this Specification and by the New Mexico Registered Professional Engineer in responsible charge of the design mix development;

B. Certification of compliance of design mix's component materials by a manufacturer/supplier. The certification shall include laboratory test results of companion samples of the component material used in the laboratory prepared design mix, verifying the component materials comply with the specifications. For a mix design based on statistical methods, certification(s) of component materials shall be based on results performed within two (2) months of the submittal date.

C. Plastic characteristics of the design mix to include concrete temperature, slump, entrained air content, wet unit weight, yield and cement factor, reported in English and metric units;

D. Performance characteristics of the hardened concrete to include the compressive strength of all test cylinders averaged for a respective test and the corresponding average compressive strength reported in English units;

E. Compressive strength test (3 cylinder tests each point) shall be reported for each water to cementitious material ratio design mix proportioned at 3, 7, 14 and 28 days laboratory cure normal concrete; and, 1 day, 3 days, 7 days and 28 days laboratory cure for high early release concrete.

F. The "trial mix" compressive strength vs. water to cementitious ratio curve graphically plotted to include the water to cementitious ratio for the proposed design mix. A proposed design mix water to cementitious ratio outside the limits of a trial mix curve shall be rejected.

G. When a proposed design mix is based on statistical analysis of historical data, certification that the design mix represented by the historical data was batched with the same or similar materials from the same sources as the materials proposed in the design mix shall be included in the submittal. Under this design certification procedure, the proposal shall include a statistical analysis for a period of 12 months prior to sampling aggregates of the characteristics of a) slump, b) entrained air, and c) $f_c@28$ day compressive strength test. A compressive strength test shall be the average of two (2) cylinders tested at 28 days. An annual average aggregate gradation analysis may be used if the data represents the 12 month period prior to sampling for a design mix. A minimum of three production gradations per month will be required in the data base, as directed by the ENGINEER.

H. Batch proportions for concrete made by Volumetric Batching and Continuous Mixing, ASTM C685, shall include 1) component batch weights, 2) component batch volumes, and 3) gate settings for each type of batching equipment the design mix that may be batched.

J. High Range Water Reducing Admixture(s) (hrwra), Superplastizers

- a.A prescription for use of the hrwra in a design mix shall be provided by the CONTRACTOR to include but not limited to the following
 - 1. Maximum dosage per cubic yard (meter) by standard measure, ozs/yd³;
 - 2. Admixture introduction location (plant or Job site);
 - 3. Minimum mixing after admixture introduction (drum revolution count at mixing speed);
 - 4. Air entrainment dosage adjustment, if required;
 - 5. Base mix water reducing admixture (wra) dosage adjustment, if required;
 - 6. Consistency (slump) targets for before and after admixture introduction;
 - 7. Concrete temperature limitations, if required; and,
- b. Laboratory demonstrated performance of the design mix, at the specified maximum admixture dosage, shall be reported, including slump, entrained air content, unit weight, water to cementitious materials ratio, seven (7) and twenty eight (28) day compressive strength (fc), and three (3) days and seven (7) day compressive strength (fc) for high early release concrete. Submittal compressive strength shall be based on the average value of three cylinders required.
- K. Accelerating Admixture(s)
 - a.A prescription for use of the accelerating admixture in a design mix shall be provided by the CONTRACTOR to include but not limited to the following:
 - 1. Maximum dosage per cubic yard (meter) by standard measure, ozs/yd³;
 - 2. Concrete temperature limitations, if required;
 - 3. Admixture introduction location, plant or project;

- 4. Restrictions of use in combination with other admixtures, as applicable; and,
- b.Special considerations for mixing, placing, and curing, as applicable.
- L.Color Admixture(s)
 - a. A prescription for use of a color admixture in a design mix shall be provided by the CONTRACTOR to include but not limited to the following:
 - 1.Maximum dosage per cubic yare (meter) by standard measure, ozs/yd³;
 - 2. Admixture introduction location, plant or project;
 - 3. Restrictions of use in combination with other admixtures; and
 - b.Special considerations for mixing, placing, and curing, as applicable.
- M. Submittal Format

- a.A standard design mix submittal may include some or all of the above information as directed by the CONTRACTOR to define use as "optional" admixture(s). The standard design mix code would be the same for applications with and without the optional admixture(s)
- b.A specific design mix submittal can be made to include either color, or accelerating, or high range water reducing admixture for use under a specified application only. Separate design mix submittals will be required to include the information specified above.

101.7.5.2 A submittal shall be rejected if it does not include the specified information and samples. A design mix submittal shall be accepted or rejected within ten (10) days of receipt by the ENGINEER.

TABLE 101.C - DESIGN MIX SPECIFICATIONS-PORTLAND CEMENT CONCRETE [1, 2, 3]

Application	Use In Section(s)	f 'c @ 28	Entrained Air Range	Slump, Not To Exceed, nte [5]	Portland Cement	w:(c+fa) max [7]
		1	01-6			

		days psi, min	[11]	Diagoment	<u>ir</u>	nches	min, lbs./yd ³	
		[4]	(2	Placement	Norm	HRWRA		
Interior Concrete (heated areas) Foundations and slab on grade.	510	3,000	(See par.101.7.2)	Hand Place	4	6	423	0.50
Exterior Concrete a) Structure, foundations, slab on grade, steps/stairs; b) sidewalks, drive pads, wheel chair ramps, stamped pattern concrete, curb & gutter, and valley gutter; c) storm drain structures, channels, drop inlets, and manhole bases; d) retaining walls; and, e) miscellaneous concrete.	340, 346, 420, 510, 511, 602 [12,13], 701, 800, and, 1500	3,000	(See par.101.7.2)	Hand Place	4	6	470	0.45
				Slip Formed	2	3		
Pavement For design of PCCP, use MR= 600 lbs/in ² [4]	337	4.000	(See	Hand Place	4	6	564	0.40
		1,000	par.101.7.2)	Slip Formed	2	3	001	
<u>Hydraulic Structures</u> Reservoirs	510 and	3.500	(See	Hand Place	4	7	517	0.40
	512		par.101.7.2)	Slip Formed	2	3	• • •	
<u>Structures</u> Buildings, bridges/bridge decks, and parking structures	500	4,000 [8, 9]	(See par.101.7.2)	Hand Place	4	7	564	0.40
		[-,]	, i i i i i i i i i i i i i i i i i i i	Slip Formed	2	3		
Sanitary Sewer Facilities Structures, manholes and bases.	900	4,000	(See	Hand Place	4	7	658 [6]	0.40
		[8, 9]	par.101.7.2)	Slip Formed	2	3	[-]	
High Early Release Concrete fcr= 3,400 lbs/in ² @ release to service [10]	All	4,000 @ 7	(See	Hand Place	4	7	Design	Design
	applications	davs	par.101.7.2)	Slip Formed	2	3		

1. Use of material(s) not defined by this specification must be approved by the ENGINEER.

2. Maximum size aggregate shall comply with the requirements of par. 101. 4.4.2.

- 3. Portland cement concrete shall be proportioned with Class F fly ash complying with the requirements of 101.6.4, proportioned 1: 4, minimum, fly ash to portland cement, by weight.
- 4. *MR*-Modulus of Rupture, *fc*-compressive strength at 28 days.
- 5. When authorized by the ENGINEER, a high range water reducing admixture (HRWRA), super plasticizer, may be used to increase slump. When a HRWRA is proposed for use on a project. The design mix shall be proportioned to include the HRWRA. The use of a HRWRA in a design mix that was not originally proportioned with a HRWRA is not acceptable under this specification. Higher slump(s) may be used, as directed by the ENGINEER.
- 6. If portland cement complying with ASTM C150 Type VLA is used, a minimum of 564 lbs/cy may be used.
- 7. "w : (c+fa)" is defined as *water to cementitious* materials ratio: w-water; (c+fa)-cementitious material as the sum of the portland cement and fly ash. Units are lbs/yd³.
- 8. Lightweight structural concrete for structures, parking decks, and bridge decks shall be proportioned with a minimum compressive strength of f'c= 4,750 lbs/in² @ 28 days.
- 9. Minimum requirements for prestressed/post tensioned concrete. Actual criteria may differ as specified in the plans and supplemental technical specifications.
- "High Early Release Concrete" may be used where early release of structure to either service or construction loads may be required (< 3 days), as authorized by the ENGINEER. "fcr" is the minimum compressive strength for release, as determined by field cured cylinders. Maximum size aggregate shall be 3/4 inch.
- 11. Designated interior concrete, placed, finished, cured, and maintained by the Contractor in a temperate environment of 40°F or greater, may be constructed with non air entrained concrete complying with all other

requirements of this specification for the calendar period after April 30 and before October 1, as authorized by the Engineer. Concrete for wet exposures, showers and wash down areas, vehicle repair and storage floors shall not be included in this variance.

101.8 BATCHING

101.8.1 Portland cement concrete shall be batched in accordance with the requirements of either ASTM

C94, or ASTM C685, and the requirements of this Specification, as authorized by the ENGINEER. Batching facilities, mixing, and transporting equipment shall be certified within 12 months prior to batching of a design mix. The plant shall be certified by a NM Registered Professional Engineer, to comply with the requirements of this Specification. The certification shall have been competed within 12 months of batching an authorized portland cement concrete design mix. Written certification shall be available for review at the plant by the ENGINEER, and, submitted to the ENGINEER upon request.

101.8.2.1 Ready-mix concrete batch plants shall be certified to comply with the requirements of this Specification. Written certification of compliance shall be available for review at the batch plant by the ENGINEER.

101.8.2.2 Central-Mix Batch Plants shall be certified to comply with this Specification and standards of the National Ready-Mix Concrete Association. The central-mixers rated capacity shall be posted at the batch plant in the operator's area.

101.8.2.3 Portable batch plants shall be certified after erection at a project and prior to batching concrete to be used at the project site. The batch plants rated capacity shall be posted at the batch plant in the operator's area.

101.8.2.4 Ready-mix concrete trucks shall be certified to comply with the requirements of this Specification and the "Standards for Operation of Truck Mixers and Agitators of the National Ready-Mix Concrete Association", and the "Truck Mixer Manufacturer Bureau", latest editions. Written certification of compliance shall be carried in/on the vehicle for verification by the ENGINEER. The manufacturers rated capacity, mixing and agitating speeds shall be posted on the truck mixer. Mixers shall have an operable mixer drum revolution counter and water metering system to measure temper water that may be added to a mixer after batching and prior to discharge of a load.

101.8.2.5 Shrink-mixed concrete batching shall be certified to comply with the requirements of this Specification. Written certification of the program to include a) maximum concrete volume defined for the process/equipment, b) minimum time of mixing in the stationary mixer of materials after the addition of all cementitious material, and, c) minimum supplemental mixing revolutions in the transit mix truck. A copy of the certified procedure shall be shall be available at the batch plant for review by the ENGINEER, and submitted upon request. the ENGINEER shall be notified by the CONTRACTOR in writing which concrete supplied to a project is produced with this procedure. Shrink mixed batching shall not be used on a project without authorization by the ENGINEER.

101.8.2.6 Volume batching central mix and concrete mobile trucks shall be certified to comply with this Specification. Certification shall include

discharge gate settings/material weight batching references for each material carried and a certified water meter and calibration chart to define water settings. Discharge calibration settings shall be established for each production batching rate and authorized design mix batched. The equipment shall be recalibrated if a change in materials or source of materials occurs. Written certification of compliance shall be carried in/on the vehicle for verification by the ENGINEER.

101.8.2.7 On-site batching and mixing equipment for concrete volumes of less than 1 cubic yard shall conform to the requirements of ASTM C192, and shall be approved by the ENGINEER. On-site batched concrete for volumes less than 1 cubic yard shall be either "Redi-2-Mix", "Quikrete", or equal prepackaged concrete mix. The concrete shall be proportioned with water not to exceed a maximum of 1.5 gallons per 60 lbs./bag or equivalent. Concrete batched under this paragraph shall not be used for finished, interior and/or exterior exposed concrete surfaces.

101.9 MIXING

101.9.1 Concrete batched in accordance with ASTM C94, shall be mixed in accordance with the requirements of that Specification and as follows.

101.9.2 Central-Mixed Plants: Concrete mixed in a stationary mixer and transported to the point of delivery shall be mixed from the time all the solid materials are in the drum. The batch shall be so charged with some water in advance of the aggregates and cementitious materials, and all water shall be in the drum by the end of one-fourth the specified mixing time. Mixing time shall be a minimum of 1 minute for the first cubic yard plus 15 seconds for each additional cubic vard, or fraction there of additional capacity. Where mixer performance tests have been conducted in accordance with ASTM C94, with the mixer to rated capacity, the mixing time may be reduced to the time at which satisfactory mixing defined by the performance tests shall have been accomplished. When the mixing time is so reduced the maximum mixing time shall not exceed this reduced time by more than 60 seconds for air entrained concrete. Certified concrete uniformity tests shall be conducted in accordance with ASTM C94. If the uniformity requirements are not met, that mixer shall not be used until the condition is corrected.

101.9.3 Shrink-Mixed Concrete:

Concrete mixed in a shrink mix production program shall be mixed in accordance with the certified shrink mix program as defined by the CONTRACTOR. Concrete shall be mixed in a stationary mixer not less than the certified minimum mixing time after all ingredients are batched into the drum, and not less than the minimum mixing revolutions specified for the transit mix truck after the load is transferred into the transit mix truck. Mixing in the transit mix truck shall not exceed the maximum requirements of paragraph 101.9.4. Shrink-mixed concrete procedures shall be certified to provide concrete that complies with the uniformity specifications of ASTM C94 as determined by uniformity tests specified in ASTM C94, for the maximum batch volume of concrete defined by the CONTRACTOR. If uniformity requirements are not met for the combination of stationary plant and transit mixers , the shrink mix program shall not be used. Tempering of shrink mix concrete at the job site shall comply with the requirements of 101.10 and 101.11.

101.9.4 Truck-Mixed Concrete:

Concrete mixed in a truck mixer shall be mixed after all ingredients including water, are in the drum at least 70 revolutions and not more than 100 revolutions at the mixing speed as defined by the Manufacturer. The mixing speed for the mixer shall be identified on the mixer. Certified concrete uniformity tests shall be conducted on transit mixer trucks in accordance with ASTM C94 and annually. If the uniformity requirements are not met, that mixer shall not be used until the condition is corrected. Mixing beyond the number of revolutions at mixing speed found to produce the required uniformity of concrete shall be at the agitation speed defined by the mixer manufacturer. The manufacturer's recommended mixing and agitation speeds shall be posted on the truck mixer.

101.9.5 Volume Batched Concrete:

Concrete batched in accordance with ASTM C685, shall be mixed in accordance with the requirements of this Specification and the Manufacturer's recommendations. The continuous mixer shall be an auger type mixer or any other type suitable for mixing concrete to meet the requirements for uniformity specified in ASTM C685,

101.10 TEMPERING BATCHED CONCRETE

101.10.1.1 The slump of a concrete mix sampled at final discharge shall comply with the requirements of TABLE 101.C. Non complying material shall be removed from the structure as directed by the ENGINEER.

101.10.1.2 A load of concrete may only be tempered with water after the mix cycle is complete when, upon arrival at the job site, the slump of the concrete is less than specified, and the time limit and revolution limit specified in 101.9 are not exceeded.. When additional water is required, the total water in the truck shall not exceed the maximum water to cementitious ratio specified in the authorized design mix when the concrete is discharged. When tempering is required and allowed as defined by the water to cementitious ratio for the design mix, the water shall be injected into the mixer and the drum or blades turned a minimum of 30 revolutions at mixing speed before discharge as long as the revolution limit specified in 101.9 is not exceeded.. Additional water shall not be added to the batch after tempering without authorization by the ENGINEER.

101.10.1.3 When the slump of a sample taken within the time limits specified in 101.9 the specification requirements of TABLE 101.C, the mixer truck may be mixed a minimum of 15 revolutions at mixing speed, as long as the revolution limit specified in 101.9 is not exceeded, sampled and tested. If the slump of the second sample exceeds the maximum specified slump by 0.25 in (6 mm), the load may be rejected as directed by the ENGEINEER.

101.10.2.1 The air content in air entrained concrete, when sampled from the transportation unit at the point of discharge, shall comply with the requirements of this specification. Non complying material shall be removed from the structure as directed by the ENGINEER.

101.10..2.2 When a preliminary sample taken within the time limits specified in 101.9 and prior to discharge for placement shows an air content below the minimum specified level, the CONTRACTOR may add additional air entraining admixture to achieve the specified air content, if the revolutions on the drum counter are less than 300, and the total revolutions, after air entrainment addition will not exceed 300 following mixing a minimum of 30 revolutions at mixing speed after dosage with the admixture. Additional air entraining admixture may not be added to the batch after the initial air entraining admixture tempering. Air entraining admixture shall be batched in accordance with 101.7.2. In addition to sampling and testing for compliance after tempering with the air entraining admixture, a sample shall be taken during discharge from the second half of the load to verify slump and entrained air compliance through the load with the specification.

101.10.2.3 When the entrained air exceeds the specified requirements, the load may be mixed a minimum of 15 revolutions, sampled and tested, if the drum revolutions do not exceed 300, and will not exceed 300 following mixing. If the entrained air exceeds the specification by 0.1 %, the load may be rejected as directed by the ENGINEER.

101.10.3 High range water reducing admixtures, superplasticizers shall be batched as recommended by the manufacturer.

101.10.4 Aggregates and cementious material may not be used to temper a batched load of portland cement concrete.

101.10.5 All samples shall be tested for slump, entrained air, and unit weight after tempering..

101.10.6 The field dosage amounts of admixtures and water shall be reported on the truck ticket.

101.10.7 The OWNER shall pay for quality assurance sampling and testing specified 101.15, or as directed by the ENGINEER.

101. 11 DELIVERY & DISCHARGE:

101.11.1 Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. These limitations may be waived by the ENGINEER if (1) the concrete is proportioned and certified for use after mixing/agitation time in excess of 1-1/2 hrs, or (2) is of such a slump that it can be placed and finished, without the addition of water to the batch after the time limit noted above is exceeded. In hot weather or under conditions contributing to quick stiffening of the concrete, a time less than 1-1/2 hrs. may be specified by the ENGINEER.

101.11.2 The minimum discharge temperature of concrete in cold weather shall be equal or greater than the temperature specified in Table 101.D.

TABLE 101.D - Cold Weather Construction Concrete Temperature, min [1]

Ambient Air Temperature	Thin Sections	Heavy Sections & Mass Concrete [2]
30 to 45 $^{\circ}$ F	60°F	50°F
0 to 30 $^{\rm O}$ F	65°F	55°F
Below O ^O F	70°F	60°F

- [1] The maximum concrete discharge temperature of all concrete, except "high early release concrete", produced with heated aggregates, heated water, or both, shall be 70°F. The discharge temperature of "high early release concrete" in cold weather shall be 70 °F - 76 °F.
- [2] Sections having dimensions in all directions greater than 2 feet (24 inches)

101.11.3 The discharge temperature of concrete in hot weather should be kept as cool as possible. Concrete supplied to a project site having a discharge temperature greater than 90 °F may be rejected by the ENGINEER if the concrete cannot be placed and finished after a single tempering with water as authorized under 101.10. Retarding admixtures may be used to control setting in hot weather. The discharge temperature of "high early release concrete"in hot weather shall be specified by the CONTRACTOR. 101.11.4 The CONTRACTOR shall provide to the ENGINEER with each batch of concrete batched and/or delivered to the job site, before unloading at the site, a delivery batch ticket on which the information specified in TABLE 101.E is printed, stamped or written, certifying said concrete. One copy of the ticket shall be available for the ENGINEER and one copy of the ticket shall be available for the quality assurance testing program.

TABLE 101.E BATCHING TICKET INFORMATION REQUIREMENTS

- A. Name of Concrete Supplier
- B. Delivery Ticket Number
- C. Date of Delivery
- D. Contractor
- E. Project Name (Optional)
- F. Design Mix Number
- G. Volume of Concrete in Load
- H. Time loaded
- J. Batched Weight (mass) of Cement
- K. Batched Weight (mass) of Fly Ash
- L. Batched Weight (mass) of Fine Aggregate
- M. Batched Weight (mass) of Coarse Aggregate(s)
- N. Batched Weight (mass) or Volume of Each Admixture
- O. Weight or volume of water batched at the plant
- P. Design Mix Target Proportions
- Q. Weight or volume (gal.) of temper water added at the site
- R. Weight or volume of each temper admixture added at the site
- S. Signature and name (printed) of CONTRACTOR'S representative who authorized the tempering, if any, at the site and affiliation to project

101.12 PLACEMENT

101.12.1 Portland cement concrete shall be placed to the lines, sections, grades and elevations, with the procedures specified in the CONTRACT documents. The material shall be consolidated to eliminate all voids, internal rock pockets and defects in the finish concrete. Casting subgrade and formed surfaces shall be damp, at the placement of the concrete. Removable forms shall be treated with a form release agent prior to placement of the forms for ease of removal of the forms without damage to the supported concrete. Forms shall be sealed to prevent leakage. Form release agents shall not stain the adjacent concrete. Placement and finishing shall be completed prior to the start of the initial set of the concrete.

101.12.2.1 The CONTRACTOR shall submit a concrete pumping plan to the ENGINEER for review and authorization one week prior to the start of a pumped concrete construction program for placements complying with 101.1.1. The submittal should identify the pump manufacturer, size and type, rated capacity(s) for the line diameter(s) to be used and distance(s) to be pumped.

101.12.2.2 Pumping shall conform to the recommendations of the pump manufacturer. The pump manufacturer's operation manual shall be available on the pump equipment, and submitted to the ENGINEER, upon request.

101.12.2.3 Concrete shall be pumped in a uniform continuous flow to point of discharge, with all lines kept full, during the pumping operation. The CONTRACTOR shall provide either a system for controlled discharge of the concrete, or the last 5 feet of the pump line, immediately prior to the line discharge opening, shall have a slope equal or less than 10:1, horizontal to vertical, during the pumping of concrete, as authorized by the ENGINEER. The concrete shall not be dropped a vertical distance greater than four feet at discharge from the pump line without a tremey. Concrete placed by pump shall conform to the requirements of this specification after discharge from the pump line. Pumping of concrete shall not commence without authorization by the ENGINEER.

101.13 FINISHING

The CONTRACTOR shall finish Portland cement concrete as required by the CONTRACT documents, Supplemental Technical Specifications, or as directed by the ENGINEER.

101.14 CURING CONCRETE

The CONTRACTOR shall cure concrete as required by the CONTRACT documents, SECTION 349 of this specification, the Supplemental Technical Specifications, or as directed by the ENGINEER. A concrete structure or element shall not be released to service loads until it has achieved a minimum of 85% of the design strength, f'c, at the time the structure is placed in service, or the curing program specified in SECTION 349 is completed, or as directed by the ENGINEER. Service loads shall include construction loads, design loads and environmental exposure.

101.15 QUALITY ASSURANCE SAMPLING AND TESTING

101.15.1.1 Quality assurance sampling and testing shall be performed in accordance with the requirements of this Specification, the Supplemental

Technical Specifications, or as required by the ENGINEER. Concrete shall be sampled and tested by a technician/engineer certified as either an ACI certified Concrete Field Testing Technician Grade I, or the equivalent National Institute for Certification of Engineering Technologies Technician, with Specialty Concrete Work Elements Level I 82001, 82002, and Level II 84002, 84003, 84004, 84010.

101.15.1.2 Quality assurance testing and analysis shall be performed in a laboratory accredited in accordance with the requirements of the New Mexico State Highway and Transportation Department "Procedure for Approval of Testing Laboratories to Perform Inspection, Testing, and Mix Design Services", April 13, 1998 Edition, under the direct supervision of a New Mexico Registered Professional Engineer.

101.15.1.3 Testing equipment used in the performance of specified testing shall be calibrated annually with calibration standards traceable to the National Bureau of Standards. Certification records shall be maintained at the laboratory for review by the ENGINEER. A copy of the certifications shall be submitted upon request to the ENGINEER. Quality assurance testing shall be directed by the ENGINEER and paid by the OWNER

101.15.2.1 Samples will be taken in the field by the ENGINEER, in accordance with ASTM C172, at discharge to the structure/application after all tempering at the job site has been completed.

101.15.2.2 A sample shall be taken for each design mix of concrete placed each day, once for each 100 cu yd of concrete, once for each 5000 sq.ft. area of slabs or walls, or fractions thereof, whichever is greater, or as directed by the ENGINEER. Hi-lo thermometers will be provided by the CONTRACTOR to monitor field curing concrete temperatures and companion test specimens while in the field, as directed by the ENGINEER.

101.15.3 Slump tests will be performed on each quality assurance sample in the field in accordance with ASTM C143. Concrete used for slump tests shall not be used in specimens for strength tests. The slump shall not exceed the maximum value defined in TABLE 101.C plus 0.25 in (6 mm). Slumps shall be reported to the nearest 1/4 inch (1 mm).

101.15.4 Entrained air tests will be performed on each quality assurance sample in accordance with the requirements of ASTM C231 for normal weight concrete, and ASTM C173, light weight concrete as specified in TABLE 101.C. Concrete used for entrained air tests shall not be used in specimens for strength tests. The entrained air shall not be less than the minimum nor greater than the maximum entrained air specified plus 0.1 %. Entrained air shall be reported to the nearest one tenth of one percent.

101.15.5.1 The cement content per cubic yard for a load of concrete shall be determined on each quality assurance sample in accordance with ASTM C138. The unit weight shall be reported to the nearest one tenth of a pound per cubic foot (one kilogram per cubic meter). The cement factor shall be reported to the nearest pound per cubic yard (kilogram per cubic meter).

101.15.5.2 The portland cement content per cubic yard for a load of concrete shall be calculated by dividing the batched weight of the portland cement reported on the truck ticket for the load represented by a quality assurance test sample, by the yield, in cubic yards, determined in 101.15.1. The cement content shall be reported to nearest one pound per cubic yard. The portland cement content shall not be less than the minimum cement content for the application specified in TABLE 101.C.

101.15.5.3 The water to cementitious ratio for a load of concrete sampled and tested under this specification shall be calculated by comparing the total water in a load, by weight, the batched water reported on the load's batch ticket plus any water added in the field, to the sum of the portland cement and fly ash reported on the batch ticket. The weight of the water shall be divided by the weight of the cementitious materials and reported to the nearest one hundredth value (xx.xx). The water to cementitious ratio shall be less than or equal to the water to cementitious ratio for the application specified in TABLE 101.C.

101.15.6 A non complying field test, slump test, entrained air test, cement content, shall be verified by sampling and testing a second sample from the same load represented by the non complying sample/tests. If the second sample/tests determine the material is in compliance, the load may be authorized for placement and the all quality assurance tests required shall be performed. If the second test confirms the initial test results, the concrete load may be rejected as directed by the ENGINEER. If the second test confirms the initial sample non complying test, the second sampling and testing shall be payed by the CONTRACTOR, as specified. The OWNER shall pay for all complying test.

101.15.7.1 Quality assurance compressive strength concrete specimens/cylinders shall be molded in accordance with ASTM C31. Cylinders shall be sealed metal or plastic molds complying with ASTM C31. The specimens will be submerged in water during the initial field curing at the site when the average ambient temperature is equal or greater than 60 °F, site conditions permitting, as directed by the ENGINEER. If the initial field cure submersion procedure is not used, high-low thermometers shall

be used to monitor the initial field cure temperature of the quality assurance specimens, and the recorded temperatures shall be reported in the sampling and testing report. If the curing temperature recorded on the high-low thermometer exceeds 85 °F, concrete compressive test strengths shall be reported as information only, and the lab of record shall revise the initial cure procedure for the assurance specimens to control the curing temperature to less than 85 °F. Cylinders left in the field longer than the maximum specified time shall be so identified and reported "for information only". A sample may be taken to the testing laboratory for testing and casting provided the cylinders can be molded within 15 minutes after sampling.

101.15.7.2 Strength specimens shall be molded and tested in accordance with ASTM C31, C39, C78 & C93, C192, and this specification. The number and type of compressive strength test cylinders shall be a minimum of four (4) 6"dia. x 12"H cylinders for channel concrete, and normal concrete with nominal maximum size aggregate of 1.5 inch to 2.0 inch. The number and type of compressive strength test cvlinders shall be a minimum of four (4) 4" dia x 8" cylinders for normal concrete with nominal maximum size aggregate 1 inch and less. The number and type of cylinders shall be a minimum of six (6) 4" dia x 8" cylinders for high early release concrete compressive strength tests. The number and type of Modulus of Rupture flexure test beams shall be a minimum of three (3) 6"x6"x42" beams or equivalent for Modulus of Rupture Tests, as directed by the ENGINEER. Strength specimens shall be cast using concrete from the same load as the concrete field tests. When 4"dia. x 8" cylinders are used, they shall be cast in two equal lifts, each lift rodded twenty five times with a three eights inch (9.5 mm) diameter rod with a three eights inch (9.5 mm) semi spherical tip. The rodding of a lift placed on a lift of concrete shall penetrate into the top of the preceding lift.

101.15.7.3 When strength tests are required for stripping of forms or release of structure, a minimum of 2 test specimens complying with the specimen type specified in 101.15.7.2 for each test shall be molded and cured at the site under the same conditions as the concrete represented by the specimens. The specimens shall be returned to the Lab at the end of the field curing period and tested in accordance with ASTMC39. The test strength shall be the average of the test strengths of the two specimens. The critical concrete compressive strength (f_c) shall be a minimum of 85% of the specified design strength.

101.15.7.4 Concrete strength test specimens shall be tested at 7 days and 28 days. One specimen shall be tested at 7 days and 2 specimens shall be tested at 28 days, and reported to the Engineer. The test strength shall be the average of the test strengths of the two specimens tested at either 28 days, or as specified in the Supplemental Specifications, drawings, or by the ENGINEER.

101.15.7.5 High early release concrete strength test specimens shall be tested at 3, 7, and 28 days for concrete. One specimen shall be tested at 3 days and 2 specimens shall be tested at 7 and 28 days, and reported to the ENGINEER. The test strength for high early release concrete shall be the average of the test strengths of two specimens tested at 7 days, or as specified in the Supplemental Specifications, drawings.

101.15.8. Not Used.

101.15.9.1 Evaluation and acceptance of concrete shall meet the criteria established in Chapter 5, Section 5.6, "Evaluation and acceptance of concrete," ACI 318-89. Each strength test result shall be the average of two cylinders from the same sample tested at 28 days or the specified age. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength tests results equal or exceed the required f'c and no individual strength test result falls below the required f'c by more than 500 psi. Quality assurance compressive strength specimens sampled and cast when the average ambient temperature is greater than 60 °F, and cured with an initial field cure procedure other than submersion method specified in

101.15.7.1, shall be evaluated using the highest curing temperature recorded by the high-low thermometer provided for the field cure and Table 101.E. The test compressive strength shall be compared to the estimated strength corresponding to the highest initial cure temperature indicated in Table 101.E. An assurance compressive strength test shall be equal or greater than the compressive strength defined by Table 101.E when the initial field cure temperature is equal or greater than 85 °F and the initial field cure is not the submerged method specified in 101.15.7.1.

TABLE 101.E

MINIMUM COMPRESSIVE STRENGTH, f_C

°F [2]	73	80	85	90	95	100	105	110	115	120
Cure Day(s)	P _{TI} , % of Specified Strength, f' _c [1,3]									
3	100	108	114	120	122	123	125	120	115	110
7	100	101	102	103	100	98	95	91	78	75
28	100	97	95	93	90	88	85	82	78	75

 $f_c P_{TI} x f'_c / 100$, psi

Notes: 1. Reference ACI 306, 6.6.1

2. The Non Submerged assurance cylinder cure recorded maximum initial field cure temperature. If a high-low thermometer was not used, the highest ambient temperature recorded for the initial cure period by the national weather service will be used as the initial cure temperature. 3. f_c specified compressive strength

101.15.9.2 If individual tests of either laboratory-cured specimens produce strengths more than 500 psi (3.4 MPa) below f'c, or, if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is adequate. If the presence of low-strength concrete is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled from the area in question shall be required in accordance with ASTM C42, as directed by the ENGINEER. Three cores shall be taken for each case of an individual cylinder test more than 500 psi (3.4 MPa) below f'c or where the average of any set of three consecutive strength test results is below f'c. If the

concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 °f and relative humidity less than 60 percent) for seven days before test and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet. If coring is required a coring plan will be prepared by the ENGINEER no later than 42 calendar days after the placement date. Coring shall be completed and a report submitted no later than 56 calendar days after placement. Core sampling for non complying tests shall be taken at the direction of the ENGINEER and paid by the OWNER. The CONTRACTOR shall be responsible for material replacement of the same design mix in adjacent concrete at no cost to the OWNER where samples are removed.

101.15.9.3 Concrete in the area represented by core tests shall be considered structurally adequate if the average strength of three (3) cores is equal or greater than 85% of the specified design strength (f'c), and no single core has a compressive strength less than 75% of the specified design strength. To check testing accuracy, locations represented by erratic core strength may be retested. If these strength acceptance criteria are not met by the core tests, and if structural adequacy remains in doubt, The OWNER and ENGINEER may order load tests as outlined in Chapter 20, ACI 318 for the questionable portion of the structure. Load tests shall be

paid for by the CONTRACTOR.

101.15.9.4 If the structure under consideration does not satisfy the above strength acceptance criteria or the criteria of Section 20.2 or 20.4, ACI 318 The OWNER may order The CONTRACTOR to remove and replace any portion of the structure which is not in compliance with the above. If so ordered, the CONTRACTOR shall perform such work at his own expense. The CONTRACTOR shall patch all core sample holes with the same or similar materials adjacent to the core hole. The patching concrete shall be placed and cured in accordance with the requirements of this specification.

101.15.10 TEST REPORTS

101.15.10.1 Test reports shall include but not limited to the following, as directed by the ENGINEER.

- A. Field Data
 - 1 Date of Sampling
 - 2 Time of Sampling
 - 3 City of Albuquerque Project or
 - 4 City of Albuquerque project or Permit Number
 - 5 Contract Title
 - 6 Portland Cement Concrete Supplier
 - 7 Delivery Ticket Number
 - 8 Design Mix Number
 - 9 Sampling location as defined by the Project Plans and Specifications
 - 10 Ambient temperature at time of sampling, ^oF
 - 11 Material temperature at time of sampling, ^OF
 - 12 Mixer drum revolution count at start of discharge of concrete

В.	Field Tests Results, with specifications.	Accuracy		
	1 Slump, in (mm)	0.25	1	
	2 Entrained Air, %	x	x.x	
	3 Unit Weight, pcf (kg/m ³)	XXX.X	(xxxx)	
	4 w:(c+fa) ratio	X.XX	X.XX	
	5 Cement Factor, C.F., lbs/yd ³ (kg/m ³)	XXX	(xxxx)	

6 Cement pay factor determined in accordance with 101.16.2

- C. Comments
 - 1 Report any addition of water and materials and amounts by either volume or weight, prior to and after sampling.
 - 2 Report mixer revolutions count at time of discharge.
 - 3 Record number of mixer revolutions after field tempering with water and/or admixtures, and @ what mixer speed, mixing or agitating speed.
- D. Laboratory Tests
 - 1 Calendar reference and day count from date of sampling for each strength test sample
 - 2 fc compressive strength test result reported to psi/ MPa1013 M.R. Modulus of rupture reported to psi/ MPa50.5

E. Analysis & Certification

The testing laboratory shall provide certification the sampling and testing were performed in compliance with the requirements of the specifications. Certification shall be provided by the New Mexico Registered Professional Engineer in direct responsible charge of the laboratory testing program.

101.15.10.2 Test results shall be reported to the ENGINEER, CONTRACTOR, concrete supplier and OWNER in writing, within 7 working days of completion of the test, as directed by the ENGINEER. Non-complying tests shall be reported within one working day of completion of the test.

101.16 MEASUREMENT AND PAYMENT

101.16.1 Measurement for Portland cement concrete supplied under this specification shall be by LOTS as the area, volumes, and as specified in the contract documents, as directed by the ENGINEER.

101.16.2 Payment for Portland cement concrete supplied under this specification shall be for each LOT, at the contract unit price adjusted in accordance with the

formula below and TABLE 101.F, as directed by the ENGINEER. A LOT shall be defined as either the volume or area of concrete for each design mix placed on a project in a day as defined in the CONTRACT. The adjusted unit price shall be calculated using the formula below and the pay factor, CF_P, defined in TABLE 101.F. The pay factor shall be defined by the number of samples representing a LOT, and, the % variance of the mean/average (M) portland cement content of the LOT from the minimum cement content specified in TABLE 101.C for the application, as determined by field quality assurance sample test results. Acceptance samples for a LOT shall be sampled and tested in accordance with 101.15. All acceptance samples taken in one day for a type of concrete shall represent a LOT of that type of concrete.

UP' = PF X UP UP', Adjusted Contract Unit Price PF, Pay Factor , PF= $0.50 \times (1.00 + CF_P)$ UP, Contracted Unit Price

n, number of samples	Deficiency, $D = (C - M)/C$	CF _P
3, OR MORE	D 0.0	1.00
	0.0 < D 1.0	1.00
	1.0 < D 2.0	0.95
	4.0 < D 6.0	0.90
	6.0 < D 8.0	0.85
	8.0 < D 10.0	[1]
	D > 10.0	Remove and Replace

TABLE 101.F - CEMENT PAY FACTOR CALCULATION, CFP

D, Deficient cement content as % of C, minimum

C, Minimum cement content specified for the application in TABLE 101.C

M, Average or mean (M) cement factor for a LOT. The cement factor shall be calculated as the average of cement factors of all tests taken for a LOT, but not less than three tests, determined in accordance with 101.15.6.

[1] If determined by the ENGINEER to be more practical to accept the material, the LOT may be accepted under written agreement between the OWNER and the CONTRACTOR at an assigned pay factor CFp= 0.70.

SECTION 102

STEEL REINFORCEMENT

102.1 GENERAL

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed; and before being placed in any concrete work shall be cleaned of all rust, mill scale, mortar, oil, dirt, or coating of any character which would be likely to destroy, reduce, or impair its proper bonding with the concrete. No reinforcing steel will be accepted under this specification until it has been approved by the ENGINEER as conforming with requirements prescribed therefor. When required by the ENGINEER, the CONTRACTOR or vendor shall furnish samples thereof for testing and notify the ENGINEER as to when and where they will Such samples shall be be available. expense furnished at the of the CONTRACTOR or vendor, but the cost of any testing that may be required will be borne by the OWNER. Samples shall only be taken in the presence of the ENGINEER. The CONTRACTOR shall furnish a certificate mill test report for each heat or size of steel when required by the ENGINEER.

102.2 REFERENCES

102.2.1 ASTM

A 82	A 615
A 185	A 616

102.2.2 ACI

318

102.3 BAR REINFORCEMENT

102.3.1 Reinforcing steel bars shall be deformed intermediate grade billet steel conforming with ASTM A 615. Rail steel conforming with ASTM A 616 may be permitted by the ENGINEER. The Grade shall be 40 or 60, unless Grade 60 is specified on the standard detail drawings or on the construction plans.

102.3.2 In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

102.3.3 Bending of steel will conform to requirements of ACI 318. The various grades of steel shall not be used interchangeably in structures. If rail steel is used, shop and field bending shall comply with the following provisions:

102.3.3.1 Continuous and uniform application of force throughout the duration of the bending operation.

102.3.3.2 Unrestricted movement of the bar at points of contact with the apparatus.

102.3.3.3 Close wrapping of the specimen around the pin or mandrel during the bending operations.

102.3.4 Bending or straightening of reinforcing steel shall be accomplished in such a manner and by such means as to insure that no damage to the material will result as a consequence thereof. Bars shall not be heated to perform bending of bars. Kinked bars shall not be used.

102.3.5 Cutting reinforcement steel or wire by means of a cutting torch is prohibited.

102.3.6 Welding of reinforcing steel or wire is prohibited.

102.4 WIRE REINFORCEMENT

Wire reinforcement shall, in all respect, fulfill requirements prescribed in ASTM A 82.

102.5 WIRE MESH REINFORCEMENT

Mesh reinforcements shall conform to ASTM A 185. The gauge of the wire and the dimensions of the mesh will be specified in the Supplementary Specifications or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during the necessary handling. The effective cross- sectional area of the metal shall be equal to that specified or indicated on the plans.

102.6 WIRE TIES

Wire for ties shall be black, annealed, not lighter than 16 gauge.

102.7 CHAIRS

Chairs used for support or spacer of reinforcement shall be approved by the ENGINEER.

102.8 MEASUREMENT AND PAYMENT

Steel reinforcement will be included in the measurement for reinforced concrete per cubic yard or square yard in place, unless otherwise stipulated in the Bid Proposal. Payment will be made at the unit price per cubic yard or square yard as defined in the bid proposal.

SECTION 105

CONCRETE CURING COMPOUND

105.1 GENERAL

This section shall govern the type of concrete curing compound used, in curing fresh concrete. The curing compound shall consist of a liquid which, when applied to fresh concrete by means of a spray gun, will form an impervious membrane over the exposed surfaces of the concrete.

105.2 REFERENCES

105.2.1 ASTM

C-156 C-309 E-97

105.2.2 This Publication

Section 111

105.3 MATERIALS

105.3.1 Curing compound shall be Type 2, White Pigmented as specified in ASTM C-309, unless modified on the plans or the Supplemental Technical Specification, or as approved by the ENGINEER.

105.3.2 When required, the curing compound manufacturer shall supply certification, to the ENGINEER that his product has been tested and complies with ASTM C-309 and for Type 2 compounds, ASTM E-97.

105.3.3 EXCEPTION: Type 2, White Pigmented curing compound shall not be used on colored concrete. The curing compound used on colored concrete shall be as specified in Section 111.

105.4 APPLICATION

The curing compound shall be applied so as to form a uniform, continuous, unbroken film over the concrete surface. The rate of application shall be per the manufacturer's recommendations but in no case greater than 250 square feet per gallon.

105.5 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for curing compound. The cost of the curing compound and its application shall be included in the cost of the work it is applied too.

CEMENT MORTAR AND GROUT

106.1 GENERAL

Cement mortar prepared under this specification shall consist of a mixture of cementitious materials, aggregate, and water.

106.2 REFERENCES

106.2.1 ASTM		
	C 5	C 207
	C 91	C 266
	C144	C 270

106.2.2 This publication

SECTION 101

106.3 DESIGNATIONS

106.3.1 The designation of cement mortar according to type listed in the following tabulation indicates the proportions of materials to be used in the preparation thereof; the proportions indicated are on a volume basis. The type of mortar to be used shall be as specified in Tables 106.3.1.1, 106.3.1.2, as shown on the plans, or as approved by the ENGINEER

106.3.2 Grout shall be Type M mortar, unless otherwise approved by the ENGINEER. Neat cement grout shall consist of cement mixed with water as necessary to obtain a fluid and workable mix.

106.4 CEMENT AND LIME

Cement to be used shall conform with the requirements in Section 101. Masonry cement shall conform to ASTM C 91. Quicklime shall conform to ASTM C 5. Hydrated lime shall conform to ASTM C 207.

106.5 AGGREGATES

Aggregates to be used shall conform with ASTM C 144.

106.6 WATER

Water shall be clean and free of deleterious amounts of acids, alkalis, or organic materials.

106.7 ADMIXTURES OR MORTAR COLORS

Admixtures or mortar colors shall not be added to the mortar at the time of mixing unless approved by the ENGINEER and, after the materials are so added, the mortar shall conform to the requirements of this specification.

106.8 ANTIFREEZE COMPOUNDS

No antifreeze liquid, salts, or other substances shall be used in mortar to lower the freezing point.

106.9 MORTAR FOR REPAIRING SPALLED AREAS AND FOR NOSING GROUT.

Mortar shall have a fast setting Portland cement base, no metallic additives, and shall mix, place and finish similar to regular concrete. It shall develop minimum compressive strengths (psi) of 3200 @ 24 hr. and 4500 @ 7 days. The mortar shall meet the resistance to the action of freeze-thaw cycles as ascertained using the rapid method outlined in ASTM C-266 and shall show no excessive spalling after 300 cycles of rapid freezing and thawing in water.

106.10 MEASURING AND MIXING OF MATERIALS

106.10.1 The method of measuring materials for the mortar used in construction shall be such that the specified portions of the mortar materials can be controlled and accurately maintained.

106.10.2 All cementitious materials and aggregate shall be mixed for a least 3 minutes with the maximum amount of water to produce a workable consistency in a mechanical batch mixer.

106.10.3 Mortars that have stiffened because of evaporation of water from the mortar shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2 1/2 hours after initial mixing.

106.11 TESTS

The mortar shall be designed and the laboratory mix tested in accordance with ASTM C 270.

106.12 MEASUREMENT AND PAYMENT

106.12.1 Measurement and payment for mortar and grout used in repair of spalled areas and for joint nosing material in drainage channels shall be by the square foot and shall include all chipping, sawing, sandblasting, and materials and work required for the completion of the repair. 106.12.2 No separate measurement and payment will be made for mortar and grout in other applications unless designated by the ENGINEER.

106.12.3 Grout shall be Type M mortar, unless otherwise approved by the ENGINEER. Neat cement grout shall consist of cement mixed with water as necessary to obtain a fluid and workable mix.

106.14 CEMENT AND LIME

Cement to be used shall conform with the requirements in Section 101. Masonry cement shall conform to ASTM C 91. Quicklime shall conform to ASTM C 5. Hydrated lime shall conform to ASTM C 207.

106.15 AGGREGATES

Aggregates to be used shall conform with ASTM C 144.

106.16 WATER

Water shall be clean and free of deleterious amounts of acids, alkalis, or organic materials.

106.17 ADMIXTURES OR MORTAR COLORS

Admixtures or mortar colors shall not be added to the mortar at the time of mixing unless approved by the ENGINEER and, after the materials are so added, the mortar shall conform to the requirements of this specification.

106.18 ANTIFREEZE COMPOUNDS

No antifreeze liquid, salts, or other substances shall be used in mortar to lower the freezing point.

106.19 MORTAR FOR REPAIRING SPALLED AREAS AND FOR NOSING GROUT.

Mortar shall have a fast setting Portland cement base, no metallic additives, and shall mix, place and finish similar to regular concrete. It shall develop minimum compressive strengths (psi) of 3200 @ 24 hr. and 4500 @ 7 days. The mortar shall meet the resistance to the action of freeze-thaw cycles as ascertained using the rapid method outlined in ASTM C-266 and shall show no excessive spalling after 300 cycles of rapid freezing and thawing in water.

106.20 MEASURING AND MIXING OF MATERIALS

106.20.1 The method of measuring materials for the mortar used in construction shall be such that

the specified portions of the mortar materials can be controlled and accurately maintained.

106.20.2 All cementitious materials and aggregate shall be mixed for a least 3 minutes with the maximum amount of water to produce a workable consistency in a mechanical batch mixer.

106.20.3 Mortars that have stiffened because of evaporation of water from the mortar shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2 1/2 hours after initial mixing.

106.21 TESTS

The mortar shall be designed and the laboratory mix tested in accordance with ASTM C 270.

106.22 MEASUREMENT AND PAYMENT

106.22.1 Measurement and payment for mortar and grout used in repair of spalled areas and for joint nosing material in drainage channels shall be by the square foot and shall include all chipping, sawing, sandblasting, and materials and work required for the completion of the repair.

106.22.2 No separate measurement and payment will be made for mortar and grout in other applications unless designated by the ENGINEER.

TABLE 106.3.1.1 MORTAR TYPES

Mortar Type	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate, Measured In A Damp, Loose, Condition
М	1	1 (type II)	0	Not less than 2 1/4 and not
М	1	0	1/4	more than 3 times the sum
S	1/2	1 (type II)	0	of the volumes of the cement
S	1	0	Over 1/4 to 1/2	and lime used.
Ν	0	1 (type II)	0	
Ν	1	0	Over 1/2 to 1 1/4	
0	0	1 (type I or II)	0	
0	1	0	Over 1 1/4 to 2 1/2	
К	1	0	Over 2 1/2 to 4	

TABLE 106.3.1.2 MORTAR TYPE VS STRENGTH

Mortar Type	Average Compressive Strength
	<u>at 28 days, psi</u>
М	2,500
S	1,800
Ν	750
0	350
K	75

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 these specifications. 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 109.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.B.

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 determine 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 TI03, 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 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

C	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

MAXIMUM VARIATION RIPRAP DESIGNATION 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 122

PLASTIC LINER PLATE

122.1 GENERAL

These specifications include material requirements and installation of the plastic liner plate.

122.2 REFERENCES

122.2.1 ASTM

D 1243

122.3 MATERIALS

122.3.1 PROPERTIES OF MATERIALS:

122.3.1.1 The materials used in all sheets of plastic liner plate and in all joint, corner, and welding strips shall be a polyvinyl chloride resin and other necessary ingredients compounded to make permanently flexible sheets and strips which are impermeable to Copolymer resins will not be sewage. permitted. Polyvinyl chloride shall constitute not less than 99 percent by weight, of the resin used in sheets and joint strips. The resin shall have a specific viscosity of 0.40 when measured in accordance with Standard Method of Test ASTM D 1243 and a 10 gram sample of the resin when heated in a 30 cu. cm. crucible at 100 degrees C for one hour shall have a loss not exceeding 0.7 percent. The resin used in welding and corner strips and other accessory pieces shall be of the highest molecular weight that is compatible with field welding.

122.3.1.2 The material used in joint strips and in plain sheets of plastic liner plate shall be identical to that used in sheets having locking extensions.

122.3.1.3 The CONTRACTOR shall submit to the ENGINEER manufacturer's certifications of compliance of each type of plastic liner sheet and strip proposed for use, together with a list of all ingredients from which the sheets and strips are to be compounded. The list shall show the percentage of use of each ingredient. 122.3.1.4 The samples will be subjected to the tests set forth hereinafter; and when the samples and their ingredients have been approved, no changes will be permitted without prior approval by the ENGINEER.

122.3.1.5 The samples shall show no significant changes when exposed to soaps; detergents; animal, vegetable, or mineral oils, fats, greases, or waxes; enzymes of sewer bacteria and fungi; or water solutions of any of the following chemicals at 85 degrees F:

<u>Concentration</u>
(Percent)
1
1
20
1
5
5

122.3.1.6 All plastic liner plate sheets; joint, corner, and welding strips; and accessories shall have the following physical properties when tested at 70 degrees F:

Tensile strength, minimum --- 2000 psi Elongation at break, Minimum --- 200 percent

<u>Shore Durometer (Type D) Readings</u> <u>Instantaneous</u> 50 minimum 60 maximum

<u>10 Seconds</u> 35 minimum 50 maximum

122.3.1.7 Liner plate locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicular to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature between 70 degrees F to 80 degrees F inclusive.

122.3.1.8 All plastic liner plate sheets, including locking extensions, and joint, corner, and welding strips shall be free of

cracks, cleavages, or other defects adversely affecting corrosion resistance or required strength. The ENGINEER may authorize the repair of defects by approved methods.

122.3.1.9 Specimens taken at any time prior to final acceptance of the work from sheets and strips, when tested in accordance with tests specified herein-before, shall show no greater reduction in quality or change in dimensions than the reduction in quality and change in dimensions shown by the original approved samples when tested.

122.4 DETAILS AND DIMENSIONS

122.4.1 APPROVAL OF DETAILS: The CONTRACTOR shall submit for approval by the ENGINEER 30 days prior to any manufacturing of material, drawings showing details of liner plate, joint, corner, and other accessory plastic strips and devices. Such details shall conform to the requirements of these specifications and applicable provisions of the standard plans showing liner plate installation methods.

122.4.2 THICKNESS OF MATERIAL: Liner plate which is to be locked in concrete by means of integral extensions embedded in the concrete shall have a minimum thickness of 0.065 inch. Liner plate which is to be bonded to concrete or steel surfaces by means of adhesive shall have a minimum thickness of 0.075 inch. Welding strips shall have a minimum thickness of 0.125 inch plus or minus 0.031 inch.

122.4.3 SHEET AND STRIP SIZE: Sheets of liner plate used for pipe and cast-inplace sewers shall not exceed 16 feet 4 inches in length measured along the conduit. Sheets of liner plate for all other construction shall not exceed 16 feet by 16 feet. Said permitted maximum size shall be reduced where necessary to produce satisfactory results. Large sheets shall be formed by lapping basic size sheets a minimum of 1 inch in fusing the sheets together in such a manner as to produce a continuous welded joint. Specimens taken from welded joints shall show no cracks or separation and shall be tested in tension after flexing. Fach specimen shall withstand a minimum load of 132 pounds per linear inch of weld or the product of 1800 and the minimum thickness

in inches of the material adjoining the weld, whichever is greater. The thickness shall be taken within a 1 inch gauge length. The composition, corrosion resistance, and impermeability of specimens taken from the welded joints shall comply with the requirements of Subsection 122.3 above. Evidence of tears, cracks, or separation in the laps will be cause for rejection. Joint strips shall be four inches plus or minus 1/4 inch in width. Welding strips shall be one inch plus or minus 1/8 inch in width. Joint strips shall have each edge beveled prior to application. All welding and outside corner strips shall have edges beveled at time of manufacture. Sloping of the longitudinal terminal edges of liner plate at designated variations in circumferential coverage shall be as specified under Subsection 122.8 herein.

122.4.4 LOCKING EXTENSIONS: All liner plate applied to concrete shall have integral locking extensions embedded in the concrete, except that liner plate may be bonded to concrete surfaces with an adhesive if such is specifically shown on the plans, set forth in the Supplementary Specifications. or permitted by the ENGINEER. Locking extensions shall be of the same material as that of the liner plate, shall be integrally molded to or extruded with the sheets of liner plate, shall have an approved cross section with a minimum height of 3/8 inch and a minimum web of 0.090 thickness inch. shall be approximately 2 1/2 inches apart, and shall be such that when the extensions are embedded in concrete the liner plate will be held permanently in place. Locking extensions shall be parallel and shall be continuous except where omitted for joints and transverse weep channels. Weep channels which involve the omission of one inch of locking extensions as described in Subsection 122.8 herein may be made during the manufacture of liner plate. A locking extension shall be provided along all lower, terminal oblique, or longitudinal edges of liner plate.

122.4.5 PROVISIONS FOR STRAP CHANNELS: Unless alternate methods are approved by the ENGINEER, liner required to be secured to the inner form with straps shall have strap channels at not more than 20 inches on center perpendicular to the locking extensions. The channels, one-inch wide maximum, shall be formed by removing the locking extensions at strap locations so that a maximum of 3/16 inch of the base remains in the strap channel. Strap channels shall not be provided in the final two locking extensions adjacent to the terminal edge of the liner coverage.

122.5 TESTS

All liner plate shall be shop tested for holes, using an approved spark detector with a minimum of 20,000 volts. Sheets having holes shall be satisfactorily repaired in the shop and retested prior to shipping the sheets to the job site or the pipe manufacturing plant. Shop welds shall be subjected to testing for composition of the material after the weld has been made and for corrosion resistance, impermeability, and strength. Samples of liner plate shall be taken at the point of manufacture each week during production of sheet and strip material. These samples will be submitted to the ENGINEER for testing as provided in these specifications.

122.6 ADHESIVE

Adhesives used on liner plate shall be limited to those products made by the liner plate manufacturer specifically for use with the liner plate. Adhesives, solvents, and activators proposed for use shall be submitted to the ENGINEER for testing prior to use.

122.7 INSTALLATION OF PLASTIC LINER PLATE--GENERAL

112.7.1 INSPECTION: Wherever possible, liner plate shall be applied and secured to the forms and inspected and approved prior to the placement of reinforcing steel.

122.7.2 QUALIFICATIONS OF INSTALLERS:

122.7.2.1 APPLICATORS: The application of plastic liner plate to forms and other

surfaces shall be considered as highly specialized work, and personnel performing this type of work shall be trained in methods of installation and demonstrate their ability to the ENGINEER.

122.7.2.2 WELDERS: Each welder shall successfully pass a welding test before making any field weld and may be retested at any time deemed necessary by the ENGINEER. All test welds shall be made in the presence of the ENGINEER and shall consist of the following: Two pieces of liner plate, at least 15 inches long and 9 inches wide, shall be lapped 1 1/2 inches and held in a vertical position. A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner plate. Each end of the welding strip shall extend at least two inches beyond the liner plate to provide tabs. The weld specimen shall be submitted to the ENGINEER and tested as follows: Each welding strip tab, tested separately, shall be subjected to a 10 pound pull normal to the face of the liner plate with the liner plate being held firmly in place. There shall be no separation between the welding strip and the liner plate when the welding tabs are submitted to the test pulls. Three test specimens shall be cut from the welded sample tested in tension across the welds. If none of these specimens fail in the weld or within 1/2 inch adjacent to either edge of the weld when the specimens are individually subjected to a pull of 132 pounds per linear inch of weld or the product of 1800 and the minimum thickness in inches of the material adjoining the weld, whichever is greater, the weld will be considered as satisfactory in The thickness used will be the tension. minimum measured within a 1 inchgauge length. If one of the specimens fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory. A disgualified welder may submit a new welding sample when, in the opinion of the inspector, he has had sufficient off-the-job training or experience to warrant re-examination.

122.8 PLACING LINER PLATE

122.8.1 COVERAGE: Liner plate shall cover, as a minimum, the areas shown on the plans to be lined. The variation in circumferential coverage at each longitudinal terminal edge of adjoining sheets of liner plate shall not exceed one inch or one percent of the inside diameter of pipe. whichever is greater. In the case of cast-in-place conduits, the inside height of the conduit shall be used in lieu of pipe diameter allowable in determinina variation in circumferential coverage. At a station where there is a difference in coverage, as shown on the plans, and the longitudinal terminal edges of liner plate downstream from said station are lower than those upstream, the terminal edges of the liner plate installed in the section of pipe or structure immediately upstream from the station shall be sloped uniformly for the entire length of the section of pipe or structure from the limits of the smaller coverage to those of the greater coverage. Wherever the longitudinal terminal edges of liner plate downstream from the station are higher than those upstream, the slope shall be accomplished uniformly throughout the length of the section of pipe or structure immediately downstream from the station. An approved locking extension shall be provided along all tapered lower terminal edges of liner plate.

122.8.2 POSITIONING LINER PLATE: All liner plate installed in pipe shall be positioned so that the locking extensions are parallel with the axis of the pipe. Liner plate shall be centered with respect to the "T" of the pipe when the inner form is positioned. Liner plate shall be set flush with the inner edge of the bell end of the pipe section and shall extend to the spigot end or to approximately four inches beyond the spigot end, depending upon the type of liner plate joint to be made with adjoining pipe. All liner plate installed in a cast-in-place sewer shall be positioned so that the locking extensions are parallel to the axis of the sewer, and all liner plate installed in other sewer structures shall be positioned with locking extensions horizontal unless otherwise indicated on the plans or in the Supplementary Specifications. Liner plate sheets shall be closely fitted to inner forms. Sheets shall be cut to fit curbed and warped surfaces using a minimum number of

separate pieces. The CONTRACTOR shall furnish field sketches to the ENGINEER showing the proposed layout of liner plate sheets for cast-in-place sewerage structures. The sketches shall show the location and type of all field welds. The ENGINEER may require the use of patterns or the markings of sheet layout directly on the forms where complicated or warped surfaces are involved. At transverse joints between regular size sheets of liner plate, the space between ends of locking extensions, measured longitudinally, shall not exceed four inches. Where sheets are cut and joined for the purpose of fitting irregular surfaces, this space shall not exceed two inches.

SECURING LINER PLATE IN 122.8.3 PLACE: Liner plate shall be held snugly in place against inner forms by means of light gauge steel wire, light steel banding straps, or other approved means. Banding straps or wire shall be located in strap channels to prevent crushing or tilting the extensions. Means approved by the ENGINEER shall be provided, if necessary, to prevent crushing or tilting locking extensions on extruded sheets. Where the form ties or form stabilizing rods pass through liner plate, provisions shall be made to maintain the liner plate in close contact with the forms during concrete placement.

WEEP CHANNELS: 122.8.4 At 8-foot intervals longitudinally along liner plate installed in sewers, a gap not less than one inch nor more than four inches wide shall be left in all locking extensions to provide an unobstructed transverse weep channel. Any area behind liner plate which is not properly served by regular weep channels shall have additional weep channels one inch wide provided by cutting away locking extensions. Provisions shall be made to permit water behind the liner of concrete manhole shafts to drain into the weep channels of the lined sewer. A transverse weep channel shall be provided approximately twelve inches away from each liner plate return where surfaces lined with plastic liner plate join surfaces which are not so lined. As a part of the work of installing liner plate, all outlets of transverse weep channels shall be cleared of obstructions which would interfere with their proper function.

122.8.5 LINER PLATE RETURNS: A liner plate return shall be installed wherever required as shown on the plans and wherever surfaces lined with plastic liner plate join surfaces which are not so lined, such as brick, clay pipe, cast-iron pipe, manhole frames, and metal, or clay tile gate guides. Unless otherwise indicated by the plans, the Supplementary Specifications, or the plans showing liner plate installation methods, returns shall be made as follows: Each liner plate return shall be a separate strip of liner plate at least four inches wide joined to the main liner plate by means of approved corner strips. Corner strips shall be continuously welded to the return and to the main liner plate and applied wherever possible from the back of the lining. Locking extensions shall be provided on returns to lock the returns to the concrete or plastic lined, cast-in-place structures. Locking extensions will not be required on liner plate returns installed on lined precast concrete pipe. Each liner plate shall be sealed to adjacent return construction with which it is in contact by means of a chemically resistant elastomeric material recommended by the manufacturer of the liner plate. If the joint space is too wide or the joint surfaces too rough to allow satisfactory sealing with this material, the joint space shall be filled with two inches of densely caulked cement mortar, lead wool, or other caulking material approved by the ENGINEER and finished with a minimum of one inch of an approved corrosion resistant material.

122.8.6 CORNERS: Liner plate corners shall be installed as detailed on the plans. If not so detailed and if the corner is a straight line, liner plate may be bent around the corner provided that the liner plate can be bent and secured in the forms in such a manner as to produce a satisfactory corner in the opinion of the ENGINEER. The radius of such a bend in liner plate shall not exceed one inch. Bending of liner plate to form a liner plate return will not be permitted. A separate liner plate return shall be installed at said locations in accordance with requirements specified in Subsection 122.8.5.

122.9 CONCRETE OPERATIONS

122.9.1 CONCRETE PLACEMENT: Concrete placed against liner plate shall be carefully vibrated so as to avoid damage to the liner plate and to produce a dense, homogeneous concrete securely anchoring the locking extensions into the concrete. External vibrators shall be used if deemed necessary by the ENGINEER. If steel stiffener rods are used along locking extensions of liner plate installed in forms for pipe, they shall be completely withdrawn during the placement of concrete in the forms. The concrete shall be revibrated to consolidate the concrete in the void spaces caused by the withdrawal of the stiffener rods.

122.9.2 REMOVING FORMS: In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the liner plate shall be pulled without tearing the liner plate and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of serious abrasion of the liner plate shall be marked.

122.10 JOINING LINER PLATE

122.10.1 GENERAL: No field joint shall be made in liner plate until the lined sewer or structure has been backfilled and flooding required therefor has been completed. Liner plate at joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made. Hot joint compounds shall not be brought in contact with liner plate. No coating of any kind shall be applied over any joint, corner, or welding strip, except where nonskid coating is applied to liner plate surfaces.

PIPE IN 122.10.2 FIELD JOINT INSTALLATION: Field joints in liner plate at pipe joints shall be one of the following types: Type P-1--A Type P-1 joint shall consist of a four-inch joint strip, centered over the mortared pipe joint and secured along each edge to adjacent liner by means of a welding strip. Type P-2--A Type P-2 joint shall be made with an integral part of the liner plate extending four inches beyond the spigot end of the pipe, overlapping the liner plate downstream from the pipe joint and secured to the downstream liner by means of a welding strip. The four-inch strip of liner plate

extending beyond the spigot end of the pipe shall be devoid of locking extensions and shall be protected from damage during pipe handling and jointing operations. Excessive tension and distortion in the strip caused bybending it back sharply at the end of the pipe will not be permitted. Any four-inch integral joint strip which has been bent and held back during pipe laying and jointing operations shall be released well in advance of making the liner plate joint to allow the strip to return to its original shape and flatness. On beveled pipe, the liner plate extension at the spigot end of the pipe shall be trimmed to extend four inches beyond and parallel to the beveled end. Joints between lined pipe and lined cast-in-place structures shall be either Type C-1 or Type C-2 specified hereinafter.

FIELD JOINTS IN 122,10.3 CAST-IN-PLACE STRUCTURES: Field joints in liner plate on cast-in-place structures shall be one of the following types: Type C-1--A Type C-1 joint shall be made in the same manner as a Type P-1 joint. The width of the space between adjacent sheets of liner plate in a Type C-1 joint shall not exceed 1/2 inch. This type of joint is the only type permitted as transverse contraction joints in concrete. Its only other use is for joints between pipe and cast-in-place structures. Type C-2--A Type C-2 joint shall be made by over- lapping sheets not less than 1 1/2 inches and securing the overlap to the adjacent liner plate by means of a welding strip. The upstream sheet shall overlap the downstream sheet. The length of that part of the overlapping sheet not having locking extensions shall not exceed four inches. A welding strip shall be applied to the back of the joint if necessary to prevent leakage of concrete. This type of joint may be used at any transverse liner plate joint other than those at transverse contraction joints in concrete and shall be used for liner plate joints made at longitudinal joints in concrete. Type C-3--A Type C-3 joint shall be made by butting sheets of liner plate together and applying a welding strip over the back of the joint before concrete is poured and applying a welding strip over the front of the joint after concrete is poured. A Type C-3 joint will not be permitted at a transverse joint which extends to a lower terminal edge of liner plate or any joint where the gap between adjoining sheets of liner plate exceeds 1/8 inch.

122.10.4 INSTALLATION OF WELDING STRIPS: Welding strips shall be fusion welded to joint strips and liner plate by qualified welders using only approved methods and techniques. The welding operation of any joint shall be continuous until that joint has been completed.

122.11 APPLICATION OF LINER PLATE TO CONCRETE SURFACES BY MEANS OF ADHESIVE

122.11.1 Application and bonding of liner plate to concrete surfaces by means of adhesive shall be accomplished by the following steps: The concrete surface shall be etched in lieu of being sandblasted. After the sand blasting, the concrete surface shall be thoroughly cleaned of dust. Surfaces etched with acid shall be thoroughly washed with clear water after the etching and thoroughly dried before applying primer.

Grouting Procedure - All concrete imperfections such as water and air pockets in poured concrete surfaces must be filled with cement grout. The concrete surface shall then receive two brush coats of an approved primer. Coverage shall not exceed 250 square feet per gallon for each coat. The first coat of primer shall be thinned with an equal amount of approved thinner. The first primer coat shall be permitted to dry for at least two hours before the application of the second primer coat. The second coat of primer shall be applied unthinned and permitted to dry for at least four hours. Brush apply one coat of manufacturer's recommended 19Y primer (at approximately 250 square feet/ gallon). The concrete surface and the back surface of the liner plate shall each be given one coat of an approved adhesive. Coverage shall not exceed 250 square feet per gallon for each coat.

122.11.2 One coat of an approved activator shall be applied to both the underside of liner plate and the adhesive coated concrete. Application of activator shall be limited to the extent that the application of coated liner plate can be completed within a 20-minute period. The activator shall be applied evenly by brushing. Coverage of activator shall not exceed 500 square feet per gallon. When the surface of the adhesive is barely tacky to the touch, the liner plate shall be positioned with one edge firmly pressed down. The liner plate shall then be rolled into place, care being taken to avoid the formation of air pockets. All joints shall be tight-fitting butt joints. The surface of the liner plate shall be rubbed vigorously to secure the liner plate firmly in place. Corner and welding strips shall be positioned over all joints and welded in place. No adhesive shall be applied to liner plate or to any of the liner plate strips which willdeleteriously affect the plate or strips in any way. Adhesive shall not be applied to the surfaces of concrete at liner plate joints or to the surfaces of liner plate or joint strips opposite said mortar and concrete surfaces.

122.12 NONSKID SURFACES

All surfaces of liner plate shown on the plans to be nonskid shall be treated as follows: After all corner and welding strips have been installed, the surface of the liner plate shall be cleaned, dried, and sprayed with an adhesive coating recommended by the manufacturer of the liner plate. The surface shall then be liberally sprinkled with clean, dry, well-graded sand, all of which will pass a No. 40 sieve but be retained on a No. 70 sieve. After the sanded surface has thoroughly dried, all excess sand shall be brushed away and a seal coat of the coating shall be sprayed over the sand in sufficient quantity to coat and bond the sand to the liner plate. The coat sand surface shall be allowed to dry thoroughly before any walking is permitted thereon.

122.13 APPLICATION OF LINER PLATE TO STEEL

Fabrication and welding of steel to be lined with plastic liner plate shall be completed before the liner is installed. Steel surfaces to which plastic liner is to be applied shall be sandblasted, leaving surfaces free of all mill scale, rust, grease, moisture, and other deleterious substances. All interior welds shall be ground smooth and all weld spatter removed. The application of primer unthinned, adhesive, and liner plate to steel surfaces shall conform to the requirements set forth herein for bonding of liner plate to concrete surfaces with adhesive. Field joints shall be tight-fitting butt joints. After the liner plate has been applied to steel surfaces, corner strips, or welding strips shall be applied over all joints and welded in place.

122.14 PROTECTION AND REPAIR OF LINER PLATE

All necessary measures and precautions shall be taken to prevent damage to liner plate from equipment and materials used in or taken through the work. Any damage to installed liner plate shall be repaired by the CONTRACTOR in accordance with the requirements set forth herein for the repair of liner plate. All nail and tie holes and all cut, torn, and seriously abraded areas in the linerplate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. The use of this method is limited to patches which can be made with a single welding strip. The use of parallel, overlapping, or adjoining welding strips will not be permitted. Larger patches may consist of smooth liner plate over the damaged area with edges covered with welding strips fused to the patch and to the liner plate adjoining the damaged area. The size of a single patch of the latter type shall be limited only as to its width, which shall not exceed four inches. Wherever liner plate is not properly anchored to concrete or wherever patches larger than those permitted above are necessary, the repair of liner plate and the restoration of anchorage shall be as directed by the ENGINEER.

122.15 FIELD TEST

All liner plate, when installed, will be tested by the CONTRACTOR in the presence of the ENGINEER, using a spark type detector set at a minimum of 20,000 volts. All areas of liner plate failing to meet the field test shall be properly repaired and retested.

122.16 MEASUREMENT AND PAYMENT

Measurement for furnishing and installing plastic liner plate shall be included in the payment for the pipe or structure required to be lined, unless a different measurement is stipulated in the Bid Proposal.

SECTION 123

REINFORCED CONCRETE PIPE

123.1 GENERAL

123.1.1 These specifications cover reinforced concrete pipe intended to be used for the construction of storm drains, sewers, and related structures.

123.1.2 The size and class of the concrete pipe to be furnished shall be as shown on the plans or as specified under the item of work for the project of which the pipe is a part.

123.1.3 Unless otherwise specified, pipe will shall be either cast, spun, or manufactured by an approved equal method.

123.1.4 The interior surface shall be smooth and well finished. Joints shall be of such type and design and so constructed as to be adequate for the purpose intended so that, when laid, the pipe will form a continuous conduit with smooth and uniform interior surface.

123.1.5 Bell and spigot shall be free from any deleterious substance or condition which might prevent a satisfactory seal at the joints.

123.1.6 Pipe stronger than that specified may be furnished at the manufacturer's option and at his own expense, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

123.1.7 Reinforced concrete pipe utilized for sanitary sewers shall be fully lined with no longitudinal seams in accordance with Section 122.

123.2 REFERENCES

123.2.1 ASTM:

C-33	
C-76	
C-150	C-260
C-361	C-441
C-443	C-494
C-618	

123.2.2 American Concrete Pipe Association (ACPA)

Concrete Pipe Design Manual

123.2.3 This Publication Section 102 Section 122

123.3 PIPE LINE LAYOUTS

123.3.1 When specials and radius pipe and/or fittings are required, the required number of sets of the pipe line layout be furnished to the ENGINEER prior to the manufacture of the concrete pipe. Storm inlet or inlet connector pipe need not be included in the pipe line layout; however, pipe stubs shall be included. In lieu of including storm inlet connector pipe line layout, a list of storm inlet connector pipes shall accompany the layout. The connector pipe list shall contain the following information:

123.3.1.1 Size, class. and wall type.

123.3.1.2 Station at which pipe joins main line.

123.3.1.3 Number of sections of pipe, length or section, type of sections (straight. horizontal bevel, vertical bevel, etc.).

123.4 MATERIALS

123.4.1 Reinforced Concrete Pipe shall consist of a mixture of Portland cement, water aggregates, and admixtures, proportioned and manufactured accordance with the requirements of ASTM C76, latest edition, and this specification. The pipe shall be certified in accordance with the requirements of these specifications. Certification of compliance shall be submitted by the CONTRACTOR and approved by the ENGINEER prior to manufacture of the Reinforced Concrete Pipe, Reinforced Concrete Pipe shall not be
used on a project without written approval of the ENGINEER.

123.4.2 Portland cement shall comply either with the requirements of ASTM C 150. Types I, II, III, and V, Low Alkali (LA) cements, or as specified herein. in the Supplementary Technical Specifications, plans, or as approved by the ENGINEER. CONTRACTOR The shall submit certification of compliance signed by the cement manufacturer, identifying the cement type and source (plant location), stating the portland cement used in the Reinforced Concrete Pipe delivered to the project complies with this specification. Portland cement concrete used in the manufacture of Reinforced Concrete Pipe shall have a minimum cemetitious content of 470 lbs./cu.yd.. except as either specified herein, as specified in the Supplemental Technical Specifications, or as approved by the ENGINEER. Portland cement shall be of the same source and type for all Reinforced Concrete Pipe delivered to a project.

123.4.2.1 Portland cement concrete for Reinforced Concrete Pipe shall be proportioned to provide a minimum cemententitious content of 470 lbs./c.y. (5 sks/c.y.) and a maximum water (W) to cementitious material ratio by weight, W:(C+FA)=0.40. Cementitious material shall consist of portland cement and class F fly ash complying with this specification. The fly ash shall be proportioned to provide a fly ash (FA) to portland cement (C) ratio by weight of 1:5, minimum.

123.4.3 Mineral admixtures shall be "Class F fly ash" and comply with the requirements of ASTM C 618 including Table 4 "Supplementary Optional Physical Requirements."

- A. Uniformity requirements, air entraining agent dosage for 18.0% vol of mortar, shall not vary by more than 20%
- B. Reactivity with cement alkalies: Reduction of mortar bar expansion at 14 days, minimum (ASTM C441) 65%

Reactivity with cement alkalis shall be determined in accordance with the requirements of ASTM C44I, using DOW CORNING glass rod base for aggregates. The CONTRACTOR shall submit certification of compliance identifying the type fly ash and source (plant location), stating the fly ash used in the Reinforced Concrete Pipe delivered to the project complies with this specification. Fly ash shall be of the same source and type for all Reinforced Concrete Pipe delivered to the project.

123.4.4 Admixtures of any type, shall not be used without written approval of the ENGINEER. The CONTRACTOR shall submit certification of compliance signed by the admixture manufacturer, identifying the admixture and its source (plant location), stating the admixture(s) used complies with this specification. Admixtures shall be of the same source for all reinforced concrete Pipe delivered to a project.

123.4.4.1 Air entraining admixtures shall be used in all Reinforced Concrete Pipe provided under this specification. It shall conform to the requirements of ASTM C 260. Entrained air content shall comply with the following requirements:

Nominal Max Size Aggregate Air Cont. Range

(inches)	(%)
3/8, 1/2 & 3/4	4 - 8
1	4 - 7
1-1/2	3 - 6

or as required by the Supplementary Technical Specifications, on the plans and/or as approved by the ENGINEER.

123.4.4.2 Chemical admixtures shall conform to either the requirements of ASTM C 494, and/or as specified in the Supplementary Technical Specifications, on the plans, and/or as approved by the ENGINEER.

123.4.4.3 Neither calcium chloride nor noncalcium chloride accelerating admixtures shall be used in Reinforced Concrete Pipe provided to a project under this specification.

123.4.4 Aggregates shall be assumed to be alkali-reactive. Variance for a specific aggregate may be approved by the Engineer upon written request by the CONTRACTOR and submittal of test data, as required by the ENGINEER. Aggregates shall comply with the requirements of ASTM C 33 and ASTM C 76 and as specified herein. Aggregates shall be of the same source and type for all Reinforced Concrete Pipe manufactured and delivered to the project.

123.4.5 Reinforcement shall comply with the requirements of this specification and Section 102. The CONTRACTOR shall submit certification of compliance signed by the reinforcement manufacturer, identifying the material and its source (plant location), stating the reinforcement complies with this specification. Reinforcement shall be of the same source for all Reinforced Concrete Pipe delivered to the project.

123.5 CAUSES FOR REJECTION

Such inspection of pipe as may be deemed necessary by the ENGINEER will be made at the place of manufacture and pipe may be rejected for any of the reasons described in ASTM C 76, unless it can be repaired in accordance with the requirements noted therein and the approval of the ENGINEER.

123.6 ACCEPTANCE

Basis of acceptance shall be in compliance with ASTM C 76.

123.6.1 D-LOAD BEARING STRENGTH METHOD

123.6.1.1 The ENGINEER will select at random at the point of manufacture test specimens of the pipe to be furnished for the project.

123.6.1.2 The required number of test specimens and the test pipe shall conform in all respects to the applicable requirements of ASTM C 76. The pipe shall be tested by one of the two standard methods of testing; namely, (A) the three-edge bearing, (B) the sand bearing, as prescribed in ASTM C 76, and the required strength of the pipe specimens undergoing the bearing tests shall conform with the D-Load requirements designated therein.

123.6.2 STRUCTURAL DESIGN METHOD:

Where structural details of the pipe are shown on the plans, the manufacture of pipe shall be checked by making the appropriate tests on the concrete placed in the pipe forms, by inspection of the steel reinforcing cages that are to be used in the pipe. and by inspection of the fabrication of the pipe.

123.6.3 "DOWNGRADING" OF PIPE:

123.6.3.1 For the purpose of these specifications, "downgraded" pipe shall be defined as pipe which is to be used under loads less than that for which they have been designed.

123.6.3.2 Pipe manufactured in accordance with these specifications which have not met their designed test loads may be "downgraded" by the ENGINEER and used provided that:

123.6.3.2.1 Enough load tests are made to establish the load under which they may be used. The number of tests to be made shall be as determined by the ENGINEER; this may require the testing of each section for acceptance.

123.6.3.2.2 The comply with the test and inspection requirements of these specifications.

123.6.3.3 Individual specimens of pipe embodying major repairs or having numerous hairline cracks extending the full length of the section on the inside of the pipe at the minor axis or on the outside of the pipe at the major axis may be tested for acceptance at the discretion of the ENGINEER.

123.6.4 STOCKPILED PIPE:

123.6.4.1 Stockpiled pipe may be used only when approved by the ENGINEER provided the pipe meets all other specified requirements.

123.6.4.2 For the purpose of these specifications, "stockpiled" pipe shall be defined as pipe manufactured in quantity which will meet requirements of this section but which was not manufactured for use in specific projects; however, pipe which has been rejected by another agency will not be considered as "stockpiled" pipe. nor will such pipe be accepted.

123.7 JOINTS

123.7.1 For circular pipe, rubber gasket joints shall be required. Such joints shall conform to the requirements of ASTM C 443 and the requirements set forth in this document. The joint shall be designed for not less than 15%, or more than 50% deformation of the rubber gasket when the off-center pipe is joined with all manufacturing tolerances considered. Minimum manufacturing tolerances shall be assumed to result in a centered annular space of 1.75 times the nominal design annular space. Joint mating surfaces shall be parallel and not be greater than 3.5° slopes. In addition to the hydrostatic joint test requirements per ASTM C 443, the pipe shall be loaded to cause maximum joint annular space to occur at the top. The pipe shall then be subjected to an internal hydrostatic pressure of 13 psi for 10 minutes. The test set up shall include a minimum of (2) pipe sections per lot. Bulkheaded end joints are acceptable, only mating pipe joints are allowed. Moisture or beads of water appearing on the surface of the joint will not be considered as leakage. If leakage of joints should initially occur, the manufacturer shall have the option to allow the pipe to soak under pressure for up to 24 hours and then retest. Any leakage during such retest will constitute failure of the test.

Pipe with beveled ends or pipe joints specifically designed to allow unsymmetrical joint closure may be provided for use around curves, the radii of which are shown on the drawings. Unless otherwise shown on the plans or specified in the Supplementary Specifications, either one or both ends may be beveled up to a maximum of 5 degrees. as required to provide well fitted joints. Beveled ends may conform to the Typical Method of Designing Curved Concrete Pipe sewers, as shown in the ACPA Concrete Handbook. Deflections per joint shall be limited to the manufacturer's standards for each particular diameter and type of pipe used.

123.7.2 For elliptical or arch reinforced concrete pipe, the joints shall be either bell and spigot or tongue and groove. Mastic material, such as RAMNEK, KENT SEAL, or approved equal, will be used to seal the joints.

123.7.3 Cement mortar joint fillers will not be accepted for round, elliptical, or arch reinforced concrete pipe.

123.7.4 If required by the ENGINEER to meet specified laying tolerances, the pipe shall be "match marked" at the place of manufacture, and laying diagrams furnished to the CONTRACTOR by the manufacturer shall be subject to approval by the ENGINEER.

123.8 DIMENSIONS

123.8.1 LENGTH

123.8.1.1 The nominal length shall be as supplied by the manufacturer unless otherwise specified in the Supplementary Technical Specifications on the plans or required for bends or special joints.

123.8.1.2 Except for special shapes, the plain of the ends of the pipe shall be perpendicular to the longitudinal axis of the pipe, with the exception that variations in laying lengths of two opposite sides of pipe shall be not more than 1/8 inch per foot of diameter with a maximum of 5/8 inch in any length of pipe.

123.8.2 WALL THICKNESS

The wall thickness of pipe shall conform to the requirements indicated for Wall B or Wall C. reinforced concrete pipe specified in ASTM C 76 unless otherwise specified.

123.9 REINFORCEMENT

Fabrication and placement of reinforcement for the various sizes and strengths of pipe shall conform to the applicable requirements of ASTM C 76.

123.10 CURING REQUIREMENTS

The pipe shall be cured in conformance with the applicable requirements of ASTM C 76.

123.11 MARKINGS:

123.11.1 Each section of pipe shall be conformance with marked in the of ASTM C 76. The reauirements at the ENGINEER mav place of manufacture, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

123.11.2. If the pipe is subsequently rejected, the mark placed thereon by the ENGINEER shall be defaced. No pipe will be marked, "Reject." Only pipe accepted shall be marked, "Accepted ."

123.12 LOW-HEAD PRESSURE PIPE

Reinforced concrete low-head pressure pipe shall conform to the requirements of ASTM C 361.

123.13 SELECTION FOR CLASS OF PIPE

123.13.1 The classes of reinforced concrete pipe and the D-Load to produce a 0.0l-in. crack for each class of pipe are specified in ASTM C 76.

123.13.2 The appropriate formulas, tables and figures contained in the "Concrete Pipe Design Manual," prepared by the American Concrete Pipe Association, will be used, to determine the class of pipe to be installed between manholes or for a culvert. It is essential that maximum trench width, class of bedding and soil weight be considered in the pipe class selection.

123.13.3 The construction plans will indicate the following information for each length of pipe between manholes or for a culvert: the nominal diameter of the pipe, the class of pipe, the class of bedding and the maximum trench width at top of pipe.

123.14 MEASUREMENT AND PAYMENT

123.14.1 The measurement and payment for the materials specified in this section will be made as specified in section will be made as specified in the applicable section of these specifications or as specified in the supplemental technical specifications or as called for in the plans and as shown in the Bid Proposal.

SECTION 161

GRAY IRON CASTINGS

161.1 GENERAL

161.1.1 Gray iron castings shall be as shown on the construction plans or the Standard Detail Drawings, and shall be as specified herein. The castings may include: rockers, rocker plate bearings, bearing plates, manhole frames and covers, water valve frames and covers, railings, railing posts, wheel guards, gratings, etc.

161.1.2 The castings shall be true to patterns in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted at angles, and risers shall be sharp and true.

161.2 REFERENCES

161.2.1 ASTM

A 48 A 438

161.3 TEST SPECIMENS

161.3.1 The number of tension test specimens and their machined dimensions shall be as specified in ASTM A 48.

161.3.2 Depending on the configuration and use of the castings, the ENGINEER may specify that transverse tests of the casting material shall be made in accordance with ASTM A 438. These tests shall be made in addition to the tensile tests.

161.3.3 The manufacturer shall furnish a notarized certificate of compliance which states that the casting material meets or exceeds the requirements for the specified class of material. Test results shall be included with the certificate. The CONTRACTOR shall forward the manufacturer's certificate of compliance and test results to the ENGINEER for each project on which the castings are installed. The CONTRACTOR shall also furnish the ENGINEER with a copy of the manufacturer's shop drawing at the time the certificate of compliance is submitted.

161.4 MANHOLE FRAMES AND COVERS

161.4.1 Castings shall conform to ASTM A 48, Class 30B.

161.4.2 The frame and cover dimensions shall conform to the dimensions shown on the Standard Detail Drawing.

161.4.3 The bearing surfaces of the frames and covers shall be machined or ground to provide a uniform, flat, non-rocking seat for the cover on the frame.

161.4.4 The contact sides of the frame and cover shall be tapered as shown on the Standard Detail Drawing.

161.4.5 Manhole frame shall weigh a minimum of 140 pounds and cover shall weigh a minimum of 170 pounds.

161.4.6 The word "WATER", "SEWER", or "STORM" shall be cast on the manhole cover to indicate the respective system and the name of the city. The letter size shall be 1 inch in height. The words shall be placed as shown in the Standard Detail Drawing. In addition the name of the foundry shall be cast on the top of the cover, either in the center or within one of the inner concentric circles.

161.5 WATER VALVE FRAME AND COVER

161.5.1 Castings shall conform to ASTM A 48, Class 30B.

161.5.2 The frame and cover dimensions shall conform to the dimensions shown on the Standard Detail Drawing.

161.5.3 The bearing surfaces of the frames and covers shall be machined or ground to provide a uniform, flat, non-rocking seat for the cover on the frame.

161.5.4 The word, "WATER", shall be cast on the cover. The letter size shall be 1 inch in height and shall be placed as shown on the Standard Detail Drawing. In addition the initials of the foundry shall be cast on the top of the cover opposite the word, "WATER".

161.6 RAILINGS, RAILING POSTS, AND WHEEL GUARDS

Castings shall conform to ASTM A 48, Class 40B.

161.7 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES

161.7.1 Castings shall conform to ASTM A 48, Class 50B.

161.7.2 Castings shall be machined and finished as specified on the plans. Tool marks on sliding contact surfaces shall run in the direction of plate movement, and in case of rocker plate bearings marks shall be perpendicular to the rocker movement.

161.8 UNCLASSIFIED CASTINGS

All castings, not specifically classified, shall conform to the minimum requirements of ASTM A 48, Class 30.

161.9 COATINGS

Manhole frames and covers, and other castings will show bare metal. If specifically required, the castings shall be painted with or dipped in commercial quality asphaltum paint.

161.10 ORIGIN OF MANUFACTURE

To ensure that the specified quality of castings will be guaranteed, only castings manufactured in the United States of America will be acceptable.

161.11 MEASUREMENT AND PAYMENT

Measurement and payment shall be per unit price per defined unit in the bid proposal, or the cost of the castings may be included in major construction item unit cost, such as manhole frame and cover may be included in the cost of the manhole.

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 Clearing and grubbing shall be in specified. 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.

SECTION 204

FILL CONSTRUCTION

204.1 GENERAL

Fill construction shall consist of constructing roadway embankments (including the preparation of areas upon which they are to be placed), 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.

204.2 REFERENCES

204.2.1 ASTM

D 1557 D 4254

204.3 PLACING

204.3.1 Unless otherwise specified, the upper 6 inches of the original ground area upon which fills are to be constructed shall be compacted to a density of not less than 90 percent of maximum density as determined by ASTM D 1557, or in soils containing less than 5 percent passing the #200 sieve, a minimum relative density of 70 percent as determined by ASTM D 4254.

204.3.2 Rocks, broken concrete, or other solid materials which are larger than 4 inches in greatest dimension shall not be placed in fill areas where piles are to be placed or driven.

204.3.3 When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built 1/2 width at a time, the slopes of original hillsides and old or new fills shall be started wherever the vertical cut of the next lower bench intersects the existing ground.

204.3.4 Material thus cut out shall be recompacted along with the new embankment material at the CONTRACTOR's expense, unless the width of the bench required exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

204.3.5 Clods or hard lumps of earth of 6 inches in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph.

204.3.6 When the fill material includes large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be

placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within 2 feet of the finished grade of the fill.

204.3.7 Embankment construction shall not be performed when material is frozen.

204.4 COMPACTING

204.4.1 Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception.

204.4.2 Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable material in a uniformly distributed layer of a thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

204.4.3 The placing and compacting of approved material within the project (where unsuitable material has been removed, and the filling of holes, pits and other depressions has been accomplished) shall conform to all of the requirements herein specified for compacting fills.

204.4.4 The loose thickness of each layer of fill material before compacting shall not exceed 8 inches, except as provided in the following paragraph for rocky material. The ENGINEER may authorize roadway fill materials to be placed in layers in excess of 8 inches thickness if the CONTRACTOR can demonstrate that the required compaction can be achieved for the full depth of the lift. However, in no case shall the loose layer exceed 24 inches. Each layer shall be compacted in accordance with the following requirements to a density of not less than 90 percent of maximum density, as determined by ASTM D 1557, or in soils containing less than 5 percent passing the #200 sieve, a minimum relative density of 70 percent as determined by ASTM D-4254. In areas of new or widened roadways and required appurtenances, the density of the upper 12 inches shall not be less than 95 percent as determined by ASTM D 1557.

204.4.5 When fill material contains by volume over 25 percent of rock larger than 6 inches in greatest dimension, the fill below a plane 3 feet below

finished grade may be constructed in layers of a loose thickness before compaction not exceeding the maximum size of rock in the material but not exceeding 3 feet in thickness. When more than 65 percent is retained on the No. 4 sieve, moisture and density control is not required.

204.4.6 The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken portland cement concrete obtained from the project excavation will be permitted in the fill with the following limitations.

204.4.6.1 The maximum dimensions of any piece used shall be 6 inches.

204.4.6.2 Pieces larger than 4 inches shall not be placed within 12 inches of any structure.

204.4.6.3 Pieces larger than 2 1/2 inches shall not be placed within 12 inches of the subgrade for paving.

204.4.6.4 "Nesting" of pieces will not be permitted.

204.4.7 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 relative compaction.

204.4.8 At the time of compaction the moisture content of fill material shall be optimum plus or minus 2 percent. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the unit price per Bid Proposal and no additional compensation will be allowed. Fills shall be maintained to the grade and cross sections shown on the plans until the acceptance of the contract.

204.5 MEASUREMENT AND PAYMENT

Fill construction shall include excavation, placement, compaction and all related work, and shall be measured in place after compaction. Payment will be made on the unit price per cubic yard for compacted fill unless otherwise noted on the Bid Proposal.

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-Valve 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 sha11 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, sidewa1ks, 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 +/-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 and CONTRACTOR 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 410

FENCES

410.1 GENERAL

This work shall consist of the construction of fences and gates in substantial compliance with the specifications, lines, and grades shown on the plans or established by the ENGINEER.

410.2 REFERENCES

410.2.1 ASTM:

A1	A 153
A 36	A 392
A 116	A 499
A 120	A 525
A 121	A 569
A 123	B 209

- 410.2.2 AASHTO:
 - M 111 M 133 M 181

410.2.3 COMMERCIAL STANDARD, U.S. DEPT. OF COMMERCE: 184 246

410.3 MATERIALS

410.3.1 GENERAL:

410.3.1.1 The CONTRACTOR shall submit the required number and type of test certificates to the ENGINEER certifying that the fencing materials conform with the requirements herein provided. When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the ENGINEER has the opportunity to check for compliance prior to or during incorporation of materials in the work.

410.3.1.2 All materials shall be new and without flaws or defects of any type.

410.3.2 WIRE FENCE

410.3.2.1 WIRE:

410.3.2.1.1 Barbed wire shall conform to ASTM A 121, Class 3, coating and shall consist of two strands of 12-1/2 gauge wire with 4-point 14-gauge round barbs spaced approximately 5 inches apart. In lieu of Class 3 galvanizing, the wire may be coated with aluminum alloy at the rate of not less than 0.30 ounce per square foot of wire surface and the barbs at the rate of not less than 0.25 ounce per square foot of wire surface.

410.3.2.1.2 Woven wire shall conform to ASTM A 116, design number 832-6-11 (shown in Appendix Table) or as shown on the plans, Class 3 coating or coated with aluminum alloy at the rate of not less than 0.25 ounce per square foot of wire surface. The height shall be 32 inches.

410.3.2.1.3 Staples for fastening fence wire to wood posts shall be galvanized 9 gauge, 1 1/2 inches long.

410.3.2.1.4 Brace wire shall be 9 gauge, galvanized and shall be used in the construction of braces and intermediate braces when wood posts are used.

410.3.2.1.5 Tie wires for fastening barbed wire or woven wire to steel posts shall be not less than 12-1/2 gauge and galvanized. Eleven gauge or heavier wire fasteners or metal clamps may be used in lieu of tie wires when approved by the ENGINEER. Aluminum tie wires will not be accepted.

410.3.2.1.6 Stays for barbed wire fences shall be not less than 9-1/2 gauge galvanized wire conforming with ASTM A 116 and of length and spacing shown on the plans. 410.3.2.2 POSTS: Corner, brace, intermediate brace, gate, and line posts shall be metal or wood and of the type, size, and length shown on the plans and as herein provided.

410.3.2.2.1 Metal posts and braces shall be fabricated from rail, billet, or commercial grade steel conforming with any of the following ASTM Designations: A 1, A 499, and ASTM A 120 (for pipe posts) or Commercial Standard 184, published by the U.S. Department of Commerce and shall be aalvanized or painted as reauired. Galvanizing shall conform with ASTM A 123 painting shall conform with the and requirements shown on the plans. Corner, gate, and intermediate brace posts shall be tubular, section, or angles of the type and dimensions shown on the plans. Corner, gate and intermediate brace posts and braces shall be set in concrete as shown on the plans. Line posts shall have a minimum weight of 1.33 pounds per foot exclusive of anchor plates. A minus tolerance of not to exceed 5 percent of the minimum weight of each post will be permitted. A plus tolerance of 2 inches and a minus tolerance of 1 inch in the length of each post will be permitted. Line posts may be I-beam, T-beam, U-beam, Y-bar, or H-column section. Line posts shall be provided with corrugations, lugs, ribs, or notches spaced approxi- mately 1 inch on centers to engage the required fence wire in designated spaces. Posts with punched tabs intended to be crimped around the wire will not be accepted. Anchor plates shall have an area of not less than 19 square inches, shall weight not less than 0.64 pound each, and shall be securely welded, bradded, or riveted to each line post.

410.3.2.2.2 Wood corner. brace. intermediate brace, gate and line posts shall be southern yellow pine, lodgepole pine, or ponderosa pine and of the length and dimensions shown on the plans. Posts shall be cut from live trees and shall be straight and free from decay and other defects. Line posts may have a single crook in one direction but shall not vary more than 1 1/2 inches from a straight line connecting both ends of the post. All bark shall be peeled and the posts trimmed and smooth of all knots and projections, and both ends of the posts shall be sawed off perpendicular to the centerline.

410.3.2.2.3 Wood corner, brace, intermediate brace, and gate posts shall be of the length shown on the plans. The average

nominal diameter of the top of each post shall be not less than 6 inches. The circumference of corner, brace, intermediate brace, and gate posts shall be measured 6 inches below the top of post and shall not be less than 19 inches. The average nominal diameter of the top of each line post shall be not less than 3 inches. The circumference of line posts shall be measured 6 inches below the top of the post and shall be not less than 9 1/2 inches.

410.3.2.2.4 Wood posts shall be pressure treated with standard creosote oil or petroleum-pentachlorophenol consisting of not more than 95 parts by weight of petroleum and not less than 5 parts by weight of pentachlorophenol. The empty cell process shall be used. The amount of creosote oil retained shall be not less than 6 pounds per cubic foot of wood, and the amount of pentachlorophenol retained shall be not less than 0.3 pound of dry salt per cubic foot of wood. Wood preservatives shall conform with AASHTO M 133.

410.3.2.2.5 Braces for wood posts shall be coast region Douglas fir, New Mexico red spruce or fir and shall conform with dimensions shown on the plans.

410.3.2.3 GATES: Gates shall be only tubular steel frame or tubular steel frame with filters of wire fabric, metal panel, chain link, or barbed wire, conforming with the dimensions and details shown on the panels. Materials and galvanizing shall be in conformity with the requirements of ASTM A 116 Class 3, A 120, A 392, A 525, and A 123 where applicable. Aluminum panel gates shall conform to ASTM B 209, and shall be installed if specifically required by the construction plans. Aluminum gates will not be arbitrarily substituted for tubular steel frame gates.

410.3.2.4 FITTINGS: All fittings, hardware, and appurtenances for fences and gates shall be commercial quality steel, malleable iron or wrought iron and shall be galvanized in accordance with the requirements of ASTM A 153.

410.3.3 CHAIN LINK FENCE:

410.3.3.1 Post shall be galvanized steel, tubular or H-column, conforming with the

lengths, dimensions and weights shown on the plans. Tubular posts, braces, and top rails shall conform with the requirements of ASTM A 120 for galvanized standard weight pipe, except that the pipe shall not be threaded nor subjected to hydrostatic test. H-column posts shall conform to ASTM A 36. The galvanizing shall conform to the requirements of AASHTO M 111 (ASTM A 123).

410.3.3.2 Post tops, stretcher bars, hardware and other required fittings shall be of commercial quality steel or malleable iron, and the galvanizing shall conform with the requirements of ASTM A 153.

410.3.3.3 Tie wires for fastening chain link fence to posts and rails shall be 9 gauge and galvanized. Galvanized steel or noncorrosive metal bands or fasteners may be used in lieu of tie wires when approved by the ENGINEER. Aluminum tie wires will not be accepted.

410.3.3.4 Compression braces shall conform with the same requirements as top rails. Tension truss rods shall be not less than 3/8 inch round galvanized rods with drop-forged turnbuckles or other approved tension device.

410.3.3.5 Chain link fabric shall conform to the requirements of AASHTO M 181 or Commercial Standard 246 published by the U.S. Department of Commerce. Unless otherwise provided, the wire shall be No. 9 gauge galvanized wire and the fabric shall be 2 inch mesh.

410.3.3.6 Gates may be double drive, single drive, or single walk and shall conform with the dimensions and details shown on the plans. Gate frames shall be fabricated from galvanized steel pipe conforming with ASTM A 120 and A 123. Chain fabric filler shall conform to the requirements herein provided for chain link fabric.

410.3.3.7 Corner posts shall be 3 inches O.D. with a minimum weight of 5.8 lb. per ft. Line posts shall be 2-1/2 inches O.D. with a minimum weight of 3.66 lb. per ft. Top rail and braces shall be 1-5/8 inches O.D. with a minimum weight of 2.27 lb. per ft.

410.3.3.8 At the option of the CONTRACTOR, posts, rails, braces, and gate framing members may be pipe conforming to ASTM A 120, and coated with a minimum or 1.8 ounces of zinc per square foot or vinyl- bonded pre-galvanized steel chain link fabric and fence components according to U.S. Government Specifications RR-F-191J/GEN. (See Table 410.3.3.8 for Fence Piping Dimensions and Weights.)

410.3.3.9 When outriggers with barbed-wire are installed the lowest strand shall not be less than 8 feet high measured from ground level. The same clearance distance will be required for coiled security wire.

410.4 CONSTRUCTION REQUIREMENTS

410.4.1 CONSTRUCTION METHODS: The CONTRACTOR shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment. At locations where breaks in a run of fencing are required or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of closure indicated. When the plans require that posts, braces, or anchors be embedded in concrete, the CONTRACTOR shall install temporary guys or braces as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. permitted Unless otherwise by the ENGINEER, no materials shall be installed on posts or strain placed on guys and bracing set in concrete until 4 days have elapsed from the time of placing of the concrete. The tops of all posts shall be set to the required depth and alignment. Cutting of the tops of posts shall be allowed only with the approval of the ENGINEER and under the conditions specified by him. Wire or fencing of the size and type required shall be firmly attached to the posts and braced in the manner indicated. All wire shall be stretched taut and be installed to the required elevations. At each location where an electric transmission, distribution, or secondary line crosses any of the types of fences covered by these specifications, the CONTRACTOR shall furnish and install a ground conforming to the drawings shown on the plans.

410.4.2 WIRE FENCE:

410.4.2.1 Wire fences shall be constructed in conformity with the details and at locations shown on the plans or staked by the ENGINEER. All posts shall be set plumb and to the depth and spacing shown on the plans. Excavations for footings and anchors shall be to dimensions shown on plans or established by the ENGINEER. Metal line posts may be driven. Post hole backfill shall be placed in thin layers and each layer solidly compacted. Posts set in rock shall be placed as per construction plans.

410.4.2.2 Fence wire shall be stretched by mechanical stretcher or other device designated for such use. Stretching by motor vehicle will not be permitted. The length between pull posts shall not exceed 995 feet for barbed wire and 660 feet for woven wire.

410.4.3 CHAIN LINK FENCE:

410.4.3.1 Chain link fences shall be constructed in conformity with the details and at locations shown on the plans or staked by the ENGINEER. Posts shall be spaced at not more than 10 foot intervals. The intervals shall be measured from center to center of post. All posts shall be set in concrete footings conforming with the dimensions and details shown on the plans. Posts set in rock shall be approved by the ENGINEER. Chain link fabric shall not be attached to posts until the concrete footings have completely set. Pull posts shall be line posts braced to 410.4.2.3 Intermediate braces shall be placed at intervals not to exceed 1000 feet and shall be spaced evenly between corner and gate posts or cattle guards.

410.4.2.4 A corner post and brace shall be placed at the intersection of cross fences with the right-of-way fence. Cross fence wires shall be stretched and firmly attached to the corner posts.

410.4.2.5 Right-of-way fences shall be attached to roadway structures when shown on the plans.

410.4.2.6 Fence materials of the same manufacture, type or process, conforming with the details shown on the plans shall be used throughout the Work unless otherwise authorized in writing by the ENGINEER.

adjacent line posts as shown on the plans. Pull posts shall be spaced at intervals not to exceed 500 feet. End posts shall be not less than 2.875 inches in outside diameter and braced in the same manner as corner posts. Braced tension rods or cables, hardware, and appurtenances shall be installed as shown on the plans.

410.4.3.2 Chain link fabric shall be stretched by mechanical stretcher or other device designed for such use. Stretching by motor vehicle will not be permitted.

TABLE 410.3.3.8

Nominal	Decimal	Minimum	Minimum
Pipe Size	Equivalent	Wall	Weight
<u>I.D. (in)</u>	<u>O.D. (in)</u>	<u>Thickness (in)</u>	<u>Ibs per foot</u>
1-1/4	1.660	0.111	1.836
2	2.375	0.130	3.117
2 1/2	2.875	0.160	4.640
	Nominal Pipe Size <u>I.D. (in)</u> 1-1/4 2 2-1/2	Nominal Pipe Size I.D. (in)Decimal Equivalent O.D. (in)1-1/41.66022.3752-1/22.875	Nominal Pipe Size I.D. (in)Decimal Equivalent

FENCE PIPING DIMENSIONS AND WEIGHTS

410.5 REMOVING AND REBUILDING FENCE

As shown on the construction plans or directed by the ENGINEER existing fences may require removal and re-erected. Such fences shall be reconstructed to the same condition as the original fence or better. The materials in existing fences to be removed and rebuilt shall be salvaged and incorporated in the rebuilt fences. Fence materials damaged beyond reuse during removal or rehandling shall be replaced by the CONTRACTOR at his expense. Posts shall be firmly reset to the line shown on the plans. The spacing of the posts and the material to be strung and secured to the posts shall be the same as the original fence. New tie material or staples shall be used to fasten the fence material to the posts and shall be furnished by the CONTRACTOR at his expense.

410.6 MEASUREMENT AND PAYMENT

410.6.1 For new fences the measurement and payment will be by one of the following methods:

410.6.1.1 By the linear foot. Measurement will be along the top of the fence from outside to outside of end posts for each continuous run of fence. The accepted quantities of fence will be paid for at the Bid Proposal's unit price per linear foot complete in place for the specified type of fence.

410.6.1.2 By the square foot. Measurement will be the horizontal distance of the fence from outside to outside of end posts for each continuous run multiplied by the vertical measurement of the material; the product area shall be designated in square feet. Payment will be made on the Bid Proposal's unit price per square foot complete in place for the specified type of fence.

410.6.1.3 Regardless of which method is used, payment shall include the cutting, removal, and replacement of any concrete or asphalt surfacing associated with the fence installation. 410.6.2 Removal and rebuilding of a fence shall be measured by the linear foot of fence removed and rebuilt and payment will be made on the unit price per linear foot for the type of fence as specified in the Bid Proposal.

410.6.3 Removal and disposal of a fence shall be measured by the linear foot of fence removed and disposed of by the CONTRACTOR. Payment will be made on the unit price per linear foot for the type of fence as indicated in the Bid Proposal.

410.6.4 Measurement and payment for gates will be the unit price per each for the type of fencing material specified in the Bid Proposal.

SECTION 450

TRAFFIC SIGNS AND SIGN STRUCTURES

450.1 GENERAL: This work shall consist of furnishing and installing traffic signs and sign structures in compliance with the specifications and details shown on the plans at the locations shown on the plans, or as established by the ENGINEER.

450.2 REFERENCES

- 450.2.1 Aluminum Association Standards, Latest Edition
- 450.2.2 American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications, Latest Edition
- M120 Zinc (ASTM B6)
- 450.2.3 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition
- A123 Zinc (Hot Galvanized) on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips
- A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- B209 Aluminum and Aluminum-Alloy Sheet & Plate
- B545 Electrodeposited Coatings of Tin
- E97 Directional Reflectance of Opaque Specimens by Fiber Photometry
- 450.2.4 Federal Highway Administration (FHWA) Standards, Latest Edition

Highway Signs Color Specifications

- 450.2.5 Government Services Administration (GSA) Standards, Latest Edition
- 450.2.6 Manual on Uniform Traffic Control Devices (MUTCD), Latest Edition
- 450.2.7 This Publication, Latest Edition
- 450.2.8 United States Standards, Latest Edition

Product Standard for Construction and Industrial Plywood

450.3 MATERIALS.

450.3.1 GENERAL: Materials shall be manufactured in conformity with the requirement of GSA L-S-300C and ASTM Standards.

450.3.2 RETROREFLECTIVE SHEETING.

450.3.2.1 The CONTRACTOR shall provide certification that retroreflective sheeting complies with the requirements of GSA L-S-300C. Retroreflective sheeting shall consist of a smooth, flat exterior film with retroreflective elements having a uniform homogeneous appearance. The sheeting shall be weather resistant and shall have a protected pre-coated adhesive backing.

450.3.2.2 COLORS

450.3.2.2.1 The diffuse day color of the retroreflective sheeting shall conform to the requirements of Table I of GSA L-S-300C and shall be determined in accordance with ASTM E 97 Standard Method of Test for 45-Deg., 0-Deg. Directional Reflectance of Opaque Specimens by Filber Photometry. (Geometric characteristics must be confined to illumination incident with 10 of, and centered about, a direction of 45 from the perpendicular to the test surface; viewing is within 15 of and centered about the perpendicular to the test surface. Conditions of illumination and observation must not be interchanged.) The standards to be used for reference shall be the Musnell Papers designated in Table 1. Papers shall have been recently calibrated on a spectrophotometer.

450.3.2.2.2 The test instrument shall be one of the following:

1. Advanced retrotechnology Model G920.

2.Gardner Multipurpose Reflectometer or Model XL20 and XL23 color and color difference meter

450.3.2.2.3 Colors shall be matched visually and shall be within the limits shown on the Color Tolerance Charts issued by the Federal Highway Administration, Office of Traffic Operations. The CONTRACTOR shall provide certification that the diffuse day color of the reflective sheeting will conform to the requirements of GSA L-S-300C, Table I, determined in accordance with the requirements of ASTM E 97.

450.3.2.2.4 If a dispute arises about the results of instrumental testing using diffuse lighting and unidirectional viewing, acceptance of the material will be based on the results of the visual test using the appropriate color tolerance chart. Daytime color and nighttime color shall conform to the Standard Highway Signs Color Specification issued by FHWA.

450.3.2.3 SPECIFIC INTENSITY

450.3.2.3.1 The sign faces shall have the minimum specific intensity per unit area (SIA) values at 0.2 and 0.5 observation (divergence) angles expressed as average candlepower per footcandle per square foot (candles per lux per square meter) of material as shown in Tables 1,2, 3, 4, 5, and 6. Measurements shall be conducted in accordance with photoelectric testing procedures for reflective sheeting as provided in paragraph 4.4.7 of GSA L-S-300C and paragraph 441.02(a) of FHWA Specification FP-85.

450.3.2.3.2 Measurements shall be made with the entrance (incidence) and observation angles positioned in the same place.

TABLE 1 Type II Sheeting (Enclosed Lens)								
MINIMUM REFLECTIVITY (Average Candlepower Per Footcandle Per Square Foot)								
O A	EA	W ht	Or	Ye I	Re d	Gr n	BI u	Br n
0.2	-4	70. 0	25. 0	50. 0	14. 5	9.0	4.0	1.0
0.2	30	30. 0	7.0	22. 0	6.0	3.5	1.7	0.3
0.5	-4	30. 0	13. 5	25. 0	7.5	4.5	2.0	0.3
0.5	30	15. 0	4.0	13. 0	3.0	2.2	0.8	0.2

Where OA = Obse	ervation Angle in	Degrees
EA = Entra	ance Angle in De	grees
Wht = White	Or = Orange	Yel = Yellow
Grn = Green	Blu = Blue	Brn = Brown

Blu = Blue Brn = Brow	'n

TABLE 2 Type II-A Sheeting (Enclosed Lens)								
(4	MINIMUM REFLECTIVITY (Average Candlepower Per Footcandle Per Square Foot)							
O A	EA	W ht	Or	Ye I	Re d	Gr n	BI u	Br n
0.2	-4	14 0.	60. 0	10 0.	30. 0	30. 0	10. 0	5.0
0.2	30	60. 0	22. 0	36. 0	12. 0	10. 0	4.0	2.0
0.5	-4	50. 0	20. 0	33. 0	10. 0	9.0	3.0	2.0
0.5	30	28. 0	12. 0	20. 0	6.0	6.0	2.0	1.0
Where W	Where OA = Observation Angle in Degrees EA = Entrance Angle in Degrees What = White Or = Orange Yel = Yellow							

Blu = Blue	Brn =	Brown

TABLE 3 Type III Sheeting (Encapsulated Lens)								
MINIMUM REFLECTIVITY (Average Candlepower Per Footcandle Per Square Foot)								
O A	EA	W ht	Or	Ye I	Re d	Gr n	BI u	Br n
0.2	-4	25 0	10 0	17 0	45	45	20	12
0.2	30	15 0	60	10 0	25	25	11	8.5
0.5	-4	95	30	62	15	15	7.5	5
0.5	30	65	25	45	10	10	5	3.5

Grn = Green

Г

Where OA = Observation Angle in Degrees EA = Entrance Angle in Degrees

Yel = Yellow Wht = White Or = Orange Grn = Green Blu = Blue Brn = Brown

450.3.2.4 RETROREFLECTIVE SHEETING ADHESIVE: Retroreflective sheeting shall include a pre-coated pressure sensitive adhesive (GSA L-S-300C, Class I) or a tack free, heat activated adhesive (GSA L-S-300C, Class II), either of which can be applied without necessity of additional adhesive coats on the sheeting or application surface. The protective liner attached to the adhesive backing shall be removable by peeling without soaking in water or other solvent and shall be easily removed after accelerated storage for four (4) hours at 150 degrees F under weight of 2.5 pounds per square inch. During removal, the liner shall not break, tear, nor adhesive be removed.

450.3.2.5 RETROREFLECTIVE SHEETING DURABILITY AND WORKMANSHIP

450.3.2.5.1 Retroreflective sheeting shall have sufficient strength and flexibility to be handled, and processed. applied according to the recommendations of the sheeting manufacturer without appreciable stretching. When processed and applied in accordance with recommended procedures, retroreflective material shall be weather resistant and following cleaning shall show no appreciable discoloration, cracking, crazing, blistering, or dimensional change. Retroreflective material, when exposed to normal traffic and weather, shall not support fungus growth or accumulate dirt to the extent that the retroreflective brightness before cleaning is less than 75 percent of the retroreflective brightness after cleaning, when measured at 0.2 divergence and -4 incidence. The sheeting surface shall be readily refurbished by cleaning and clear overcoating in accordance with the manufacturer's recommendations.

450.3.2.5.2 Retroreflective sheeting shall be applied to properly treated substrate as recommended by the sheeting manufacturer. Paints and sealers shall be dry before succeeding coats are applied and before packaging. Finished signs shall show careful workmanship and have a smooth and uniform surface. All letters and numbers shall be clean-cut and sharp.

450.3.2.5.3 The sheeting surface of Type II and Type II-A sheeting shall be solvent resistant to gasoline, VM&P naphtha, mineral spirits, turpentine and methanol.

450.3.2.5.4 The sheeting surface of Type III A, B, C and Type IV, sheeting shall be solvent resistant such that it can be cleaned with a soft, clean cloth dampened with VM&P naphtha or mineral spirits.

450.3.2.6 RETROREFLECTIVE SHEETING DELIVERY AND HANDLING: Retroreflective sheeting shall be delivered in good condition and shall have a good appearance, free from ragged edges, cracks, and extraneous materials. When retroreflective sheeting is furnished in continuous rolls, splices shall be smooth with no discernible line of demarcation, and the sheeting shall be suitable for continuous application. Retroreflective sheeting shall be packaged so that no damage or defacement can occur during shipment or storage. Sheeting shall be used within the time frame recommended by the manufacturer. 450.3.2.7 MULTIPLE PIECES OF SIGN SHEETING: Sign faces comprising two (2) or more pieces or panels of retroreflective sheeting shall match in color and provide uniform appearance and brilliance by day and night. The entire face of each sign panel shall be covered with one (1) unspliced sheet of retroreflective sheeting, except that splicing is permissible where the substrate panel exceeds 48 inches in vertical dimension. No vertical splicing of sheeting shall be used. Materials shall be color-matched and the top piece shall overlap the bottom by a minimum of ½ inch in order to eliminate water penetration.

450.3.2.8 SCREENING INKS AND PROCESS PASTE

450.3.2.8.1 Unless otherwise prohibited, screening inks, process pastes or film overlays can be used, in lieu of manufactured colors at the option of the sign manufacturer, to produce both the legend and background. Only the film overlays or screened colors of green, blue, red, brown and black may be used. Only those screening inks, process pastes or film overlays recommended by the retroreflective sheeting manufacturer shall be used. Said recommendations shall be obtained in writing and a copy filed in accordance with the requirements of this Section 450.

450.3.2.8.1.1 OUTDOOR WEATHERABILITY: The outdoor weatherability of the applied screening inks, process paste or film overlay shall be comparable to the outdoor durability of the retroreflective sheeting.

450.3.2.8.1.2 ADHERENCE: No screening inks, process pastes or film overlay shall be removed when tested by applying cellophane tape over a properly cured, color processed area and removing the tape with one quick motion. The tape shall be 3/4 inch wide 3M Company Scotch Brand Cellophane Tape No. 600, or approved equal.

450.3.2.8.1.3 SOLVENT RESISTANCE: After proper curing, screened sign faces shall be solvent resistant to cleaning solvents recommended by the manufacturer of the retroreflective sheeting and the screening inks, process pastes, and film overlay.

450.3.2.8.1.4 VANDAL RESISTANCE: Screened sign faces shall be resistant to aromatic type solvents. The process and materials used shall be as recommended by the manufacturers of the retroreflective sheeting, screening inks, process pastes, and film overlay in order to facilitate the removal of paints or other oil based matter sprayed or painted on signs.

450.3.2.8.1.5 COLOR: The color of the screened sign faces surface as specified shall meet all applicable requirements and shall conform to the Standard

Highway Signs Color Specification issued by the FHWA.

450.3.2.8.1.6 RETROREFLECTIVE INTENSITY (Transparent Colors)

450.3.2.8.1.6.1 Transparent colored inks or transparent colored film overlays shall be processed and applied in accordance with the recommendations of the sheeting manufacturer.

450.3.2.8.1.6.2 The minimum retroreflective intensity value of the transparent color area processed on white sheeting shall be not less than those specified below in Table 7, 8, 9, 10, 11 and 12 for each color at 0.2 degrees observation and -4 degrees entrance angles, expressed in candelas per footcandle per square foot of processed area.

450.3.2.8.1.7 PROCESS COLORS ON SHEETING.

TABLE 4 Type II Retroreflective Intensity						
Process Color on Type II Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)						
(Candelas Pe	(Candelas Per Footcandle Per Square Foot)					
RED BLUE GREEN						
10 3 6						

TABLE 5 Type II Retroreflective Intensity					
Process Color on Type II-A Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)					
(Candelas Per Footcandle Per Square Foot)					
RED	BLUE	GREEN			
21	7	21			

TABLE 6 Type III-A Retroreflective Intensity

TABLE 6 Type III-A Retroreflective Intensity			
Process Color on Type III-A Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)			
(Candelas Per Footcandle Per Square Foot)			
RED	BLUE	GREEN	
31.5	14	31.5	

TABLE 7	
Type III-B Retroreflective Intensity	

Process Color on Type III-B Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
31.5	14	31.5

TABLE 8	
Type III-C Retroreflective Intensity	

Process Color on Type III-C Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
24.5	14	24.5

TABLE 9 Type IV Retroreflective Intensity		
Process Color on Type IV Enclosed Lens Sheeting (White Reflective Sheeting Per Retroreflective Intensity Value)		
(Candelas Per Footcandle Per Square Foot)		Square Foot)
RED	BLUE	GREEN
24.5	14	24.5

TABLE 10

TABLE 10				
Min. Color Contrast Ratios of Fully Reflectorized Sign (For Information Only)				
Sheetin g Type	White/ Red	White/ Green	White/ Blue	White/ Brown
Ш	5:1	8:1	17:1	70:1
IIA	5:1	5:1	14:1	25:1
Ш	6:1	6:1	13:1	18:1

450.3.3 SIGN LEGENDS AND SHEETING.

450.3.3.1 The word "legend" used herein and on the plans indicates all letters, numerals, symbols, arrows, borders, or other accessories that contain and convey the sign message and shall be either a sign sheeting with integral, semi-rigid, 0.005 inch minimum thickness aluminum backing, or sign sheeting applied to a demountable 0.030 inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy; or approved self-adhering machine cut sheeting. Retroreflective sheeting for legends including letters, numerals, symbols, borders and route markers, shall be white as specified in Table 3 of this Section 450. Legends shall conform with the details shown on the plans and the provisions of MUTCD. Color, reflectorization, and configuration of legends shall be as shown on the plans and herein provided:

450.3.3.1.1 PLYWOOD AND ALUMINUM SIGNS: The legend may be a sign sheeting with integral, semirigid 0.005 inch and minimum thickness aluminum backing; or sign sheeting applied to demountable 0.030 inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy; or approved self adhering; machine cut sheeting as specified in Table 3 of this Section 450; or reverse screened using a weatherproof screen process enamel that is compatible with the background and that will provide the designated colors and reflectorization of the sign; or reverse film overlaid with an approved film overlay. These legends shall be applied edge sealed, reverse screened, clear coated, and finished as applicable, as recommended by the manufacturer of the retroreflective sheeting.

450.3.4 SIGN BACKGROUNDS

450.3.4.1 Color and configuration of sign backgrounds shall be as shown on the plans. The sign face shall provide a plane surface free from warps, dents, burrs, mars, or other defects resulting from fabrication, shipment, storage, or installation. The entire sign face may be rejected because of any of these defects or because of dirty, marred, or defective background or legend. Completed sign faces mounted in place will be inspected at night.

450.3.4.1.1 Plywood and aluminum signs shall be surfaced with Type II sheeting as specified in Table 1 of this Section 450.

450.3.5 PLYWOOD PANEL SIGNS

450.3.5.1 Plywood shall be classed as group 1, 5/8 inch thick, 5 ply, grade B-B or better, high density overlay on both sides, exterior type plywood conforming to the requirements of the current U.S. Product Standard for Construction and Industrial Plywood marked with a trademark by an approved testing agency, or Canadian Standards Association, bearing legible grade marking of the American Plywood Association or the Canadian Council of Forest Industries.

450.3.5.1.1 Edges shall be finished to produce a smooth surface without holes. All edges and corners of the sign panels shall be rounded to eliminate edge sharpness and chipping. All edges shall receive two thick coats of exterior type, polysilicone alkyd resin base enamel paint or one thick coat of ready-mixed polysilicone alkyd resin primer followed by one thick coat of polysilicone alkyd resin base enamel. The paint must be thick enough so the individual plys are not visible. The first coat of paint or primer shall be either white or yellow and the second coat shall be either brown or black.

450.3.5.1.2 All painting shall be completed before the retroreflective sheeting is placed.

450.3.5.1.3 The plywood sign blank shall be prepared for retroreflective sheeting as specified by the facing material manufacturer. Retroreflective sheeting, legend and clear coat, shall be applied in accordance with manufacturer's recommendations, this Section 450. Hardware for mounting plywood panel signs shall comply with the requirements of this Section 450.

450.3.6 ALUMINUM PANEL SIGNS.

450.3.6.1 Aluminum panel signs under 24 inches in width shall be 0.080-inch minimum thickness 6061-T6 or 6062-H38 aluminum alloy. Aluminum panel signs 24 inches and over in width shall be 0.125-inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy. All aluminum alloys shall conform to the requirements of ASTM B 209 and shall be supplied as flat stock material. All aluminum panel signs shall have smooth edges and corners.

450.3.6.2 The aluminum sign blank shall be prepared for retroreflective sheeting as specified by the facing material manufacturer. Retroreflective sheeting,

legend, and clear coat, shall be applied in accordance with manufacturer's recommendations, this Section 450 Retroreflective Sheeting and this Section 450 Sign Legends and Sheeting. A copy of the manufacturer's recommendations shall be kept on file as specified in this Section 450 for review by the ENGINEER during the periodic inspections of the manufacture's sign shop. The aluminum sign panel shall have a square punched hole to receive a carriage bolt or a lock washer for use with a carriage bolt and tamper proof nut. Hardware for mounting aluminum panel signs shall comply with the requirements of this Section 450, Sign Structures and Hardware.

450.3.7 SIGN STRUCTURES AND HARDWARE

450.3.7.1 Steel posts and base posts for plywood or aluminum panel signs shall be of the dimensions and cross section shown on the plans. Steel posts and base posts shall either be finished by one of the following methods:

450.3.7.1.1 Hot dipped galvanized in accordance with the requirements of ASTM A 525 or ASTM A 123;

450.3.7.1.2 Hot dip galvanized zinc coating in accordance with the requirements of AASHTO M 120, followed by a chromate conversation coating and a cross-linked polyurethane acrylic exterior coating;

450.3.7.1.3 Painted with a green paint meeting the requirements of GSA 595-A, (Color No. 14109). Said green paint shall be a minimum of one (1) mil in thickness.

450.3.7.2 Hardware for post assembly shall be hot dipped galvanized or cadmium plated in accordance with ASTM A 165, stainless steel, or mechanically galvanized in accordance with ASTM B 545 (Class Fe/Sn 20). Post assembly hardware shall be of the dimensions shown on the plans.

450.3.8 BOLTS: Size 5/16 inch-18 UNC for sign attachment shall be a tamper proof carriage bolt, either hot dipped galvanized, cadmium plated in accordance with ASTM A 165, stainless steel, or mechanically galvanized in accordance with ASTM B 545 (Class Fe/Sn 20). Tamper resistant nuts, size 5/16 inch-18 UNC shall be used and fabricated from C1008 hot rolled steel, case hardened to R55-60, and plated with zinc yellow dichromate, 0.002 inch and 0.005 inch thick.

450.4 CONSTRUCTION REQUIREMENTS.

450.4.1 CERTIFICATION OF MANUFACTURER: The CONTRACTOR shall submit, in writing, the name of the proposed sign manufacturer, project number, and certification that all sign materials comply with the specifications. 450.4.2 SIGN IDENTIFICATION

450.4.2.1 The following identification labels shall be affixed to all signs and shall include the information as listed:

450.4.2.1.1 MANUFACTURING IDENTIFICATION LABELS: These labels shall include the wording: "Manufactured By", the initials of the sign fabricator, the month and year of fabrication, the initials of the reflective sheeting manufacturer and the wording "Theft is a Crime";

450.4.2.1.2 CONTRACTORS IDENTIFICATION LABEL: This label shall include the CONTRACTOR's Name, Date Installed, Month and Year.

450.4.2.2 The above labels may be either die stamped in 3/8 inch letters and numerals, or made with high-tack adhesive sign sheeting (reflective or non-reflective) prepared with screened ink in ½ inch letters and numerals.

450.4.2.3 The labels shall be placed on the lower back side of the sign, and located so as not to fall behind any post or frame member. Die stamping shall be performed in a manner that will not damage the finished sign. The label shall have similar weather resistance characteristics as the sheeting and shall last for at least the expected service life of the sign. The labels shall be affixed at the time the sign is manufactured.

450.4.3 APPROVAL OF SHOP DRAWINGS.

450.4.3.1 Standard signs shall be constructed in accordance with the detail drawing furnished to the CONTRACTOR. The CONTRACTOR shall submit detailed shop drawings of all special code signs (those other than the standard MUTCD coded signs) to the ENGINEER for approval. The CONTRACTOR shall not begin fabrication of special coded signs until the shop drawings are approved by the ENGINEER. These drawings shall show the complete legend, arrangement of letters and numerals, letter and numeral height, letter series, symbols, borders and dimensions.

450.4.3.2 The CONTRACTOR shall not erect the signs until the shop drawings are approved.

450.4.3.3 The CONTRACTOR must verify the post lengths with the ENGINEER before installation operations are started.

450.4.4 INSPECTION

450.4.4.1 All material and finished signs shall be

subject to inspection and release or installation by the ENGINEER at the Project site prior to installation, and shall be subject to final inspection at the project after installation. The entire sign may be rejected if there are mars, damages, stains, discolorations, or defacements resulting from fabrication, storage, shipment or installation.

450.4.4.2 The ENGINEER shall at all times during work hours, have free entry to the parts of the sign manufacturing plant that are involved in the manufacture and production of signs. Adequate facilities required for inspection shall be furnished without charge to the ENGINEER for inspection of signs and to verify the manufacturer's Q.C. Program.

450.4.4.3 Test panels, twelve (12) inches by twelve (12) inches representative of each state of production, shall be furnished on request, to the ENGINEER. These panels shall be processed along with regular production run and witnessed by the ENGINEER. Should there be any question as to validity of a test panel, a completed sign shall be furnished upon request. Signs not conforming in all respects to the requirements of these specifications may be rejected and the manufacturer's Q.C. Program may be withdrawn. The ENGINEER may select a sign at random for further inspection. The ENGINEER will return the sign to the CONTRACTOR in time for the sign to be installed in accordance with the CONTRACTOR's schedule.

450.4.5 PACKAGING AND SHIPPING: All signs shall be suitably packaged and protected for proper shipment and storage. Signs shall be delivered undamaged to the project site.

450.4.6 FABRICATION

450.4.6.1 Material ½ inch thick or less may be sheared, blanked, sawed, or milled. Material over ½ inch thick shall be sawed or milled. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be filleted by drilling prior to cutting. Unless the plans show otherwise, flame cutting will not be permitted.

450.4.6.2 Bolt holes shall be drilled to finish sizes.

450.4.6.3 Steel surfaces to be in contact with aluminum shall be galvanized or of stainless steel.

450.4.6.4 Aluminum surfaces to be in contact with concrete or earth shall be given a heavy coat of an alkali-resistant bituminous paint.

450.4.7 INSTALLATION AND REMOVAL OF SIGNS: The CONTRACTOR shall erect traffic sign structures at locations shown on the plans. Existing

traffic control signs removed by the CONTRACTOR shall be delivered to locations designated by the ENGINEER. The CONTRACTOR shall verify the sign locations with the ENGINEER prior to their installations.

450.4.8 USE OF CERTIFIED SIGNS ONLY: The CONTRACTOR's sign manufacturer must supply signs with an identification on the back of the sign as specified in this Section 450 which matches the approved sign manufacturer identified on the documentation letter. The CONTRACTOR shall not install permanent signs until the ENGINEER has verified that the shipment of signs delivered has a manufacturer's check list and has given the CONTRACTOR authorization to begin sign installations. The CONTRACTOR must use the manufacturer for which certification was requested.

450.4.9 SIGN STORAGE: The CONTRACTOR shall store material, including posts, under a roof or otherwise covered for protection against the elements. Materials shall be stored so as not to be on the ground or come in contact with surface runoff water.

450.4.10 REMOVING AND RESETTING PLYWOOD OR ALUMINUM PANEL SIGNS: The CONTRACTOR shall remove existing designated plywood or aluminum panel signs, sign posts, and base posts and stockpile sign posts and base posts at locations designated by the ENGINEER, or as shown in the plans. Removed plywood or aluminum panel signs shall be reset on new steel sign posts and base posts in compliance with this Section 450 and details shown on the plans.

450.4.11 SCHEDULE: A written schedule for the removal and resetting of existing traffic signs shall be submitted to the ENGINEER for approval prior to commencement of sign removal.

450.5 MEASUREMENT AND PAYMENT.

450.5.1 Steel posts and base or anchor posts for plywood or aluminum panel signs will be measured per each post, complete in place.

450.5.2 Plywood or aluminum panel signs will be measured by the square foot of sign face area mounted on drive-down posts, complete in place.

450.5.3 Removing and resetting of plywood or aluminum panel signs and signs will be measured by the unit, complete in place.

450.5.4 The accepted quantities of traffic signs and sign structures will be paid for at the contract price per unit of measurement for each of the pay items listed as shown on the bid proposal.

EXCAVATION AND BACKFILL FOR STRUCTURES

501.1 GENERAL

The work performed under this specification shall include, but not be limited to providing the equipment, labor and materials for the excavation and backfill of areas related to structures, such as bridges, foundations, walls, storm drain inlets, as specified on the plans and therein or as authorized by the ENGINEER.

501.2 REFERENCES

501.2.1 ASTM:

C136	D422
D423	D424
D698	D1557
D2922	D3017
D4253	D4254

501.2.2 This Publication:

Section 207 Section 301

501.3 EXCAVATION

501.3.1 All excavation for structures shall be made 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.

501.3.2 When slope limit for structural excavation is shown on the plans. Those limits are to establish the pay quantities for structural excavation and backfill only and in no way shall relieve the CONTRACTOR from meeting the requirements of 501.3.1 above.

501.3.3 The bottom width of the excavation shall be a minimum of the bottom width of the structure foundation plus one foot (1') on each side to provide space for erection and removal of forms. Additional bottom area may be required due to the type and size of compaction equipment the CONTRACTOR chooses to use.

501.3.4 CONTRACTOR shall be responsible for obtaining and maintaining a temporary storage site for usable excavated material during the period of construction. CONTRACTOR may request through the ENGINEER, approval of the OWNER to store excavated material within the street right-of-way or on OWNER's property.

501.4 COMPACTED BACKFILL

501.4.1 Backfill material shall be Class I, II, III, or Class IV soils as defined in TABLE 501.4.A, or Lean Fill complying with the requirements of Section 207. The CONTRACTOR shall not place backfill against a portland cement concrete structure until the concrete has attained 80% of the design strength as determined by the average strength of two field cured cylinders. The field cured cylinders shall be cured in the field under the same condition as the concrete in the structure, represented by the cylinders.

501.4.2 The CONTRACTOR shall remove unsuitable material which either will not compact readily or serve the intended purpose and replace it with suitable material as authorized by the ENGINEER.

501.4.3 All forms, braces, and debris shall be removed before start of backfilling.

501.4.4 Backfill material shall be placed in level lifts and each compacted lift shall not exceed 6 inches.

501.4.5 Soil used for the backfill around structures shall be compacted to a dry density of not less than 90% of maximum dry density in a moisture range of optimum moisture +/-2% as determined in accordance with ASTM D1557 (modified). unless the soil contains 35% or more finer than the No.200 sieve. If the soil used has 35% or more finer than the No.200 sieve, it shall be compacted to a dry density of 90% of maximum dry density in a moisture content range of at least optimum moisture to +4% above optimum as determined in accordance with ASTM D698 (Standard).

501.4.6 When structural backfill is within the roadway area, this area shall be compacted to 90% dry density as specified in 501.4.5 and rework and compacted to 95% dry density at the same time as the surrounding subgrade area is compacted as specified in Section 301.

TABLE 501.4.A

EMBEDMENT SOILS CLASSIFICATIONS

SOILS CLASS	SOIL TYPE	DESCRIPTION
CLASS I SOILS*		Manufactured angular, granular material, ¹ / ₄ 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 with 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 nor 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% if 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	МН	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	СН	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	ОН	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.

* Soils are as defined in ASTM D2487, except for Class I soils 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 Class III

501.5 GRAVEL DRAINS

501.5.1 The construction plans may require the installation of weep holes in the concrete walls to relieve the surcharge pressure of ground water. Gravel drains are intended to provide a drainage course to the weep holes. The size, shape, and location of the gravel drain will be shown on the construction plans.

501.5.2 Gravel drain material shall consist of a material complying with the following gradation, and having the same or similar gradation curve as defined by the specification limits when graphically plotted on a standard aggregate gradation chart.

SIEVE SIZE	% PASSING
3 inch	100
1/2 inch	70-100
no.4	50-80
no.16	25-50
no.50	5-15
no.200	0-5

Liquid Limit NV (no value)

Plasticity Index NP(non plastic)

**The drain material shall comply with the following material size ratios:

R15 = ------15-percent size GDN 15-percent size BM

where:

GDM-represents the Gravel Drain Material BM -represents the Base Material (surrounding soil)

501.5.3 A separator (membrane type) geotextile fabric shall be used to encase the Gravel Drain Material in areas where the surrounding solid has 30% or greater of its material passing the no. 200 sieve.

501.6 MEASUREMENT AND PAYMENT

501.6.1 Measurement:

501.6.1.1 Unless specified on the plans, in the Supplemental Technical Specification and/or in the Bid Proposal no separate measurement will be made for excavation and backfill for structures. This work shall be considered incidental to and part of the cost of the structure.

501.6.1.2 When specified on the plans, in the Supplemental Technical Specifications and/or in the Bid Proposal excavation and backfill for structures shall be measured by the cubic yard of excavation.

501.6.1.3 Gravel drains will be measured by the cubic foot based on the neat line volume shown on the plans or as authorized by the ENGINEER.

501.6.2 Payment:

501.6.2.1 Payment for excavation and

backfill for structures shall be made at the contract unit price per structure or per cubic yard of excavated quantity, complete in place, which price shall include all equipment, labor and materials required to excavate, stock pile, backfill, compact, and the removal and disposal of excess material.

501.6.2.2 Payment for gravel drains shall be made at the contract unit price per cubic foot, complete in place, which price shall include all equipment, labor and materials required in furnishing the gravel and geotextile fabric, the installation of both and the compaction required.

SECTION 510

CONCRETE STRUCTURES

510.1 GENERAL

Concrete structures such as: bridges, culverts, storm inlets, retaining walls, abutments, piers, footings, foundations and similar structures, shall be constructed in conformity with these specifications and the construction plans.

510.2 REFERENCES

510.2.1 This Publication:

Section 101 Section 102 Section 103 Section 105 Section 307 Section 349 Section 501 Section 502

510.2.2 Others

PS-1-66 Specifications for Plywood, U.S. Products Standard, U.S. Department of Commerce.

Standard Specifications for Welding for Highway and Railroad Bridges, American Welding Society.

510.3 MATERIALS

510.3.1 CONCRETE

Concrete for use in work constructed under this section shall conform to the requirements of Section 101 and as shown on the plans or as specified in the Supplementary Technical Specifications and approved by the ENGINEER.

510.3.2 STEEL REINFORCEMENT

Reinforcement bars shall conform to the requirements specified in Section 102 and 103.

510.4 SUBGRADE FOR CONCRETE STRUCTURES

Earth subgrade upon which concrete is placed shall be firm and free from water and/or frost. All subgrade on which Structural concrete is to be placed shall be compacted to the minimum density specified in Section 501 or on the plans. Ground water shall be kept twelve (12") inches below the subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed. When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and pouring of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the ENGINEER and the base for structures shall be slush grouted or otherwise treated as the ENGINEER may direct.

510.5. FORMS

510.5.1 Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with CONTRACTOR. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited therein. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused, and the reuse of forms shall be subject to approval of the ENGINEER. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete. Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber or material which will provide a surface at least equally satisfactory. Any lumber or material which becomes badly checked or warped prior to placing concrete may be rejected. Forms for all exposed surfaces of bridges,

viaducts, over crossings, and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall conform to the specifications of the U.S. Department of Commerce, U.S. Product Standard PS 1-66 Class I or II. All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous. Unless otherwise shown on the plans, all exposed edges shall have a 3/4 inch chamfer. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve. Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portions of form to remain. Form clamps or bolts approved by the ENGINEER shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the ENGINEER. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales. The CONTRACTOR may, at his own option, place such portions of the concrete directly against the sides of the excavation or sheathing without the use of outside forms, provided that the following conditions are met:

510.5.1.2 If concrete is placed against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is placed shall be faced with building paper. Except as otherwise specified hereinafter, all sheathing shall be removed but not until either at least 7 days after placing concrete or until the concrete has attained sufficient strength to support itself and any load that may be placed on it.

510.5.2 Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles, and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated. When, in the opinion of the ENGINEER, field conditions or the type of sheathing or methods of construction used by the CONTRACTOR are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been placed shall be left in place. 510.5.3 Regardless of the method used in placing concrete without outside forms, the following stipulations shall hold:

510.5.3.1 The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the ENGINEER.

510.5.3.2 The CONTRACTOR shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

510.5.3.3 Should the method of construction of placing directly against the sides of the excavation or sheathing without use of outside forms not prove satisfactory in the opinion of the ENGINEER, the CONTRACTOR shall discontinue said method of construction and construct the structure by using outside forms.

510.6 FALSEWORK

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be superimposed were the entire superstructure placed at one time. All falsework, staging, walkways, forms, ladders, cofferdams, and similar accessories shall equal or exceed the minimum applicable requirements of the Federal and State statutes and local ordinances. Compliance with such requirements shall not relieve the CONTRACTOR from full responsibility for the adequacy and safety of said items. Falsework shall be founded upon a solid footing safe against undermining and protected from softening. When the falsework is supported on timber piles, the piles shall be driven to a bearing value as determined by the formula specified in Section 502, equal to the total calculated pile loading. Falsework and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the falsework to set the forms to grade or camber shown on the plans or to take up any settlement in the formwork either before or during the placing of the concrete. However, single wedges for this purpose will not be permitted, it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joists will be compensated for by varying the depth of the joists or by using varying depth nailing strips. Arch centering shall be removed uniformly and gradually beginning at the crown and working toward the springline to permit the arch to take its load slowly

and evenly. Centering for adjacent arch spans shall be struck simultaneously. Falsework under any continuous unit or rigid frame shall be struck simultaneously, the supporting edges being released gradually and uniformly starting at the center and working both ways toward the supports.

510.7 REMOVAL OF FORMS

510.7.1 The falsework supporting any span of a continuous or rigid frame structure subject to bending stress shall not be released until after the last concrete placed in the span and in the adjoining spans (excluding concrete above the deck slab) has attained a compressive strength of not less than 80 percent of its design strength or 21 days after the concrete is placed, whichever occurs first. Stairway riser forms shall be removed and the finish of the steps completed on the day the concrete is poured. Metal stairway treads, if required by the plans, shall be installed immediately after the steps have been poured. Forms and falsework supporting the bottom slab of the superstructure of box girder structures shall remain in place until the curing period of the deck of the superstructure has expired. Forms for the webs of box girders shall be removed before the deck slab is poured. Forms for the upper deck slab which are to remain in place shall be supported by bolts through the girder webs or some equally satisfactory method that will prevent the transfer of any load to the lower deck slab. Forms supporting the concrete deck slab of box girders may be left, in place. All interior forms in box girders, except those permitted to remain in place, shall be completely removed and the inside of the box girder. Side forms for beams, girders, columns, railings, or other members wherein the forms do not resist dead load bending may be removed after a period of 36 hours, unless otherwise directed by the ENGINEER, provided that satisfactory arrangements are made to cure and protect. the concrete thus exposed in accordance with Section 349. Side forms for arch rings, columns, and piers shall be removed before the members of the structure which they support are placed so that the quality of the concrete may be inspected. Such forms shall be so constructed that, they may be removed without disturbing other forms which resist direct load or bending stress.

510.7.2 The periods of time at which the CONTRACTOR may remove forms, as set forth in this Section, are permissive only and subject to the CONTRACTOR assuming all risks that may be involved in such removals. At his option, the CONTRACTOR may leave the forms in place for such longer periods as are, in his opinion, required.

Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections and elsewhere as necessary to prevent. shifting of bars, with wire not smaller than No. 16, and by using concrete or metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under full load. The use of wooden supports will not be permitted. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing reinforcing steel in the forms, the reinforcing steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bonds. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

510.9 SPLICING

Splices of bars shall be made only where shown on the plans or as approved by the ENGINEER. Where bars are spliced, they shall be lapped at least 20 diameters for deformed bars, unless otherwise shown on the plans. Welding of reinforcing steel will be permitted when authorized by the ENGINEER in writing and shall be in accordance with the American Welding Society (Standard Specifications for Welding for Highway and Railroad Bridges).

510.10 BENDING REINFORCEMENT

Bends and hooks in bars shall be made in the manner prescribed by the American Concrete Institute. Bars shall not be bent nor straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

510.11 WELDED WIRE FABRIC

Welded wire fabric shall be held firmly in place. Welded wire fabric shall be spliced not less than two meshes.

510.12 PLACING CONCRETE

510.12.1 Where a schedule for placing concrete is shown on the plans, no deviation will be permitted there from unless approved in writing by the ENGINEER. The placing of concrete for a given area shall start at the low point and shall proceed upgrade, unless otherwise permitted by the ENGINEER. With the exception of concrete placed in slope paving and aprons and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size, and number approved by the ENGINEER. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner, and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable, and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes but shall be built with square ends and level tops.

510.12.2 Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position. The use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted. Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or "elephant trunks" or "Trimmies." The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction, provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration. During the placing of concrete, care shall be taken that methods of consolidation used will result in a surface of even texture free from voids. water, or air pockets and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the ENGINEER. The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the ENGINEER; and wherever they are used, they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet. Columns shall be poured

preferably through pipes of adjustable length and not less than 6 inches in diameter. Horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections has been consolidated and settlement has occurred.

510.13 JOINTS

The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the ENGINEER. The CONTRACTOR shall complete, by continuous depositing of concrete sections of the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed. All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped, or roughened surface shall be cleaned by sandblasting prior to pouring the adjacent concrete. Any quality of sand may be used which will accomplish the desired results. Other methods of cleaning joints may be used provided the method and result is approved by the ENGINEER. Joint cleaning operations shall be continued until all unsatisfactory concrete and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of waste water employed in washing the concrete surfaces shall be such that the waste water will not stain, discolor, or affect exposed surfaces of the structure. The method of disposal will be subject to the approval of the ENGINEER. All horizontal construction joints or those on slight slopes shall be covered with mortar. Expansion and contraction ioints in the concrete structures shall be formed where shown on the drawings and as directed by the ENGINEER. In general, such joints shall have smooth abutting surfaces, painted, or separated and sealed in accordance with Section 107 or as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans.

510.14 PLACING CONCRETE UNDER ADVERSE WEATHER CONDITIONS

Concrete for structures shall not be placed on frozen ground nor shall it be mixed or placed while the ambient temperature is below 40°F. Concrete shall not be placed during rainfall unless adequate protection is provided. Upon written notice from the ENGINEER, all concrete which may have become damaged due to adverse weather conditions, shall be replaced by the CONTRACTOR at no expense to the OWNER.

510.15 SURFACE FINISHES

The classes of surface finish described hereafter shall be applied to various parts of concrete structures as specified. Bridge decks shall be finished in conformity with Section 337. When required by the ENGINEER, the CONTRACTOR, prior to placing of concrete, shall provide a test section for evaluation of the surface finish to be employed. There will be no separate payment made for the test sections.

510.15.1 ORDINARY SURFACE FINISH

510.15.1.1 Immediately after the forms have been removed, all exterior form bolts shall be removed to a depth of at least 1 inch below the surface of the concrete and the resulting holes or depressions cleaned and filled with mortar, except on the interior surfaces of box girders the bolts shall be removed flush with the surface of the concrete. Mortar shall consist of 1 part by volume of cement to 2 parts of sand. Mortar shall be mixed approximately 45 minutes in advance of use. Care shall be exercised to obtain a perfect bond with the concrete. After the mortar has thoroughly hardened, the surface shall be rubbed with a carborundum stone in order to obtain the same color in the mortar as in the surrounding concrete. All fins caused by form joints and other projections shall be removed and all pockets cleaned and filled. Mortar for filling pockets shall be treated as specified for bolt holes.

510.15.1.2 In the judgment of the ENGINEER, if rock pockets or other defects are of such extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the structure affected.

510.15.1.3 Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher class finish. Ordinary Surface Finish, unless otherwise specified, shall be considered as a final finish on the following surfaces:

510.15.1.3.1 The undersurfaces of slab spans, box girders, filled spandrel arch spans, and floor slabs between T girders or superstructures not for grade separation structures.

510.15.1.3.2 The inside vertical surface of T girders or superstructure not for grade separation structures and the exposed surfaces of channel walls.

510.15.1.3.3 Surfaces which are to be buried underground or covered with embankment and surfaces above finished ground of culverts where not visible from the traveled way.

510.15.1.4 On surfaces which are to be buried underground or surfaces which are completely enclosed, such as the cells of box girders, the removal of fins and form marks and the rubbing of mortared surfaces to a uniform color will not be required.

510.15.2 CLASS 1 SURFACE FINISH

510.15.2.1 After completion of the Ordinary Surface Finish, the entire surface specified shall be sanded with a power sander or other approved abrasive means as required to obtain a uniform color and texture. The use of power carborundum stones or discs will be required to remove unsightly bulges or irregularities. The Class 1 Surface Finish shall be applied after the removal of forms. The object of these operations is to obtain a smooth, even surface of uniform appearance and to remove unsightly bulges or depressions due to form marks and other imperfections. The degree of care in building forms and the character of materials used in formwork will be a contributing factor in the amount of such sanding and grinding requirement, and the ENGINEER shall be the sole judge in this respect.

510.15.2.2 Class 1 Surface Finish as hereinafter specified shall be applied to the following surfaces unless otherwise specified in the Supplementary Technical Specifications.

510.15.2.2.1 All surfaces of superstructures for grade separation structures.

510.15.2.2.2 All exposed surfaces of bridge piers, columns and abutments, and retaining walls and to at least 1 foot below finished grade.

510.15.2.2.3 The outside vertical surfaces and bottom surface of outside girders and the under surfaces of cantilever sidewalks, safety curbs, and floor slabs overhanging outside girders only of superstructures not for grade separation structures.

510.15.2.2.4 All surfaces of open spandrel arch rings, spandrel columns, and abutment towers.

510.15.2.2.5 Exposed surfaces of culvert headwalls and retaining walls, where visible from a traveled way.

510.15.2.2.6 Surfaces inside of culvert barrels having a height of 4 feet or more for a distance inside the barrel at least equal to the height of the culvert.

510.15.2.2.7 All interior surfaces of pump house motor and control rooms and engine generator rooms.

510.15.3 CLASS 2 SURFACE FINISH

Class 2 Surface Finish as hereinafter specified shall be applied to the following surfaces unless otherwise specified in the Supplementary Specifications: all surfaces of concrete railing, including barrier railing, rail posts rail end posts, and rail base. When Class 2 Surface Finish is specified, the Ordinary Surface Finish and Class 1 Surface Finish shall be completed in succession. The process specified under Class 2 Surface Finish shall then be deferred until all other work, which would in any way affect or mar the final finish, is complete. The CONTRACTOR shall then apply a brush coat or surface film of thin cement mortar composed of 1 part Portland cement and 1 part of fine sand of such size that it will pass a No. 16 sieve or, at the option of the ENGINEER, a neat cement wash. In either case, an amount of calcium chloride equal to 5 percent by volume of the cement shall be used in the brush coat. When the cement film has set sufficiently so that the sand particles or cement will not drag out of surface pin but before the final set has taken place, the entire surface shall be thoroughly rubbed either by hand or by mechanical means with fine carborundum stone until a smooth surface of even texture, color, and appearance is obtained. No greater amount of mortar shall be applied in advance of rubbing than can be completely rubbed before final setting takes place. Immediately following the rubbing process, the finished surface shall be thoroughly washed with water.

510.16 CURING

Immediately after the completion of the finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, the CONTRACTOR shall initiate the curing of the concrete as specified in Section 349 and/or as approved by the ENGINEER.

510.17 TESTS

Testing procedures shall be as provided for in Section 101. The number of test specimens to be taken for compression tests shall be as specified in Section 101 or as otherwise required by the ENGINEER.

510.18 MEASUREMENT: Structural Concrete for Concrete Structures shall be measured by the cubic yard or as part of a lump sum item as indicated in the Bid Proposal.

510.18.2 PAYMENT: The payment for Structural Concrete shall be at the contract unit price per cubic yard or lump sum, complete in place. Payment shall include all material, equipment and labor required in forming, supporting, placing, finishing, curing, form and support removal, and cleanup.
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-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: D-422 D-698 D-1557 D-2321 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, ¹ / ₄ 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			
	GW	Well graded gravels and gravel			
CLASS II SOILS** CLASS II SOILS** CLASS II SOILS**	GP SW SP	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. 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.			
		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. 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*** CLASS III SOILS*** CLASS III SOILS*** CLASS III SOILS***	GM GC SM SC	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. 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. Silty sands, sand-silt mixtures. More than 50% of coarse fraction passes No. 4 sieve. More than 50% retained on No. 200 sieve. 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 CLASS IV SOILS CLASS IV SOILS	ML CL MH CH	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve. 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. Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve. 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
CLASS V SOILS	OH	or low plasticity. Liquid limit 50% or
CLASS V SOILS	PT	less. 50% or more passes No. 200
		sieve.
		Organic clays of medium to high
		plasticity. Liquid limit greater than
		50%. 50% or more passes No. 200
		sieve.
		Peat, muck and other highly
		organic soils.

* 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 opera-tions, 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.

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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 -p1ace 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:

- The pipe outside diameter plus 2 feet for pipes 27 inches in diameter and smaller.
- 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 enforce-ment 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 deter-mined by ASTM D 1557.

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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

701.13.2.2 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 spring1ine 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 homogene-ous 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 Specifica-tions.

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 center1ine 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 compac-tion.

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

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 915

STORM SEWER DRAINAGE APPURTENANCES

915.1 GENERAL

The construction items, specified in this section, are related to the storm sewer underground facilities.

915.2 REFERENCES

915.2.1	This publication:	
	SECTION 300	SECTION 701
	SECTION 501	SECTION 910

915.3 MATERIALS

915.3.1 The construction plans will specify the size and material for the pipe between the storm sewer main and the storm water collection structure.

915.3.2 The various types of storm inlets and their relation to curb and gutter, or valley gutter are shown on the Standard Detail Drawings. Construction plans will identify the type to be constructed.

915.3.3 Grating size, material, and configuration shall conform to the Standard Detail Drawings.

915.4 INSTALLATION OF DRAINAGE FACILITIES

915.4.1 Excavation and backfilling for the storm inlet shall be accomplished in accordance with Section 501.

915.4.2 Trenching, backfilling, and compaction for the connecting pipe between the storm sewer main and the storm inlet shall conform to the specifications contained in Section 701. Pipe shall be installed in accordance with Section 910.

915.4.3 All pipe and structures shall be installed per location and elevations, as shown on the construction plans. If during the course of installation, an underground obstruction (i.e., existing utility line) the work shall stop and the ENGINEER shall be immediately notified so that the problem can be resolved.

915.4.4 Direct connection to storm sewer main will be permitted if the main is a minimum of 36 inches in diameter (I.D.) and the connecting line is not greater than 12 inches (I.D.). If storm sewer mains are 48 inches (I.D.) or larger, the connecting line diameter may be increased to 18 inches (I.D.). For connecting line sizes greater than those specified above, the connection to the main will be made into a manhole or by inserting into the main a factory constructed wye. Connection to the main will comply with the Standard Detail Drawings.

915.4.5 Removal of curb and gutter, and sidewalk for installation of a storm inlet shall be made at a scored or full depth joint.

915.4.6 Existing pavement removal and replacement shall conform to Sections 300 and 801 and shall conform to residential or arterial pavement sections of the same material (asphalt or Portland Cement concrete) as the existing pavement.

915.4.7 No width greater than 1/2 inch will be permitted between the inlet grate and the roadside portion of the inlet frame.

915.5 Private drainage facility installations, which are to be constructed under the authorization of "Drainage Facilities Within Public Right-of Way," shall comply with the Standard Detail Drawings and appropriate sections of this publication.

915.6 MEASUREMENT AND PAYMENT

915.6.1 Pavement removal and replacement will be measured by the square yard. Payment will be made at the unit price per square yard per type of replacement paving material, as specified in the Bid Proposal.

915.6.2 Trenching, backfilling, and compaction shall be measured by the linear foot from the main side wall of the inlet to the centerline of the main. Payment will be made at the unit price per linear foot per the average depth increment between connection points, as defined in the Bid Proposal.

915.6.3 Connecting pipe shall be measured by the linear foot along centerline of pipe from the main side wall of the inlet to the centerline of the main. Payment will be made at the unit price per linear foot per type and size of pipe, and shall include pipe in place and all necessary jointing materials.

915.6.4 Storm inlets shall be measured on a unit basis. Payment will be made at the unit price per each type of storm inlet, and shall include structure, grating, excavation, backfilling and compaction, and curb removal and replacement, as defined in Bid Proposal. 915.6.5 Removal and replacement of sidewalk shall be measured by the square foot and payment will be made at the unit price per square foot.

915.6.6 Measurement and payment for manholes will be as indicated in Section 920.

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 inplace, 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, per-formed for new precast units, or for largesize 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 4foot-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-footdiameter 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: "Zebron," "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-plan 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 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 appurtances 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 manhole 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 bv the CONTRACTOR as directed OWNER. by 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 4foot 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 RE-PLACEMENT 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.

NATIVE GRASS SEEDING

1012.1 GENERAL:

Work under this section consists of preparing all area indicated on the plans for native grass seeding, furnishing and installing all seed, fertilizer and soil amendments as specified herein and on the plans, or as authorized by the ENGINEER.

1012.2 REFERENCES:

1012.2.1 This Publication:

Section 1011

1012.3 WORK AREA/TIMING:

1012.3.1 Areas that are disturbed by the CONTRACTOR that are outside the construction limits shown on the plans or authorized by the ENGINEER shall be seeded with native grasses as specified herein at no cost to the OWNER.

1012.3.2 The seeding of disturbed areas shall commence upon completion of the other work in the area.

1012.4 MATERIALS:

1012.4.1 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 Specification.

1012.4.1.1 Sandy Soils. Seed rate is given in pounds of pure live seed (P.L.S.) per acre.

Variety/	<u>Genus</u> /	
<u>Common Name</u>	P.L.S/Acre Species	
"Paloma"Indian	Oryzopsis	5.0
"Viva" Galleta	Hilaria iamesii	1.0
grass		
"Niner" Side	Bouteloua	3.0
oats grama	curtipendula	
"Hatchita" Blue	Bouteloua	1.0
grama	gracilis	
Sand dropseed	Sporobolus	1.0
(NM Region)	cryptandrus	
Fourwing saltbush	Atriplex	<u>1.0</u>
(NM Region)	canescens	
	(de-winged)	
Total rate		12.0 lbs/

acre

1012.4.1.2 Clay, Clay Loam, and Sandy gravelly clay loam soils. Seed rate is given in pounds of pure live seed (P.L.S.) per acre.

<u>Common Name</u>	<u>Genus/species</u> <u>PLS/acre</u>	
"Paloma"	Oryzopsis	2.0
Indian rice	hymenoides	
grass		
"Viva" Galleta	Hilaria jamesii	2.0
grass		
"Niner"	Bouteloua curti	2.0
Sideoats grama	pendula	
"Hatchita" Blue	Bouteloua	3.0
grama	gracilis	
Sand dropseed	Sporobolus	1.0
(NM Region)	cryptandrus	
Four-wing	Atriplex	1.0
Saltbush	canescens	1.0
(NM Region)	(de-winged)	
Total rate		11.0 lbs/ac

NOTE: If the area to be seeded is along a recreational trail of any type the seed mixes for either type of soil listed above shall exclude the one (1) pound per acre of Four-wing saltbush. The seeding rate shall be lowered by one (1) pound per acre.

1012.4.1.3 Seeds may be pre-mixed by a seed dealer. Each bag of seed shall be sealed and labeled by the seed dealer in accordance with Federal Seed Laws and New Mexico Department of Agriculture Labeling Laws. This includes: variety, kind of seed, lot number, purity, germination, percent crop, percent inert, percent weed (including noxious weeds), origin, test data and net weight. Federal Seed Laws require that analysis shall be no older than 5 months for seed shipped interstate and no older than 9 months for seed shipped intra-state. The ENGINEER shall receive all labels from all bags of seed used for verification.

1012.4.2 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 of these specifications.

1012.4.3 MULCH:

1012.4.3.1 Hav Mulch: Perennial native or introduced grasses of fine-stemmed varieties shall be used unless otherwise specified on the plans. At least 65 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 of species to be seeded will be acceptable. Tall wheat grass, intermediate wheat grass, switch grass, or orchard hay will be acceptable if cut prior to seed formation. 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. Hay shall be properly cured prior to use. Hay which is brittle, short fibered or improperly cured is not acceptable.

1012.5.2 Straw Mulch: Small grain such as wheat, barley, rye, or oats will not be allowed except by prior approval of the ENGINEER and with the concurrence of the Air Division, Environmental Health Department. Alfalfa or the stalks of corn, maize or sorghum is not acceptable. Material which is brittle, shorter than 10 inches or which breaks or fragments during the crimping operation will not be acceptable.

1012.4.3.3 Gravel Mulch: Gravel mulch shall be crushed or screened gravel 3/4" to 1" maximum size with a minimum of one fractured face unless otherwise specified.

1012.4.3.4 Erosion Control Matts, Fabric or Blankets: The type of erosion control mats, fabric or blankets used shall be as specified or allowed on the plans or in the Supplemental Technical Specifications.

1012.5 SEED BED PREPARATION:

1012.5.1 General:

1012.5.1.1 Prior to the starting of any seed bed preparation the final grades of all earth work shall be inspected and approved by the ENGINEER.

1012.5.1.2 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 discing operation.

1012.5.1.3 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 recompaction occurs, the affected area shall be reworked beginning with seed bed preparation. Depth of preparation must be approved by the ENGINEER prior to the seeding and mulching operations.

1012.5.2 Mechanical Preparation: The seed bed shall be loosened to a minimum depth of 6" (six inches) by means of disc or harrow. Area of heavy or compacted soil may require additional preparation such as chiseling or ripping if discing alone does not result in preparation to the full minimum depth of 6". The soil shall be worked to a smooth surface free of clods, stones 4" and larger or any other debris or foreign material that could interfere with seeding or crimping equipment operations.

1012.5.3 Hand Preparation: Areas which cannot be prepared with mechanized equipment because of small size irregular shape or slope angle may be prepared to a minimum depth of 2" using hand tools or a rototiller. Any such areas will be specified on the plans.

1012.6 SEEDING:

1012.6.1 General:

1012.6.1.1 Seeding shall not start until the seed bed preparation has been inspected and approved by the ENGINEER.

1012.6.1.2 No more area may be seeded than can be covered with mulch and crimped, or covered with gravel mulch or erosion control mats by the end of the work day. No seeding operations may be conducted when steady wind speed exceeds 10 miles per hour. If winds exceed 10 mph while seeding is underway, seeding operations will be halted and any areas seeded to that point completed.

1012.6.2 Seed Application:

1012.6.2.1 Drill Seeding: Drill seeding is required unless otherwise specified on the plans or in the Supplemental Technical Specifications. Seed shall be applied with a "rangeland" type seed drill equipped with packer wheels. Seed shall be drilled to a maximum depth of 1/2" unless otherwise specified. Direction of seeding shall be across slopes and on the contour whenever possible.

1012.6.2.2 Broadcast Seeding: Seed may be applied using the broadcast method when size, irregular shape or slope angle exceeding 3.1 prevents the use of a seed drill. Seed may be broadcast by hand or by means of a mechanical seeder provided that the seed is evenly distributed over the seeding area. Areas of broadcast seeding will be hand raked to cover seed. Areas which are broadcast seeded shall be seeded at rate which is double that used for drill seeding.

1012.6.2.3 Seeding With Gravel Mulch: Areas to receive gravel mulch will be seeded at the broadcast seed rate with 1/2 the seed applied prior to application of gravel and 1/2 the seed applied on the surface of the gravel. Water shall be applied in quantity sufficient to wash seed from the surface and into the gravel.

1012.6.2.4 Hydro Seeding: Hydro seeding will not be allowed on areas of non-irrigated native grass seeding unless specified on the plans or in the Supplemental Technical Specifications or authorized by the ENGINEER.

1012.7 MULCHING:

1012.7.1 General:

1012.7.1.1 All seeded areas shall be mulched unless otherwise specified on the plans or in the Supplemental Technical Specifications.

1012.7.1.2 On seeded areas that are level or have slopes 3:1 or less, any of the four (4) types of mulching or erosion control specified herein may be used. On seeded areas that have slopes steeper than 3:1 only gravel mulch or erosion control materials may be used as specified on the plans and in the Supplemental Technical Specifications.

1012.7.2 Hay Mulch: Hay mulch shall be applied at a minimum rate of 1.5 tons per acre of air dry hay.

1012.7.3 Straw Mulch: Straw mulch shall be applied at a minimum rate of 2.5 tons per acre of air dry straw.

1012.7.4 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. The mulch shall be wetted down and allowed to soften for 15 to 20 minutes prior to crimping. 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 6 inches 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 the Supplemental Technical Specifications. The discs shall be of sufficient diameter to prevent the frame of the equipment from dragging the mulch.

The crimping operations shall be across the slope where practical but not be parallel to prevailing winds or by tight interlocking "S" curves to avoid straight crimp lines.

If small grain straw mulch is used it shall be crimped in two (2) directions in a cross-hatch pattern.

1012.7.5 Gravel Mulch: Gravel mulch shall be placed by hand or by mechanized equipment that provides full coverage at a uniform thickness of 2 inches in depth.

1012.7.6 Erosion Control Matts, Fabric or Blankets: the type of erosion control mats, fabric or blankets used shall be as specified on the plans or the Supplemental Technical Specifications or as approved by the ENGINEER. The anchoring of the erosion control items shall be as per the manufacturer's recommendations.

1012.8 PROTECTION OF NATIVE GRASS SEEDED AREA:

1012.8.1 GENERAL: The CONTRACTOR shall be responsible for protecting and caring for seeded areas until final acceptance of the work and shall repair at his expense any damage to seeded areas caused by pedestrian or vehicular traffic or vandalism.

1012.9 INSPECTION FOR NATIVE GRASS AREA:

1012.9.1 The following inspection shall be the minimum required inspections to native grass during the course of construction. Additional inspections shall be made at any time at the discretion of the ENGINEER.

1012.9.2 It shall be the responsibility of the CONTRACTOR to notify the ENGINEER, in writing, 48 hours in advance of each required inspection.

1012.9.3 The sequence of required inspections shall not be changed from the sequence listed below. The CONTRACTOR shall not proceed with work of the next sequence without written approval of the work of the previous sequence. Payment will not be approved for items which have not been inspected and approved in writing.

1012.9.3.1 Each phase of soil preparation shall be inspected in process.

1012.9.3.2 Finish grade shall be inspected.

1012.9.3.3 Seed shall be inspected prior to seeding.

1012.9.3.4 Seeded area shall be inspected after completion.

1012.9.3.5 Final inspection of the project and acceptance.

1012.10 MEASUREMENT AND PAYMENT

1012.10.1 MEASUREMENT: The measurement of native grass seeding shall be by the acre.

1012.10.2 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.

SECTION 1200

TEMPORARY TRAFFIC CONTROL

1200.1 GENERAL

This section pertains to barricading and temporary traffic control:

1200.2 CONTENTS

Section No.	Title

1200

Barricading and Temporary Traffic Control

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 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
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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. New Mexico Department of Transportation

203.1 DESCRIPTION

This Work consists of performing excavation in soil and rock Material, providing borrow Material, constructing Embankment, hauling, disposing, placing, and compacting Materials.

203.2 MATERIALS

The Department will provide geotechnical and/or pavement investigation data in the Contract documents, when available. The Contractor shall use the data for information only.

203.2.1 Material Classifications

203.2.1.1 Rock Excavation

Rock excavation is Material that meets one (1) of the following field test criteria:

- 1. **Ripping Test.** Material that cannot be broken down with two passes parallel to construction centerline with a single tooth ripper mounted on a crawler-type tractor in low gear with a minimum net flywheel power rating of 255 hp;
- Seismic Test. Material that has a seismic velocity greater than 6,000 ft/s. The Contractor shall submit the qualifications of the individual performing and interpreting the seismic testing to Project Manager for approval a minimum of 14 Days prior to testing. Perform the Ripping Test to resolve differences in Material classification if seismic velocities fall below 6,000 ft/s; or
- 3. **Handling Test.** Boulders or detached stones having a volume greater than one (1) yd³ that cannot be readily broken down with excavation Equipment.

203.2.1.2 Unclassified Excavation

Unclassified excavation shall consist of the excavation of all Materials other than rock excavation obtained within the Right of Way. Suitable Material obtained from unclassified excavation shall be used for areas that require Embankment.

203.2.1.3 Borrow

Borrow shall consist of Contractor provided suitable Embankment Materials obtained from an approved source outside the Right of Way, unless otherwise specified in the Contract. The Contractor shall only utilize borrow when the following conditions are met, unless approved otherwise by the Project Manager:

- 1. All unclassified excavation Material has be utilized in the Contractor's current phase of construction;
- 2. The Contractor has requested to begin Borrow operations and the Project Manager has concurred; and
- 3. Embankment areas that require borrow have been bladed and cross sectioned by the Contractor and provided to the Project Manager.

Borrow Material placed within two (2) Ft, vertically and laterally, of final Subgrade elevations shall meet the design R-Value as shown in the Contract. Prior to borrow operations the Contractor shall perform R-value testing in accordance with AASHTO T-190 at the best fit exudation pressure of 300 psi at each borrow source. This information shall be submitted to the Project Manager with the request to begin borrow operations. During borrow placement, if the Project Manager observes changes in soil properties, including gradation, plasticity limits,

Section 203: Excavation, Borrow, and Embankment

and/or additional soil characteristics, then, at the Project Manager's request, additional AASHTO T-190 tests may be required, at the Contractors expense.

When Work conforming to Section 306, "Portland Cement or Lime Treated Subgrade" is specified in the Contract, the Contractor shall perform sulfate testing in accordance with AASHTO T290 at each borrow source. Sulfate content shall be determined and reported as parts per million (ppm). Soils with sulfate contents equal to or greater than 2,000 ppm shall not be used as borrow.

203.2.1.4 Unstable Subgrade Stabilization

See Section 203A, "Unstable Subgrade Stabilization", when specified in the Contract.

203.2.1.5 Unsuitable Material

Unsuitable Material includes organic Materials, frozen lumps, ice, and soils such as peat, shale, gypsum or other soil or rock Materials that may degrade with time, or are contaminated. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material below embankment and areas identified by the Project Manager and determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with this Specification.

203.3 CONSTRUCTION REQUIREMENTS

203.3.1 General

The Contractor shall finish excavation and Embankment for the Roadway, intersections, and entrances to reasonably smooth and uniform surfaces. The Contractor shall not remove Materials from the Project limits without the approval of the Project Manager.

The Contractor shall ensure Borrow Material placed within the top two (2) Ft of the finished Subgrade meets the minimum design R-value.

The Contractor shall preserve the Materials below and beyond the lines and grades while conducting excavation operations. Before beginning excavation, grading, and Embankment operations, the Contractor shall perform the necessary clearing and grubbing in accordance with Section 201, "Clearing and Grubbing." The Contractor shall notify the Project Manager before opening excavation or borrow areas. The Contractor shall take cross section elevations of the ground surface before opening excavation or borrow areas.

The Contractor shall terminate operations in the immediate area of environmental or Cultural Resources not listed in the Contract, until the Department reviews and completes appropriate mitigation actions in accordance with Section 107.12, "Environmental, Hazardous Materials and Cultural Resource Discoveries."

203.3.2 Excavation

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Within cut sections, the Contractor shall remove excavated Material from the limits of the cut section to the Subgrade elevation for the width of the Roadbed. The Contractor shall finish Roadbed cut sections to a smooth and uniform surface. The Contractor shall remove unsuitable Material below finished Subgrade in accordance with 203.2.1.5, "Unsuitable Material." The Contractor shall take cross-sectional measurements after the removal of unsuitable Material.

203.3.3 Rock Cuts

The Contractor shall perform proper drilling and blasting operations in accordance with the specified practices. When required, the Contractor shall perform controlled blasting of rock excavation to produce a clean face on the excavated cut. The Contractor shall ensure subsequent blasting and excavation operations do not affect previously excavated faces. The Contractor shall not excavate more than six (6) inches below the specified Subgrade elevation for Roadbed cuts in rock, unless directed otherwise. The Contractor shall not leave undrained pockets on the Roadbed surface. The Contractor shall place and compact Base Course on the rock cut foundation in accordance with Section 303, "Base Course."

203.3.3.1 Blasting Requirements

The Contractor shall use controlled blasting to establish a specified backslope with minimal blast damage, and production blasting to facilitate excavation. Before the start of blasting, the Contractor shall notify adjacent property owners, occupants and utility owners.

203.3.3.1.1 Definitions

Blasting Operations. Activities related to blasting including, but not limited to the following:

- 1. Collaring and drilling blast holes;
- 2. Preparing, fixing, loading, and firing explosive charges;
- 3. Assessing the blast after detonation; and
- 4. Handling misfires.

Buffer Row. The first row of production blast holes immediately adjacent and drilled in a plane parallel to the controlled blast line. The explosive load in the buffer row should be reduced from standard production loads to minimize damage to the backslope of the final excavation.

Controlled Blasting. The controlled use of explosives and blasting accessories in carefully spaced and aligned blast holes to provide a free surface or shear plane in the rock along the specified backslope, and to limit fly rock, permanent ground displacement, air concussion, and overbreak. Controlled blasting methods include pre-splitting and cushion blasting.

Cushion Blasting (Trim Blasting). The simultaneous detonation of one (1) line of blast holes along a specified excavation backslope after the main excavation is complete. This method is performed to trim the excavation to the final backslope.

Final Line (Controlled Blast Line). Refers to the row of controlled blast holes drilled in the plane of a specified excavation backslope. The controlled blast holes drilled in this plane constitute the basis for payment under the Controlled Blasting pay item. The Department considers the blast holes drilled in front of the final line blast holes to be production blast holes, which are Incidental to the Rock Excavation pay item.

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Pre-Splitting. The simultaneous detonation of one (1) line of blast holes drilled along a specified excavation backslope before production blast holes are fired.

Production Blasting. Fragmentation blasting in the main excavation area.

203.3.3.1.2 Submittals

203.3.3.1.2.1 Blaster in Charge

The Contractor shall not begin drilling or blasting Work until the Project Manager approves of the Blaster in Charge. The Contractor shall submit the name and qualifications of the proposed Blaster in Charge to the Project Manager for approval at least 30 Days before the delivery of explosive Material to the Project. The Contractor shall provide the following information:

- 1. Proof of a license by the applicable State and/or local regulatory agencies to possess, transport, and use explosives; and
- 2. A list of, and references, for at least three (3) blasting Projects, of similar complexity, successfully completed within the previous five (5) years.

The Blaster in Charge must be on site during blasting operations.

203.3.3.1.2.2 Blasting Plans

The Contractor shall submit a General Blasting Plan to the Project Manager for each cut that requires blasting, at least two (2) weeks before the start of drilling and blasting operations on a specified cut. The Contractor shall provide the following information in the General Blasting Plan:

- 1. Description of the proposed blasting operation;
- 2. Preliminary design criteria for production and controlled blasting, including blast hole depths and patterns; and
- 3. Details regarding the proposed explosives and blasting accessories.

The Contractor shall submit a Detailed Blasting Plan at least 48 H before an individual blast. The Contractor shall provide the following information in the Detailed Blasting Plan:

- 1. Station limits of the proposed location of the blast, including the bench elevation, if applicable;
- 2. Date and time the blasting will occur;
- 3. Required removal of overburden, if applicable;
- 4. Plan and cross section diagrams of proposed drill pattern for controlled and production blast holes, including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height, and subdrill depth. Draw these Plans and cross sections to scale;
- 5. Loading diagram showing the type and amount of explosives, primers, and initiators; and the location, depth, and type of stemming;
- 6. Initiation sequence of controlled and production blast holes, including Delay times and the Delay system; and
- 7. Manufacturer's data sheets for the explosives, primers, and initiators to be used.

The Contractor shall submit the blasting Plans to the Project Manager for review and Acceptance. The Project Manager will review and provide comments to the Contractor. The

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Contractor shall submit revisions to the blasting Plans for final review and Acceptance. The Contractor shall not proceed with drilling and blasting operations related to a General Blasting Plan or loading of blast holes associated with a Detailed Blasting Plan without written notice.

The Contractor shall cease blasting operations and submit revised blasting Plans if the Department determines that the blasting operations are causing property damage in and beyond the Right of Way.

203.3.3.1.2.3 Blasting Records

The Contractor shall prepare and submit to the Department a Blasting Record for each blast, on the Day of the blast. The Contractor shall provide the following information in a Blasting Record:

- 1. Actual dimensions of the shot, including blast hole diameters and depths, burden, spacing, subdrilling depths, stemming, powder loads, powder factors, and timing;
- 2. A drawing or sketch showing the direction of the face and the physical shot layout;
- 3. The location of the blast in relation to Project stationing and elevation;
- 4. The date and time of loading and detonation;
- 5. The name and signature of the person responsible for loading and firing;
- Comments by Blaster in Charge regarding misfires, fly rock occurrences, unusual results or effects; and damage to existing facilities, adjacent property, or completed Work;
- 7. Vibration and blast monitoring results; and
- 8. Any complaints received due to the blasting.

203.3.3.1.3 Explosives

The Contractor shall transport, store, handle, and use explosives in accordance with applicable federal, State, and local laws and regulations. The Contractor shall purchase explosives and accessory devices from industry recognized Suppliers and manufactures. The Contractor shall use explosives and accessory devices in accordance with manufacturer instructions. The Contractor shall not use expired products.

The CFR specifies responsibility for the following federal agencies regarding the administration of regulations involving explosive Materials:

- Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). Storage and accountability of record keeping and security in accordance with 27 CFR part 555;
- 2. OSHA. Transportation, worker safety, and health in accordance with title 29 CFR; storage and safe blasting practices in handling and use in accordance with 29 CFR part 1926.900 et seq; and
- 3. Federal Department of Transportation (USDOT). Transportation and public safety, 49 CFR.

The fire marshal, sheriff, or other local officials, may have additional regulations for explosive Materials.

203.3.3.1.4 Safety

The Contractor shall follow safe practices, including the following:

1. Federal, State, and local regulations pertaining to the transportation, storage, and use of explosives must be strictly followed;

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- 2. When required, the Blaster in Charge must obtain a blasting permit from the local regulatory agency before blasting;
- 3. Only persons authorized and qualified based on training and experience will handle and use explosives;
- No person will smoke; carry matches or other flame producing devices; or carry firearms or loaded cartridges while in or near a motor vehicle that is transporting explosives;
- Keep track of explosives at all times. Explosives must be stored and locked in an approved magazine facility in accordance with the applicable provisions of the Department, ATF, and OSHA until used in blasting;
- 6. Post appropriate signs in the required areas and vehicles in accordance with federal regulations;
- 7. Safely station the necessary guards or flag persons on Highways during blasting to control Highway traffic; and
- Before starting Work in the cut, observe the entire blast area for at least five (5) minutes after each blast. Remove potentially dangerous rocks or other Material located beyond the excavation limits. Cease blasting operations if the required slopes are not stable, or if the safety and convenience of the public are being jeopardized.

203.3.3.1.5 Vibration Risk Survey

For each cut that requires blasting, the Contractor shall perform a vibration risk survey of nearby buildings, Structures, utilities, water supplies, or environmentally sensitive areas that may be at risk of blasting or construction damage. The Contractor shall perform the vibration risk survey in accordance with Section 617, "Vibration Monitoring and Video Taping." The Contractor shall obtain written approval for the vibration risk survey from the Project Manager before drilling blast holes.

203.3.3.1.6 Blasting Test Sections

The Contractor shall demonstrate the adequacy of proposed Blasting Plan with a blasting test section(s) for Material of different geologic characteristics. For Projects involving multiple cuts in similar geologic Materials, the Project Manager may reduce the requirement for a blasting test section in each cut. Blasting test sections include drilling, blasting, and excavating cut sections approximately 100 Ft long to determine the optimal combination of method, blast hole spacing, and charge. When field conditions warrant, the Project Manager may direct the Contractor to use test section lengths less than 100 Ft long.

Blasting test section requirements include the following:

- The Contractor shall perform the blasting test section in accordance with Section 203.3.3.1, "Blasting Requirements." The Contractor shall prepare and submit a Detailed Blasting Plan for the test section to the Project Manager at least 48 H before the planned time of the blast. The Contractor shall not start blasting the test section until the Project Manager Accepts the Detailed Blasting Plan;
- 2. Unless the Contractor's Detailed Blasting Plan indicates otherwise, the Contractor shall begin the tests with the controlled blast holes spaced at 30 inches; and
- 3. After blasting, the Contractor shall remove a sufficient amount of Material from the test section to determine if the blast hole diameter, blast hole spacing, and amount of explosives are adequate to provide the required backslope. The Contractor shall not continue drilling of the test section area until the test section is excavated and the Department evaluates the results.

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If, at any time during the progress of the main blasting operation, the methods of drilling and blasting do not produce the desired results, the Contractor shall revise and retest the blasting techniques until a technique produces the required results. The Department will consider the results to be unsatisfactory if:

- 1. There is an excessive amount of breakage beyond the indicated lines and grade;
- 2. There is excessive flyrock;
- 3. The final backslope within the specified tolerances is not uniform or overhangs are created;
- 4. Ground vibration and air blast levels exceed limits as stated in Section 617, "Vibration Monitoring and Video Taping;"
- 5. There are violations of other requirements of the Specifications;
- 6. The slopes are unstable;
- 7. The safety of the public is jeopardized; and
- 8. Property or natural features are endangered.

203.3.3.1.7 Blasting Execution

203.3.3.1.7.1 Notification and Schedule

The following requirements will apply to the notification and scheduling of blasting procedures:

- The Contractor shall coordinate blasting operations with the Project Manager and notify the Project Manager a minimum of 1.5 H before the blast. The Contractor shall provide a one (1) hour timeframe for the blast. For example, if the Contactor notifies the Project Manager by 9:00 a.m. the blast may occur between 10:30 a.m. and 11:30 a.m.;
- 2. The Contractor shall provide notice to the required federal, State, and local agencies before each blast, as required by the blasting permits;
- The Contractor shall notify occupants of buildings and owners of Structures and utilities of the blast time and location at least 48 H before the start of drilling or blasting; and
- 4. The Contractor shall detonate blasts at the planned time, unless approved otherwise by the Project Manager.

203.3.3.1.7.2 General Requirements

The Contractor shall cover the blast area with blasting mats, soil, or another equally serviceable Material, before firing blasts in areas where flying rock may result in personal injury or damage to property or the Work.

203.3.3.1.7.3 Controlled Blasting Requirements

The Contractor shall perform controlled blasting in accordance with the Detailed Blasting Plans that produced Acceptable results in blasting test sections. The Contractor shall perform control blasting using either pre-splitting or cushion blasting in accordance with the following requirements:

 If the overburden does not support the drill holes, completely remove the overburden soil and loose rock along the top of the cut to expose the rock surface before drilling the controlled blast holes;

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- 2. Mechanically monitor the blast hole angles;
- 3. Drill and space blast holes with a nominal diameter from two (2) inch to three (3) inch, in accordance with the blasting test sections or the results achieved in similar geologic Materials. Do not exceed three (3) Ft;
- 4. Use proper Equipment and technique to ensure that no blast holes deviate from the plane of the backslope shown in the Plans by more than eight (8) inches, parallel or normal to the slope. The Department will not pay for blast holes exceeding these limits unless the Project Manager approves the obtained slopes;
- 5. Drill the controlled blast holes at the required slope inclination, to the full depth of the cut, or to a pre-determined stage elevation. The maximum drill depth is 30 Ft. Use shallower holes if the directional control is inadequate. If more than five percent (5%) of the controlled blast holes are misaligned in any one (1) lift, reduce the height of the lifts until the eight (8) inch tolerance is met. The length of controlled blast holes may be incrementally increased once satisfactory directional control and blast results are demonstrated;
- 6. Drill unloaded and un-stemmed guide holes to the same diameter, in the same plane, and to the same tolerance as the controlled blast holes;
- 7. The Department will allow a maximum offset of 24 inches from the bottom of each lift to allow for drill Equipment clearances, when the cut requires more than one (1) lift. Begin drilling the control blast hole at a point that allows the necessary offsets, and adjust at the start of lower lifts as necessary to compensate for drift in the upper lifts;
- 8. Do not use horizontal blast holes for controlled blasting;
- 9. Use explosive charges, detonating cord, and other items necessary for the blasting operation in accordance with the manufacturer's recommendations and instructions;
- 10. Before placing charges, ensure the hole is free of obstructions. Use casing if necessary to prevent the walls of the hole from collapsing;
- 11. Use only standard explosives manufactured especially for the type of controlled blasting (cushion or pre-splitting). Do not load ammonium nitrate and fuel oil in the controlled blast holes. Use explosives and blasting accessories appropriate for the conditions of the blast hole (including water in the holes) and necessary to achieve satisfactory results;
- 12. Assemble and affix continuous column cartridge-type explosives to the detonating cord in accordance with the explosive manufacturer's instructions;
- 13. The bottom charge in a blast hole may be larger than the charges above, but not large enough to cause overbreak. Place the top charge far enough below the collar and sufficiently reduced in size to avoid overbreaking or heaving; and
- 14. Use a dry, angular, and granular Material that passes a 3/8 inch sieve to stem the controlled blast holes, from the top charge to the hole collar.

203.3.3.1.7.4 Pre-Split Blasting

The Contractor shall perform pre-split blasting in accordance with Section 203.3.3.1.7.3, "Controlled Blasting Requirements," and the following requirements:

- Detonate the pre-split blast holes before drilling for production blasting; or fire the pre-split blast holes at least 75 Ms before the production holes if detonated in the same blast;
- Fire pre-split blast holes simultaneously, unless ground vibrations, noise, or air blast are excessive. Fire pre-split holes in delayed sections and reduce the charge weight per delay to mitigate excessive effects;

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- 3. The line of pre-split blast holes will extend beyond the limits of the production blast holes to be detonated. The minimum length of this extension will be 30 Ft or to the end of the cut, but will not be greater than one-half of the distance of the expected blast advance; and
- 4. Do not perform pre-split blasting if the distance between the controlled blast line and free face is less than 20 Ft or less than three (3) times the blast hole depth, whichever is greater.

203.3.3.1.7.5 Cushion Blasting

The Contractor shall perform cushion blasting in accordance with item No. 3 of Section 203.3.3.1.7.3, "Controlled Blasting Requirements," and the following requirements:

- 1. Perform cushion blasting as part of the final shot after other blasting is finished;
- 2. If the final shot includes production blast holes, detonate the cushion blast no more than 75 Ms or less than 25 Ms after the production blast; and
- 3. Fire cushion blast holes simultaneously, unless ground vibrations, noise, or air blast are excessive. Fire cushion blast holes in delayed sections and reduce the charge weight per delay to mitigate excessive effects.

203.3.3.1.7.6 Production Blasting

The Contractor shall perform production blasting in accordance with the Blasting Plan that produced Acceptable results in blasting test sections and the following requirements:

- 1. Minimize blast damage to the final excavation backslope;
- 2. Drill buffer rows of production blast holes on a plane approximately parallel to the controlled blast line;
- Place the buffer row of production blast holes no closer than six (6) Ft to the controlled blast line unless the Contractor can prove the final excavation backslope will not be damaged by the production blast;
- 4. Where necessary to minimize damage to the excavation backslope, load blast holes in the buffer row lighter than other production holes;
- 5. Ensure the bottoms of production blast holes are not lower than the bottom of controlled blast holes, except in the lowest lift;
- 6. Ensure the diameter of production blast holes does not exceed six (6) inches, unless approved by the Project Manager;
- 7. Before placing charges, ensure the hole is free of obstructions. Use casing, if necessary, to prevent the walls of the hole from collapsing;
- 8. Use a dry, angular, and granular Material that passes a 3/8 inch sieve to stem the holes, from the top charge to the hole collar;
- 9. Detonate production blast holes in a controlled delay sequence toward a free face;
- 10. Do not use horizontal holes for production blasting, except for Equipment access; and
- 11. Use explosives and blasting accessories appropriate for wet or dry blast hole conditions as necessary to achieve satisfactory results.

203.3.3.1.7.7 Scaling and Stabilization of Slopes Established by Controlled Blasting

The Contractor shall perform scaling and stabilization of slopes established by controlled blasting in accordance with the following requirements:

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- Observe the entire blast area following a blast before starting Work in the cut. If any rocks are loose, hanging, or potentially dangerous within a blast area, the Contractor shall remove them. Scale slopes by hand using a standard steel mine scaling rod. Use other methods to supplement or in lieu of hand scaling, such as, machine scaling, hydraulic splitters, or light blasting, if approved by the Project Manager;
- 2. Slopes shall be scaled and stabilized before further construction activities take place. Scale slopes throughout the span of the Contract and as often as necessary to keep the slopes free of hazardous loose rock or overhangs; and
- 3. Cease blasting operations if the following conditions exist:
 - 3.1. There is an excessive amount of breakage beyond the specified lines and grade;
 - 3.2. There is excessive flyrock;
 - 3.3. The final backslope within the specified tolerances is not uniform;
 - 3.4. Ground vibration and air blast levels exceed limits specified in Section 617, "Vibration Monitoring and Video Taping;"
 - 3.5. There are violations of other requirements of the Specifications;
 - 3.6. The slopes are unstable;
 - 3.7. The safety of the public is jeopardized; and
 - 3.8. Property or natural features are endangered.

203.3.4 Borrow

The Contractor shall be responsible for obtaining the borrow source, unless otherwise specified in the Contract. The Contractor shall exhaust all available suitable Material from unclassified excavation operations prior to utilizing a borrow source. The Contractor shall notify the Project Manager in writing, and request that borrow operations commence, when the Contractor exhaust unclassified excavation Material for Embankment. Borrow placed prior to this notification shall not be paid. If the Contractor places more than the specified amount of borrow and causes a waste of unclassified excavation, the Department will deduct the wasted amount from the borrow volume, as measured in the borrow area. After unclassified excavation is complete, the Contractor shall blade the areas that require borrow to allow accurate payment measurements by cross sectioning by the Contractor. The Contractor shall maintain and restore Right of Way fencing removed for borrow operations to its original condition or better to prevent livestock from entering Right of Way during the Project.

203.3.5 Embankments

The Contractor shall not place Embankment Material on frozen earth, or incorporate frozen soils in Embankments. The Contractor shall suspend Embankment construction if Embankment Materials become frozen. The Contractor shall not resume until the Materials are thawed and suitable for compaction. Before beginning Embankment construction, the Contractor shall perform scalping in accordance with Section 201, "Clearing and Grubbing." The Contractor shall bench new Embankments into the following:

- 1. Natural slopes including rock;
- 2. Existing Embankments; or
- 3. Phased Embankment construction.

The Contractor shall ensure benches are wide enough to allow operation and placement of compacting Equipment. The Contractor shall recompact new Embankment Material and

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Material that is cut out at no additional cost to the Department. The Contractor shall not place rock, broken concrete, or other solid Materials in Embankment areas where driven pilings, drilled shafts, utility lines, or other Structures are specified in the Contract.

203.3.5.1 Roadbed Embankments

The Contractor shall break up the original ground surface to at least six (6) inches by plowing, scarifying, or stepping up. The Contractor shall compact this area in accordance with Section 203.3.6, "Moisture and Density Control." The Contractor shall place Material for Roadbed Embankment in uniform lifts not exceeding eight (8) inches thick and compact in accordance with Section 203.3.6, "Moisture and Density Control."

The Department will allow rocks no larger than three (3) Ft (in any dimension) as long as the Contractor distributes and fills the interstices to form a dense mass. If the interstices between the rock fragments cannot be completely filled and compacted, the Contractor shall use bridging geotextile, approved by the Project Manager, over the top of the rock fragments to prevent the overlying Embankment Material from filling the interstices. The Contractor shall not use rock fragments that may degrade with time or may be water sensitive (such as shale or gypsum) as rock fill in Roadbed Embankments.

The Contractor may place larger rocks greater than three (3) Ft in any dimension in the toe of the slope in accordance with the following requirements:

- 1. No rock is larger than one-half the Embankment height or ten (10) Ft;
- 2. No rock is placed in fill height less than eight (8) Ft, measured at the edge of the Roadway Shoulder; and
- 3. Place rocks inside a line six (6) inches from the slope stake, space a minimum of three (3) Ft from edge to edge, and cover with approved Embankment Material.

The Contractor shall construct rock Embankments to a maximum of six (6) inches below Subgrade elevation. The Contractor shall consolidate rock fills by using the appropriate Equipment and methods approved by the Project Manager.

203.3.5.2 Non-Roadbed Embankment

The Contractor shall break up the original ground surface to at least six (6) inches by plowing, scarifying, or stepping up. The Contractor shall compact this area in accordance with Section 203.3.6, "Moisture and Density Control." The Contractor shall place Material for Non-Roadbed Embankment in uniform lifts not exceeding eight (8) inches thick and compact in accordance with Section 203.3.6, "Moisture and Density Control."

If the Embankment Material consists of rock, place the rock in layers of sufficient depth to contain the largest rock in the Material, and carefully distribute and fill the interstices to form a dense mass.

203.3.6 Moisture and Density Control

Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

The Contractor shall construct Roadbed, Roadbed Embankment, non-roadbed Embankment, and Roadway Median excavation or Embankment, with moisture and density control. The Contractor shall compact each layer of Embankment to at least 95% of maximum density as specified above. The Contractor shall ensure that the in-place moisture content of the soil shall not be less than five percent (5%) below optimum moisture content or greater

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than two percent (2%) above optimum moisture content, at the time of compaction. For soils with a plasticity index of 15 or greater, the Contractor shall ensure the moisture content of the soil at the time of compaction is between optimum moisture to optimum moisture plus four percent (4%). If the moisture content at the time of compaction is not within the specified range, the Contractor shall moisten or dry the Material, then thoroughly mix the Material to the full lift depth before re-compacting. No additional payment shall be made for the reworking of Materials that do not fall within the ranges specified above.

Roadbed Embankments that contain mostly rock or coarse-grained Material (65% or greater retained on the No. 4 sieve) do not require moisture and density control, except the top six (6) inches of the Embankment; the Contractor shall construct in accordance with Section 207.3, "Construction Requirements." Non-roadbed Embankments of rock Material will not require moisture and density control unless otherwise specified in the Contract.

The Department will perform field densities in accordance with AASHTO T 310 or other Department approved methods. Densities shall be measured at each lift before the next subsequent lift is placed in accordance with Section 906, "Minimum Testing Requirements."

203.4 METHOD OF MEASUREMENT

203.4.1 Rock Excavation

The Department will measure Rock Excavation based on the estimated percentages if shown in the Contract, unless otherwise requested by the Contractor and approved by the Department.

If the Contractor requests, the Department will measure Rock Excavation in its original position for Material classified as Rock Excavation in accordance with Section 203.2.1.1, "Rock Excavation." Before excavation, the Contractor and Project Manager must agree on the limits of Material classified as rock excavation. The Contractor shall calculate volumes in accordance with Section 203.4.3, "Unclassified Excavation and Borrow." The Contractor shall include in measurements the overbreakage in rock excavation a maximum of ten (10) inches beyond the backslope specified in the Plans or as directed by the Project Manager. The Department will use the blaster's drill-hole log cards to determine the quantities of rock excavation covered by soil or overburden. The Contractor shall provide these log cards as part of the surveying records.

The Department will pay for stabilization necessitated by existing geological conditions and for Base Course and geotextile if necessary as required to backfill rock Subgrade conditions.

203.4.2 Controlled Blasting

The Department will measure Controlled Blasting by the blast holes drilled along the final line, whether loaded or not; and will measure the lengths from the top of the rock surface to the elevation of the Roadway ditch or to a bench elevation set by the Project Manager. The Department based the quantities for Controlled Blasting shown in the Plans on assumed blast hole spacing; the actual quantities depend on field conditions and the results from test sections.

203.4.3 Unclassified Excavation and Borrow

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure the original ground surface of all areas that are designated as unclassified excavation (cut sections) and/or Embankment (fill sections using available

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unclassified excavation Material), or Borrow (fill sections when all unclassified excavation Material has been exhausted). Prior to any Work continuing in completed excavation areas, the Contractor shall measure the newly excavated ground surface (final surface). For Embankment and borrow areas the Contractor shall measure the final surface once these operations are completed and Accepted by the Project Manager. Prior to commencing Borrow operations the Contractor must ensure that all requirements of Section 203.2.1.3, "Borrow" have been met. Earthwork quantities will be calculated as the neat volume from the original ground surface (less the existing Roadway surfacing) between the limits shown on the plans, and/or authorized changes by the Project Manager, and the new ground surface. The Department will not apply any shrinkage or swell factor due to payment being made on the final cross sectioned volume.

For the measurements described above the Contractor shall survey and submit the original ground surface and final surface data at completion of each phase of construction using an electronic XML- compatible format approved by the Project Manager. The Contractor shall use a New Mexico licensed Engineer or New Mexico licensed surveyor to stamp and certify cross-sections at 50 Ft intervals, unless otherwise specified in the Contract or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall submit certified volume summary reports to the Project Manager based on this electronic data for each phase of construction including a report that summarizes the basis for the final volumes.

203.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Rock Excavation	Cubic Yard
Unclassified Excavation	Cubic Yard
Borrow	Cubic Yard
Unsuitable Material Excavation	Cubic Yard
Controlled Blasting	Linear Foot

203.5.1 Double Handling

The Department will pay for excavated Materials that require more than one (1) handling as identified within the Contract before final placement, including fertile topsoil required to be stockpiled and reserved for later use in the Work:

- 1. At the Bid Item Unit Price for unclassified excavation, for each handling approved by the Project Manager; or
- 2. As another item of Work for the second handling if specified in the Contract.

However, if the Contractor handles excavated and borrow Materials more than once, at the Contractor's request or at the convenience of the Contractor, there will be no additional cost to the Department. If the Contractor chooses to stockpile excess unclassified excavation Material to be used as borrow in a later phase, the Department will not pay for this Material as double handling. Double handling shall not be paid for Material that is excavated and placed in the same phase of the Project.

203.5.2 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 203.5, "Basis of Payment" and will not measure or pay for them separately:

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- 1. Controlled blasting drill holes through overburden;
- 2. Production blasting;
- 3. Scaling within the limits of a final backslope established by controlled blasting;
- 4. Damage resulting from blasting;
- 5. Mobilization of any Equipment and testing of rock in accordance with Section 203.2.1.1, "Rock Excavation;"
- 6. Time Delays to perform testing of rock in accordance with Section 203.2.1.1, "Rock Excavation;"
- 7. Material required to fill the voids and irregularities in Embankment areas below the tolerance limit from the specified elevation;
- 8. Bridging geotextiles required to prevent overlying Embankment Material from migrating into the interstices between rock fragments;
- 9. Fence removal and replacement;
- AASHTO T-190 Resistance R-Value and Expansion Pressure of Compacted Soils, including sampling, laboratory testing and reporting;
- 11. AASHTO T-290 Water-Soluble Sulfate Ion Content in Soil, including sampling, laboratory testing, and reporting;
- 12. Survey, calculations, and engineering;
- 13. Hauling and/or disposal related to Rock Excavation, Unclassified Excavation, Borrow, and Unsuitable Material Excavation; and
- 14. Suitable backfill Material for Unsuitable Material Excavation.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project Limits without written approval from the Project Manager.

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203-A.1 DESCRIPTION

This Work consists of stabilizing unstable Subgrade soils encountered in non-borrow sections such as cuts or existing grades within and not exceeding the top two (2) feet of finished sugbrade elevation due to no fault or neglect of the Contractor. This Work includes costs associated with design/development of the Contractor's proposed stabilization option, Materials, labor, tools, Equipment, storage, laboratory and field testing, sampling, handling, excavation, disposal, removal, placement, hauling, processing with the Subgrade, shaping, compacting, surveying, finishing to grade, proof-rolling the Subgrade including all appurtenances, and Incidentals necessary to complete the Work.

Unstable Subgrade is defined as Subgrade that is saturated, soft, gummy, pumping, and/or displaces with applied loading.

Subgrade modified by this Specification is for stabilization only and is not considered in the structural design of the pavement structure; thus, no modification of the pavement structure shall be made.

203-A.2 MATERIALS

The Contractor shall use Materials included on the Department's current approved products list for its intended use or use Materials currently Accepted in the Contract.

203-A.3 CONSTRUCTION REQUIREMENTS

Where unstable Subgrade is due to the failure of the Contractor to maintain adequate surface drainage, or is damaged due to the operations or any other fault or neglect of the Contractor, the unstable condition shall be corrected at no expense to the Department.

Prior to Base Course placement over Subgrade or proposed stabilization option, the Contractor shall proof roll the Subgrade with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water truck filled to capacity. Areas lacking sufficient stability, as defined above, or as directed by the Project Manager shall be treated as unstable Subgrade.

Areas that exhibit displacement under lightly loaded Equipment may also be considered unstable by the Project Manager. For areas that become unstable prior to reaching Subgrade level (i.e., foundations, intermediate lifts, etc.), the Project Manager may designate these areas as unstable.

The Contractor shall choose any of the stabilization options listed below unless otherwise indicated in the Contract. If site conditions warrant a change in the stabilization method, it shall be at no additional cost to the Department. The Contractor shall submit options to the Project Manager for concurrence prior to stabilization.

- 1. Ripping, drying, and recompacting;
- Excavation and replacement with Material that meets or exceeds the Project design R-value with laboratory tests performed in accordance with AASHTO T-190;
- 3. Use of Base Course, RAP, or select backfill;
- 4. Installation of underdrains and associated geotextiles and Material;
- 5. Geotextiles, geogrid base, and/or reinforcement Materials;
- 6. Blending of existing Materials with Materials approved by Project Manager; or

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7. Combinations thereof.

The Project Manager may approve the use of excess Material obtained within the ROW that has previously been shown to be stable and workable. The Material associated with the listed options and the Work involved to obtain and place the Material shall be Incidental to the "unstable Subgrade stabilization" item and will not be paid separately. Areas disturbed within the ROW but not designated in the Contract shall be revegetated in accordance with Section 632, "Revegetation" at the Contractor's expense.

After stabilization and prior to placement of the base Material, the Contractor shall proof roll the stabilized Subgrade with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water tank filled to capacity and the Subgrade shall exhibit no displacement when proof rolled.

The Contractor shall make the necessary adjustments in the Equipment or operation so that underground utilities and permanent structures are not damaged.

The Contractor shall handle the processing of Material in such a manner that the dust or debris created by the operation will not be hazardous to the public or workers.

The Contractor shall construct stabilized Subgrade in such a manner that proper drainage is maintained.

When within the top six (6) inches of the Subgrade elevation, the stabilized Subgrade shall meet the grade and compaction requirements of SECTION 207, "SUBGRADE PREPARATION," or as approved by the Project Manager. Additional payment will not be made under Item Number 207000 – "Subgrade Preparation."

203-A.3.1 Equipment

Stabilization of unstable Subgrade shall be performed with a machine or combination of machines or Equipment that will produce a satisfactory product meeting the requirements for ripping, drying, recompaction, excavation, replacement, and blending of Materials as provided in these Specifications.

Single-shaft or multiple-shaft mixers are required for blending of existing Materials with Materials approved by Project Manager. Agricultural disks or motor graders are not Acceptable mixing Equipment unless Contractor can demonstrate thorough mixing and processing to the satisfaction of the Project Manager.

203-A.3.2 Acceptance

The stabilized Subgrade shall meet the requirements of SECTION 303, "BASE COURSE;" subsection 303.3.1, "Preparation of Subgrade." Prior to placement of the base Material, the stabilized Subgrade shall be proof rolled with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water tank filled to capacity and shall exhibit no displacement when proof rolled. Stabilized Subgrade locations that continue to exhibit displacement are to be corrected at no additional cost to the Department.

203-A.4 METHOD OF MEASUREMENT

Unstable Subgrade stabilization shall be measured from the Subgrade elevation as shown in the Contract, by the square yard regardless of depth up to two (2) feet.

203-A.5 BASIS OF PAYMENT

Section 203-A: Unstable Subgrade Stabilization

The Department will only pay for the Accepted quantities of unstable Subgrade stabilization in accordance with Section 203A.3.2, "Acceptance."

Pay Item

Unstable Subgrade Stabilization

Pay Unit

Square Yard

203-A.5.1 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 203-A.5, "Basis of Payment" and will not measure or pay for them separately:

- 1. Design/Development of Contractor proposed stabilization option(s);
- 2. All Materials required for stabilization;
- 3. Labor, tools, and Equipment;
- 4. Sampling and laboratory and field testing;
- 5. Handling, excavating, removing, disposing, hauling, and placement;
- 6. Processing Material with existing Subgrade;
- 7. Shaping, compacting, surveying, finishing to grade, proof-rolling, and all appurtenances and Incidentals necessary to complete the Work;
- 8. Subgrade Preparation; and
- 9. Revegetation of areas disturbed within the ROW, used to obtain Materials for stabilization.

Section 203-A: Unstable Subgrade Stabilization

SECTION 206: EXCAVATION AND BACKFILL FOR CULVERTS AND MINOR STRUCTURES

206.1 DESCRIPTION

This Work consists of excavating, placing and compacting select backfill, bedding, and flowable fill Materials, and disposing of Material related to construction of Minor Structures. Excavation includes dewatering, pumping, bailing, draining, sheeting, bracing, and Incidentals required for proper execution of the Work.

Ditches required at Culvert inlets and outlets, and other locations indicated in the Contract are included under the item for Unclassified Excavation.

206.2 MATERIALS

206.2.1 Select Backfill

The Contractor shall furnish a suitable, well-graded, compactible Material free of Recycled Asphalt Pavement (RAP), organic matter, clay balls, lumps, rock fragments that may degrade with time such as shale or gypsum and other Deleterious Materials. Select backfill Material shall conform to the following and be placed in accordance with the Contract:

- 1. For structures and pipes other than plastic pipe:
 - a. Maximum particle size: two (2) inch;
 - b. Soil classification, AASHTO M 145 A-1 or A-2-4;
- 2. For plastic pipe:
 - a. Maximum particle size: 1¹/₂ inch; and
 - b. Soil classification, AASHTO M 145 A-1 or A-2-4.

All Backfill Material shall meet the electrochemical criteria where specified in the Contract.

206.2.2 Flowable Fill

The Contractor may substitute flowable fill for select backfill in accordance with Section 516, "Flowable Fill," at no additional cost to the Department. The Contractor shall secure Culverts and minor Structures to prevent flotation.

206.2.3 Bedding

The Contractor shall furnish a suitable, well-graded, non-plastic, free draining Material, free of Recycled Asphalt Pavement (RAP), organic matter, clay balls, lumps, rock fragments that may degrade with time such as shale or gypsum and other Deleterious Materials. Bedding Material shall conform to the following and be placed in accordance with the Contract:

- 1. Maximum particle size: $\frac{1}{2}$ inch or half the corrugation depth, whichever is smaller; and
- Material passing No. 200 (75-μm) sieve: ten percent (10.0%) max AASHTO T 27 and AASHTO T 11.

All Bedding Material shall meet the electrochemical requirements where specified in the Contract.

206.2.4 Unsuitable Material

Section 206: Excavation and Backfill for Culverts and Minor Structures

Unsuitable Material includes organic Materials, frozen lumps, ice; soils such as peat, shale, gypsum or other Materials that may degrade with time, or are contaminated soil. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material below minor Structures and areas identified by the Project Manager, determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with this Specification.

206.3 CONSTRUCTION REQUIREMENTS

206.3.1 General

The Contractor shall remove unsuitable foundation Material below the specified bottomof-structure elevation and replace with approved Material, as directed by the Project Manager. The Contractor shall use backfill Material to backfill Culverts in accordance with Section 206.2.1, "Select Backfill," or Section 206.2.2, "Flowable Fill," unless otherwise shown on the Plans. The Contractor shall ensure the moisture content of the soil; at the time of compaction is not less than five percent (5%) below optimum moisture content or greater than optimum moisture content. The Contractor shall compact the top six (6) inches of existing ground to at least 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). The Contractor shall maintain the density, approved surface elevation, and shape of the foundation immediately before placing Structures and forms.

The Contractor shall distribute backfill Material in uniform layers, each no more than eight (8) inches thick (loose measurement) and compact to 95 percent (95%) maximum density. At the time of compaction, the Contractor shall ensure that the in-place moisture content of the soil is not less than three percent (3%) below optimum moisture content or greater than three percent (3%) above optimum moisture content in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). The Contractor shall test field density and moisture content using nuclear methods in accordance with AASHTO T 310 and Section 906 "Minimum Testing Requirements."

Application of load including backfill against new masonry or concrete Structures shall be in accordance with Section 511.3.5.6, "Sequence of Placement and Application of Load." The Contractor shall maintain Structure alignment and integrity during backfill compaction. The Contractor shall not place backfill on frozen earth or with frozen Materials. The Contractor shall suspend operations until Material is thawed and meets requirements of this Specification. The Contractor shall remove sheeting and bracing before placing backfill.

206.3.2 Pipe Culverts, Storm Drains, and Structural Plate Pipe

For preparation and installation of pipe culverts, storm drains, and structural plate pipes with bottoms the Contractor shall remove rock and other unyielding foundation Material a minimum of four (4) inches (maximum 12 inches) below the bottom of the Structure. The Contractor shall backfill this added depth with an approved Material as identified in the Contract. The Contractor shall excavate trenches as described in the Contract to allow for pipe joining and compaction of the bedding and backfill Material under and around the pipe in accordance with Section 206.3.1, "Construction Requirements, General." The Contractor shall

Section 206: Excavation and Backfill for Culverts and Minor Structures

ensure that the trench width for pipes and Culverts conforms to the trench widths requirements in Section 570.3.2, "Excavation and Backfill." The Contractor shall uniformly compact the trench for its full length and width. If specified in the Contract, the Contractor shall provide the longitudinal camber of the specified magnitude for cross drains.

206.3.3 Box Culverts and Other Drainage Structures

For preparation and installation of box culverts and other drainage structures the Contractor shall excavate Material to the elevations established by the Contract. The Contractor shall not remove Material, except unsuitable Material, below the final grade, if placing footings on excavated surfaces other than rock. The Contractor shall remove rock and other unyielding foundation Material a maximum 12 inches below the bottom of the Structure. The Contractor shall clean rock seams and cavities, and fill with concrete or grout. If the Contractor's excavation extends beyond the neat lines shown in the Contract, the Contractor shall use concrete (of the same class as the footing) to backfill these areas, at no additional cost to the Department.

The Contractor shall notify the Project Manager after each footing excavation. The Contractor shall not place footings until the excavation depth and foundation Materials are approved by the Project Manager. The Contractor shall maintain the moisture and density and the approved surface elevation and shape of the foundation before installing reinforcing steel.

206.4 METHOD OF MEASUREMENT

The Project Manager will measure the void created by the removal of Unsuitable Material Excavation below the bottom-of-structure elevation.

206.5 BASIS OF PAYMENT

Pay Item

Unsuitable Material Excavation

Pay Unit Cubic Yard

The Department will pay for rock excavation in accordance with Section 203, "Excavation, Borrow, and Embankment."

206.5.1 Work Included in Payment

Excavation, disposal of unsuitable Material, bedding, backfill and select backfill Materials, placement and compaction of bedding and select backfill Materials for Culverts, storm drains, other drainage Structures, box Culverts, and minor Structures shall be included in the Contract unit price per linear foot of Structure identified in the Contract.

Excavation shall include all dewatering, pumping, bailing, draining, sheeting, bracing, and Incidentals required for proper execution of the Work. Select backfill shall include the use of Section 516, "Flowable Fill." Backfilling with concrete of the same class as the footings where the Contractor excavates below the established final elevation for bottom of footings or beyond the neat lines of the footings in rock or other hard foundation Material shall be included in the Contract unit price per linear foot of Culvert. Unrippable rock or unyielding Material will be defined and paid for as covered in Section 203, "Excavation, Borrow, and Embankment."

Section 206: Excavation and Backfill for Culverts and Minor Structures

207.1 DESCRIPTION

This Work consists of compacting and finishing the Subgrade.

207.2 MATERIALS-Reserved

207.3 CONSTRUCTION REQUIREMENTS

Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

The Contractor shall ensure the top two (2) feet of borrow Materials in the finished Subgrade is comprised of Material with the design R-value.

The Contractor shall compact the top six (6) inches of the Roadbed to 95% of maximum density.

The Contractor shall ensure the soil moisture content (at the time of compaction) is from optimum to optimum minus five percent (5%). For soils with a PI of 15 or greater, the Contractor shall ensure the moisture content of the soil at the time of compaction is from optimum moisture to optimum moisture plus four percent (4%).

Field density tests shall be performed in accordance with AASHTO T310 or by other Department approved methods and Section 906, "Minimum Testing Requirements."

207.3.1 Tolerances

The Contractor shall ensure the top surface of the finished Subgrade along centerline shall not vary by more than 0.1 foot above or below established grade and 0.05 foot above or below the typical cross-section measured on the finished surface at right angles to the centerline. The Contractor shall correct all deviations from these tolerances.

207.4 METHOD OF MEASUREMENT

The Department will measure Subgrade preparation using the dimensions shown in the Contract and/or approved modifications.

207.5 BASIS OF PAYMENT

Pay Item

Pay Unit Square Yard

Subgrade Preparation

207.5.1 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 207.5, "Basis of Payment" and will not measure or pay for them separately:

- 1. No payment will be made for rehandling or reworking Material to meet moisture and density requirements; and
- 2. Proof rolling for Unstable Subgrade Stabilization shall be considered Incidental to the Contract and will not be measured or paid for separately.

Section 207: Subgrade Preparation

SECTION 210: EXCAVATION AND BACKFILL FOR MAJOR STRUCTURES

210.1 DESCRIPTION

This Work consists of excavating, disposing of Material, supplying and placing backfill Material related to the construction of Bridges, cast-in-place retaining walls, and CBC's 20 feet or greater measured along the centerline of the Roadway. Excavation and backfill for Major Structures includes dewatering, temporary shoring and bracing and other Incidentals required for proper execution of the Work.

210.2 MATERIALS

210.2.1 Select Backfill

The Contractor shall use Base Course per Section 303 "Base Course", A-1 or A-2-4 Material as determined by AASHTO M145 composed of stone, crushed stone, crushed or screened gravel, caliche, sand, or a combination thereof, unless otherwise specified in the Contract. The Contractor shall use Material that is free of Deleterious Materials, peat, gypsum, shale or other Materials that may degrade with time or are contaminated. Material shall not contain lumps or stones with an average dimension greater than two (2) inches.

The Contractor shall not use Recycled Asphalt Pavement (RAP) as select backfill Materials. The Contractor shall not use Base Course containing RAP for use as select backfill Materials.

210.2.2 Approach Slab

The Contractor shall use AASHTO Soil Classifications A-1-a Material with a maximum coarse fraction size of 1.5 inches or Base Course per Section 303, "Base Course" under the approach slab. The Contractor shall extend the Material to a minimum of ten (10) feet beyond the end of the approach, unless otherwise specified in the Contract, for the full width of the abutment and to the depth indicated in the Contract. Recycled Asphalt Material (RAP) shall not be used within this prism.

210.2.3 Unsuitable Material

Unsuitable Material includes organic Materials, frozen lumps, ice, and soil/rock such as peat, shale, gypsum or other Materials that may degrade with time, or are contaminated. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material identified by the Project Manager and determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with Section 210.3.2, "Compaction."

210.3 CONSTRUCTION REQUIREMENTS

210.3.1 General

The Contractor shall excavate Material to the elevations established in the Contract. The Contractor shall not remove Material, except unsuitable Material, below the final grade, if

Section 210: Excavation and Backfill for Major Structures

placing footings on excavated surfaces other than rock. The Contractor shall remove rock and other unyielding foundation Material a maximum of 12 inches below the bottom of the Structure. The Contractor shall clean rock seams and cavities, and fill with concrete or grout. This additional concrete or grout is Extra Work. The Contractor shall notify the Project Manager after each footing excavation. The Contractor shall not place footings until the Project Manager approves the excavation depth and the foundation Material.

The Contractor shall dewater wet pits for inspection and for construction of footings. When necessary, the Contractor shall install well-braced cofferdams, built as watertight as practical. The Contractor shall not use timber or bracing inside cofferdams that cannot be removed without damage to the concrete. The Contractor shall make temporary Structures large enough to provide ample room for pile driving, drilled shaft construction, form construction, inspection, and sump pumps. The Contractor shall straighten or move cofferdams that threaten to damage the Structure. The Contractor shall submit to the Project Manager Working Drawings showing proposed methods of constructing cofferdams, cribs, shoring, or similar temporary Structures sealed by a New Mexico licensed Engineer. The submittal of Working Drawings does not relieve the Contractor of any responsibility.

The Contractor shall backfill excavated areas not occupied by piles, shafts, abutments, or other permanent Structures to the adjoining finished surface elevation. The Contractor shall not use rock in backfill that is within two (2) ft of the Structure. The Contractor shall place backfill Material in approximately level layers for the length and width of the backfilled area. When necessary to prevent wedge action, the Contractor shall bench the slopes bounding the area being backfilled in accordance with Section 203.3.5.1, "Roadbed Embankments." The Contractor shall dispose of unsuitable excavated Material outside of the Roadway Prism as directed by the Project Manager. Before placing backfill Material against new masonry or concrete Structures, the Contractor shall wait until the concrete has developed its specified design strength as determined in Section 510.3.5.1, "Concrete Strength" or until the concrete reaches 80% of the specified compressive strength but no less than 2,500 psi, as determined by the Maturity Method, in accordance with Section 510.3.5.2, "In-place Concrete Strength Measurements."

The Contractor shall prevent unbalanced loading while placing and compacting backfill Material.

210.3.2 Compaction

The Contractor shall place layers of uncompacted backfill no more than eight (8) inches thick. Before placing the next layer, the Contractor shall compact the Material to 95% of the maximum density near optimum moisture content as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). Test for field density and moisture content using nuclear methods in accordance with AASHTO T 310 and Section 906, "Minimum Testing Requirements."

Prior to concrete placement the foundation soils shall be compacted to at least 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

210.4 METHOD OF MEASUREMENT

210.4.1 Major Structure Excavation

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure the original ground surface of any areas that are designated as Structure Excavation. Prior to any Work continuing in completed excavation areas, the

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Contractor shall measure the newly excavated ground surface "final surface." Major Structure excavation quantities shall be measured and calculated as the neat volume below the original ground surface between the limits shown in the Contract, and/or approved changes by the Project Manager, and the final excavated ground surface.

For the measurements described above, the Contractor shall survey and submit the original ground surface and final excavated ground surface data at completion of each phase of construction or completed Major Structure using an electronic XML- compatible format approved by the Project Manager with a volume summary report summarizing the basis for the final volumes. If no cross section intervals are shown in the Plans, the Contractor shall propose cross-section intervals, to the Project Manager, that adequately quantify the volumes. The approved intervals shall be used for the entire Project unless otherwise specified in the Contract and/or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall use a New Mexico licensed Engineer or New Mexico licensed surveyor to stamp and certify the surveyed cross-sections and the volume summary report.

The Contractor shall not include the following volumes in structure excavation:

- 1. Material excavated outside vertical planes located 18 inches outside and parallel to the limits of the footings or foundations;
- 2. Excavation required because of slides, cave-ins, silting or filling due to lack of support of sides, the action of the elements or carelessness of the Contractor;
- Any Material included within the staked limits of the surfacing and unclassified excavation for which measurement is covered under other sections;
- 4. Water or other liquid Material;
- 5. Material excavated before measurements of the original ground or embankment placement;
- 6. Material rehandled, except when the contract specifically requires excavation after Embankment placement; and
- 7. Rock encountered during structural excavation will be paid per Section 203.4.1, "Rock Excavation."

210.4.2 Major Structure Backfill

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure major structure backfill by the cubic yard compacted in place in accordance with the limits shown in the Contract. The Contractor shall calculate major Structure backfill as the neat volume above the existing or excavated ground surface between the limits shown on the Plans, and/or authorized changes by the Project Manager, and the final compacted ground surface. The Department will not apply any shrinkage or swell factors due to payment being made on the final cross sectioned volume.

For the measurements described above the Contractor shall survey and submit the existing or excavated ground surface and final compacted ground surface data at completion of each phase of construction or completed major Structure using an electronic XML-compatible format approved by the Project Manager with a volume summary report summarizing the basis for the final volumes. If no cross section intervals are shown in the Plans, the Contractor shall propose cross-section intervals, to the Project Manager, that adequately quantify the volumes. The approved intervals shall be used for the entire Project unless otherwise specified in the Contract and/or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall use a New Mexico licensed

Section 210: Excavation and Backfill for Major Structures

Engineer or New Mexico licensed surveyor to stamp and certify the surveyed cross-sections and the volume summary report.

No measurement for payment will be made of backfill required because of slides, caveins, silting or filling due to lack of support of sides, over excavation or any other action of the elements or carelessness of the Contractor.

210.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Major Structure Excavation	Cubic Yard
Major Structure Backfill	Cubic Yard
Unsuitable Material Excavation	Cubic Yard

210.5.1 Work Included in Payment

Payment will be full compensation for the Work and Materials prescribed in this Section.

Excavation and Backfill for Major Structures includes the following:

- 1. Material compaction to 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified);
- 2. All temporary shoring and bracing;
- 3. Dewatering;
- 4. Suitable backfill Material for Unsuitable Material Excavation;
- 5. Hauling and disposal of Material related to Structure Excavation and Unsuitable Material Excavation; and
- 6. Survey, calculations, and engineering.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project limits without written approval from the Project Manager.

Section 210: Excavation and Backfill for Major Structures

303.1 DESCRIPTION

This Work consists of providing, hauling, and placing Base Course.

303.1.1 Stockpiling

This Work consists of providing, hauling, and stockpiling Base Course at specified locations.

303.1.2 Removing, Processing, and Placing Base Course

This Work consists of removing, hauling, processing, placing existing Base Course Material.

303.2 MATERIALS

303.2.1 General

Base Course consists of one (1) or more of the following:

- 1. Crushed stone;
- 2. Crushed or screened gravel;
- 3. Caliche;
- 4. Sand;
- Recycled Asphalt Pavement (RAP) not to exceed 50%; recycled concrete pavement (RC) not to exceed 75%; and the combined RAP and RC not to exceed 75% by weight;
- 6. Processed glass aggregate.

Base Course shall not contain organic matter or other Deleterious Materials, including silt and clay balls.

The Department will allow a maximum of ten percent (10%) (by weight) processed glass aggregate, uniformly distributed, in composite Base Course. Processed glass aggregate shall meet physical properties and deleterious substance requirements in accordance with AASHTO M 318.

303.2.2 Aggregate Acceptance

The Department will accept Base Course based on random samples taken by the Department from the Roadway. Unless the Contract specifies otherwise, the Contractor shall produce Material in compliance with Table 303.2.2:1, "Type I Base Course Gradation Band or Table 303.2.2:2, "Type II Base Course Gradation Band" as specified in the Contract and Table 303.2.2:3, "Base Course Physical Properties."

Table 303.2.2:1 Type I Base Course Gradation Band		
Sieve size	% passing	-
1.0 inch	100	
¾ inch	80100	
No. 4	30-60	

Section 303: Base Course

Table 303.2.2:1Type I Base Course Gradation BandSieve size% passingNo. 1020-45No. 2003.0-10.0

Table 303.2.2:2 Type II Base Course Gradation Band		
Sieve size	% passing	
1.0 inch	100	
¾ inch	85-95	
No. 4	40-70	
No. 10	30-55	
No. 200	6.0-15.0	

Table 303.2.2:3 Base Course Physical Properties		
Property Specification Limit		
Fractured Face ^a	Minimum 50% on Untreated Material	
Alb	Maximum 35	
LL	Maximum 25	
PI	Maximum 6	

^aMaterials retained on or above the No. 4 sieve shall have at least two (2) Fractured Faces when evaluated in accordance with AASHTO T-335, "Determining the Percentage of Fractured Faces in Coarse Aggregate."

^bMaximum AI of 35 for untreated natural aggregate source when calculated in accordance with Section 910, "AGGREGATE INDEX".

303.3 CONSTRUCTION REQUIREMENTS

303.3.1 Subgrade

The Contractor shall place base course on subgrade prepared in accordance with Section 207, "Subgrade Preparation."

303.3.2 Mixing and Placing

The Contractor shall:

- Place maximum six (6) inch (compacted) lifts, unless specified otherwise.
- Not Place Base Course Material on frozen Subgrade.
- Compact Base Course to at least 96% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

The Department will use nuclear testing methods to determine in-place densities in accordance with AASHTO T 310 and TTCP procedures for wet density moisture correction.

303.3.3 Surface Tolerance

Section 303: Base Course

The surface tolerance shall not exceed $\frac{1}{2}$ inch within ten (10) feet as verified by the Department. All deviations greater than $\frac{1}{2}$ inch shall be corrected by the Contractor and reverified by the Department.

303.3.4 Plan Base Course and Sub-base Depths

The Department will monitor and record Base Course depth during the placement in accordance with the Department's "Minimum Testing Requirements." If the placed thickness deviates from the requirements by more than minus $\frac{1}{2}$ inch, the Contractor shall add Material and reprocess to correct the deficiency.

303.3.5 Stockpiled Base Course

The Contractor shall stockpile base course material at locations shown on the Plans and prevent segregation of Materials at each stockpile. The Contractor shall maintain each stockpile in accordance with the following requirements:

- 1. Place stockpiles upon prepared sites;
- 2. Make stockpiles neat and regular to prevent segregation;
- 3. Provide enough storage space for each size of aggregate;
- 4. Prevent contamination (store stockpiles away from vehicular and Equipment traffic);
- 5. Keep the storage site neat and orderly and keep the stockpiles accessible for sampling; and
- 6. Acceptance by the Department will be at the final stockpile location.

303.3.6 Removing and Processing Existing Base Course

The Contractor shall:

- 1. Minimize contamination of Base Course Material when removing it from the Roadway for reuse, and;
- 2. Meet the requirements as indicated in Section 303.3.2 "Mixing and Placing."

303.3.7 Sampling and Testing

The Contractor and Department shall sample and test the Base Course in accordance with Section 906 "Minimum Testing Requirements" for Base Course. Department personnel may test locations other than the random locations generated for statistical analysis. These tests will not be used for pay factor determination, but may be used to determine Acceptance or rejection of localized Material.

303.3.7.1 Contractor Quality Control

The Contractor shall develop and administer a Quality Control plan that ensures the product meets the requirements of Section 902, "Quality Control." The Contractor shall ensure that the Quality Control plan addresses the following elements:

- 1. Contractor management and process control personnel,
- 2. Testing Equipment and lab facilities,
- 3. Aggregate production,
- 4. Aggregate quality,
- 5. Stockpile management,

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- 6. Proportioning,
- 7. Mixing and processing,
- 8. Transporting,
- 9. Placing and spreading,
- 10. Compaction,
- 11. Line and grade control, and
- 12. Criteria for the correction or rejection of unsatisfactory Materials.

The Contractor shall:

- 1. Provide copies of TTCP wallet cards or certifications for personnel who are responsible for sampling and testing the Base Course.
- 2. Update the list as required if personnel substitutions are made.
- 3. Use test results, inspections, and other Quality Control practices to assure the quality of each material source and to control processes for crushing, mixing, proportioning, processing, transporting, placing, spreading, and compacting quality.

303.3.8 Acceptance

The Department will accept Base Course Materials based on samples taken in accordance with the Section 906, "Minimum Testing Requirements" after placement but before compaction. Acceptance will be in accordance with Section 303.2.2, "Aggregate Acceptance" and Section 303.3, "Construction Requirements. If necessary, the Contractor shall re-work the Base Course until all requirements are met at no additional expense to the Department.

303.4 METHOD OF MEASUREMENT

When calculating the square yardage the Department will use the average Base Course width and the station-to-station length along the centerline. The dimensions will show on the typical section of the Plans. When calculating the weight of the material, the Department will deduct the weight of moisture that exceeds the optimum moisture content plus two percent (2%). No additional payment shall be made for the stockpile pad.

303.5 BASIS OF PAYMENT

The Department will pay for the accepted quantities of *Base Course* as determined in Section 303.3.8, "Acceptance."

Pay Item	Pay Unit
Base Course	Cubic Yard or Ton
Base Courseinch Depth	Square Yard
Remove, Process and Place Base Course	Square Yard or Ton
Stockpiled Base Course	Cubic Yard or Ton

303.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

- 1. Providing, hauling, placing, and compacting Base Course Material;
- 2. Stockpiling, if required by contract;

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- 3. Quality Control in accordance with Section 902, "Quality Control;" and
- 4. Remove, process, and place Base Course, if required by contract.

Section 303: Base Course

519.1 DESCRIPTION

This Work consists of constructing a pneumatically applied non-structural shotcrete onto rock, soil or structural shotcrete onto formed surfaces in accordance with the Contract and as directed by the Project Manager.

These Specifications refer to premixed cement and aggregate pneumatically applied by suitable Equipment and competent operators.

519.2 MATERIALS

Structural shotcrete shall have a design strength of 4000 psi at 28 Days. If structural shotcrete is required, the Contractor shall use a shotcrete mix that has been designed and proportioned in accordance with Section 509, "Portland Cement Concrete Mix Designs" and complies with the designated hardened properties for the class of concrete required in the specifications. All mix constituents must comply with Table 519.2:1, "Applicable Specification Sections." The Contractor shall determine all hardened properties in accordance with Section 519.2.6, "Acceptance Sampling and Testing."

Non-structural shotcrete shall have a design strength of 3000 psi at 28 Days. If the shotcrete is non-structural, the non-structural shotcrete mix design may be developed in accordance with Section 509, "Portland Cement Concrete Mix Designs" without using the special boxes required in Section 519.2.6, "Acceptance Sampling and Testing."

All shotcrete mix designs must be reviewed and approved by the State Concrete Engineer before being used on NMDOT Projects. The Contractor shall use either wet-mix or dry-mix shotcrete. The Contractor shall reinforce shotcrete in accordance with the Contract.

The Contractor shall provide Materials and perform construction requirements in accordance with the specification sections listed in Table 519.2:1, "Applicable Specification Sections."

Material/Construction Requirements	Section		
Portland cement	Section 509, "Portland Cement Concrete Mix Designs"		
Fly Ash	Section 509, "Portland Cement Concrete Mix Designs"		
Pozzolans	Section 509, "Portland Cement Concrete Mix Designs"		
Curing Materials and Admixtures	Section 509, "Portland Cement Concrete Mix Designs"		
Water	Section 509, "Portland Cement Concrete Mix Designs"		
Fine Aggregate	Section 509, "Portland Cement Concrete Mix Designs"		
Coarse Aggregate	Section 509, "Portland Cement Concrete Mix Designs"		
Neat Cement Grout	Section 521, "Non-Shrink Mortar"		

Table 519.2:1 Applicable Specification Sections

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Table 519.2:1 **Applicable Specification Sections**

Material/Construction Requirements	Section
Bar Reinforcement	Section 540, "Steel Reinforcement"
Welded Wire Fabric	Section 540, "Steel Reinforcement"
Surface evaporation	Section 512, "Superstructure Concrete"

519.2.1 Fine Aggregate Quality Requirements

The Contractor shall provide fine aggregate with the following properties:

- 1. A soundness Loss of 12 or less when tested in accordance with AASHTO T 104 using magnesium sulfate solution and a test duration of five (5) cycles; and
- 2. A sand equivalent of at least 75 when tested in accordance with AASHTO T 176.

519.2.2 Fine Aggregate Gradation Requirements

Fine aggregates shall comply with Table 519.2.2:1, "Fine Aggregate Gradation" for either Grading No.1 or Grading No. 2.

Fine Aggregate Gradation			
Sieve Size, U.S. Standard	Percent by Weight Passing Individual Sieves		
Square Mesh	Grading No.1	Grading No.2	
³ ⁄ ₄ inch (19 mm)			
½ inch (12 mm)		100	
3/8 inch (10 mm)	100	90 to 100	
No. 4 (4.75 mm)	95 to 100	70 to 85	
No. 8 (2.4 mm)	80 to 98	50 to 70	
No. 16 (1.2 mm)	50 to 85	35 to 55	
No. 30 (600 μm)	25 to 60	20 to 35	
No. 50 (300 µm)	10 to 30	8 to 20	
No. 100 (150 µm)	2 to 10	2 to 10	

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519.2.3 Water

The Contractor shall use water in the shotcrete mix that is free of elements that could stain the mix and in accordance with Section 509.2.6, "Water."

519.2.4 Anchor Bars

The Contractor shall provide anchors of appropriate size to hold reinforcement in place. The Department will allow maximum anchor spacing of 24 inches on a grid pattern over the entire area for structural applications.

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If using "L"-shaped anchors, the Contractor shall use those that consist of No. 5 reinforcement bars (or larger) bent into an "L" shape. The short leg of the "L" will be at least six (6) inches long and the long leg at least two (2) feet long.

519.2.5 Welded Wire Mesh

The Contractor shall provide non-galvanized eight (8) gauge steel with a four (4) inch × four (4) inch mesh (4×4 -W2.1 × W2.1) in accordance with Section 540, "Steel Reinforcement" for welded wire mesh. For structural applications, the Contractor shall use welded wire mesh in accordance with the Contract and as approved by the State Bridge Engineer. The Contractor shall ensure that all wire mesh has been rigidly fixed in place to prevent rebound when struck by the shotcrete.

519.2.6 Fiber Reinforcement

Synthetic Fibers shall meet the requirements of ASTM C1116.

Steel fibers should meet the requirements set forth in ASTM A820.

519.2.7 Prepackaged Product

For non-structural shotcrete; a pre-mixed and prepackaged concrete product, with or without steel fibers, specifically manufactured as a shotcrete product for on-site mixed shotcrete, may be used if approved by the State Materials Bureau. The Material shall meet the requirements of ASTM C1480 and have a minimum strength of 3,000 psi at 28 Days for non-structural Shotcrete.

519.2.8 Acceptance Sampling and Testing for Structural and non-structural Shotcrete

The Contractor shall apply shotcrete to approved test panels. The Contractor shall orient the spray nozzle to the test panel in the same position as that used on the actual Project. The Contractor shall provide test panels constructed in accordance with the requirements of ASTM C 1140. The Contractor shall use test panels with the following characteristics:

- 1. Minimum dimensions of 30 inch² × eight (8) inch deep;
- 2. Constructed from wood and sealed plywood; and
- 3. 45° sloped sides to allow rebound to escape.

The Contractor shall use at least one (1) pre-construction trial to do the following:

- 1. Obtain test cores to confirm compliance with the hardened properties of Section 510, "Portland Cement Concrete."
- 2. For structural Shotcrete only, pre-qualify the proposed nozzle operator and strike-off persons. The Department will not allow nozzle operators and strike-off persons who have not been pre-qualified to apply shotcrete on the Project. Each nozzle operator and strike-off person shall shoot pre-construction test panels in the presence of the Project Manager or designated representative. Each nozzle operator shall have a minimum of the following qualifications:
 - 2.1. Supervisor, at least one (1) year of experience as a shotcrete nozzle operator and at least two (2) years of experience on shotcrete Projects.
 - 2.2. Nozzle operator and delivery Equipment operators, at least one (1) year of apprenticeship on similar applications with the same type of Equipment.
 - 2.3. Nozzle operators shall be ACI Certified Shotcrete Nozzle Operators.

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The Contractor shall perform curing, coring, and testing of the shotcrete test panels and specimens at a private testing Laboratory approved by the State Materials Bureau for concrete mix designs.

The Contractor shall provide one half of the test panels with reinforcement and anchors representative of the same size and spacing required in the Contract for the actual Work. The Contractor shall provide the remaining panels with no reinforcement to allow for extraction of shotcrete test cores for compliance testing.

Each nozzle operator proposed for use on the Project shall shoot at least one (1) test panel at each orientation.

The Contractor shall obtain the required number of test cores in accordance with Section 510, "Portland Cement Concrete," from these test panels for testing at the designated ages for the specified performance parameters. The Contractor shall extract a minimum of three (3) four (4) inch diameter cores from locations of intersecting reinforcing steel and mesh to check the adequacy of consolidation of shotcrete around and behind the reinforcement. The Contractor shall take at least one (1) core at an anchor location.

The State Materials Bureau will evaluate the quality of the extracted cores and test panels. If the Department rejects a prequalification test panel, the Contractor shall have the nozzle operator shoot a second test panel. If the Department rejects the second test panel, the Contractor shall not allow the nozzle operator to shoot on the Project until the operator completes an appropriate training program and prepares an acceptable test panel.

The Contractor shall transport test panels in the wooden forms with care to not crack or damage the specimens.

The Contractor shall place the test panels in a moist room in the Laboratory that is maintained at a temperature of 73 °F \pm 3 °F, and a relative humidity of 98 \pm two percent (2%). After three (3) Days, the Contractor shall remove the test panels from the wooden forms and return them to the moist room until testing time.

519.2.8.1 Production Testing for Structural Shotcrete

The Contractor shall shoot two (2) construction test panels for each nozzle orientation and for each nozzle operator each Day of shotcrete production in the presence of the Project Manager. The Contractor shall shoot one (1) set of panels for each nozzle operator in the morning and one (1) set of panels for each nozzle operator in the afternoon for a full Day's production.

The Contractor shall produce test panels in accordance with ASTM C 1140, a minimum $12 \operatorname{inch}^2 \times \operatorname{eight}(8)$ inch deep. The Contractor shall use test panels constructed of wood and sealed plywood with 45° sloped sides to permit escape of rebound. The Contractor shall provide construction test panels that contain no reinforcement or embedments.

The Contractor shall store, handle, and cure construction test panels the same as specified for pre-construction test panels. The Contractor shall prepare test specimens the same as specified for pre-construction test specimens.

The Contractor shall use compressive strength test specimens that are four (4) inch \times eight (8) inch cores (length/diameter ratio of 2:1).

The mean compressive strength is acceptable if the average of three (3) cores tested at the specified age is equal to or greater than 85% of the specified strength, with no individual

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strength test being less than 75% of the specified strength.

The Contractor shall correct unacceptable shotcrete sections at no additional cost to the Department.

519.3 CONSTRUCTION REQUIREMENTS

519.3.1 Equipment

519.3.1.1 Shotcrete Placing Equipment

The Contractor shall apply wet mix shotcrete with one (1) of the following methods:

- 1. The "thick-stream" method, which involves the use of a regular concrete pump with air addition at the discharge nozzle to pneumatically apply the shotcrete on the receiving surface. The "thick-stream" method usually uses a two (2) inch to 2 1/2 inch internal diameter delivery hose.
- 2. The "thin-stream" method, which normally involves the use of a pressurized chamber to pneumatically send the shotcrete down the delivery hose to the receiving surface. The "thin-stream" method normally uses a hose with a maximum 1 1/2 inch internal diameter.

The Contractor shall only use the "thin-stream" method for non-structural shotcrete if preconstruction testing confirms the capability to properly consolidate shotcrete, fully encase reinforcing steel, and produce a Material that meets the required hardened properties.

The Contractor shall use shotcrete delivery Equipment in accordance with ACI 506R and that is capable of delivering a steady stream of uniformly mixed Material to the discharge nozzle at the proper velocity and rate of discharge.

The preferred type of the wet-mix shotcrete delivery system uses positive displacement pumps equipped with hydraulic or mechanically powered pistons (similar to conventional concrete piston pumps), surge-reduction devices, and compressed air added at the discharge nozzle. The Contractor may use pneumatic-feed guns, rotary-type feed guns (similar to dry-mix guns), and peristaltic squeeze-type pumps if the Contractor demonstrates that the guns can produce shotcrete in accordance with the performance requirements and the Project Manager approves.

The Contractor shall carefully monitor the air ring at the nozzle for signs of blockage of individual air holes. If non-uniform discharge of shotcrete becomes apparent, the Contractor shall stop shooting and clean the air ring or take other appropriate corrective actions.

The Contractor shall thoroughly clean the delivery Equipment at the end of each shift. The Contractor shall remove build-up of coatings in the delivery hose and nozzle liner. The Contractor shall regularly inspect the air ring and nozzle and replace as necessary.

519.3.1.2 Auxiliary Shotcrete Equipment

The Contractor shall supply a clean, dry air supply capable of maintaining sufficient nozzle velocity and simultaneous operation of a blow pipe.

The Contractor shall use an air supply system with a moisture and oil trap.

The Contractor shall provide auxiliary shotcrete Equipment, such as air delivery hoses, blow pipes, couplings, admixture dispensers, and fiber feeders, in accordance with the

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519.3.2 Batching and Mixing Shotcrete

519.3.2.1 Wet Mix Process

The Contractor shall batch, mix, and supply wet mix shotcrete using one (1) of the following systems:

- 1. Central Mixing with transit delivery; or
- 2. Transit mixing and delivery.

519.3.2.1.1 Central Mixing and Supply

The Contractor shall batch and mix ingredients in accordance with Section 510, "Portland Cement Concrete." The Contractor shall provide inspected transit mixers in accordance with Section 510, "Portland Cement Concrete."

The Contractor may only re-temper the shotcrete once with superplasticizer added directly to the transit mixer during the period of discharge to maintain workability (slump) of shotcrete. The Contractor shall mix the shotcrete for a minimum period of five (5) min at the rated mixing speed after adding the superplasticizer to the transit mixer.

The Contractor shall shoot shotcrete within 90 min of adding mix water to the batch. The Contractor shall use appropriate shotcrete batch sizes per load to meet this requirement.

519.3.2.1.2 Transit Mixing and Supply

The Contractor shall apply central mixing requirements to transit mixing, except add ingredients directly to the transit mixer, not the central mixer. The Contractor shall not charge transit mixers to more than 70% of their rated capacity.

519.3.2.2 Dry Mix Process for Non-Structural Shotcrete

The Contractor shall batch the cement and aggregate by weight directly at the Project site within the tolerances required in Section 510, "Portland Cement Concrete."

The Contractor shall pre-dampen the dry mix before flow into the main hopper and immediately after flow out of the packaging to ensure uniform shotcrete free of dry pockets.

The Contractor shall not use pre-dampened cement/aggregate mixtures that are more than 90 min old or that are unable to produce the specified hardened properties.

519.3.2.3 Batching and Mixing Steel Fibers

The Contractor shall submit the procedure used for adding steel fibers to the shotcrete to the Project Manager for approval. The Contractor shall demonstrate the procedure in the field to the satisfaction of the Project Manager before starting production operations.

If fiber addition takes place at the nozzle, the Contractor shall uniformly distribute fibers throughout the mortar matrix without isolated concentrations (clumping or balling).

If adding fibers to the dry or wet mix during the batching and mixing process, the Contractor shall use a screen with a mesh of from 1 1/2 inch to 2 1/2 inch to prevent fiber balls from entering the shotcrete line. The Department will not require batching through a screen if

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the Contractor demonstrates that fiber balls are not forming.

The Contractor shall not add fibers to the dry or wet mix too quickly (so they can be blended with the other ingredients without forming balls or clumps). The Contractor shall use a vibrating screen or sift to pass bulk fibers (that have a tendency to stick) into the mix as individual elements and not as clumps.

519.3.2.4 Preparation and Hardware

519.3.2.4.1 Subsurface Preparation

The Contractor shall locate and remove loose, spalled, deteriorated, and delaminated concrete, stone, or other substrate. The Contractor shall use hammer sounding to locate specific de-laminated areas of concrete or rock. The Contractor shall not damage areas of sound concrete or reinforcing steel during concrete removal operations.

The Contractor shall remove concrete using one (1) or more of the following methods:

- 1. Chip with light duty pneumatic, or electric, chipping hammers (not to exceed 15 lb).
- 2. Scarifiers, scabblers or other suitable mechanical means.
- 3. High-pressure (15,000 psi to 40,000 psi) water jetting. (If using water jetting, do not allow water to collect so that surrounding areas are not contaminated or damaged.)

If the Contractor exposes corroded reinforcing steel, the Contractor shall continue concrete removal until there is a minimum 3/4 inch clearance around the exposed, corroded reinforcing bar. The Contractor shall not damage the bond to adjacent non-exposed reinforcing steel during concrete removal.

The Contractor shall taper the perimeter of removed concrete areas at approximately 45° angles. The Contractor shall sawcut the outer edges of chipped areas to a minimum depth of 3/4 inch to avoid feather edging.

The Contractor shall use abrasive blast cleaning to remove fractured surface concrete and traces of unsound Material or contaminants, such as oil, grease, dirt, slurry or Materials that could interfere with the bond of the freshly placed shotcrete. The Contractor shall apply shotcrete to abrasive blast cleaned areas within 48 h or re-blast them.

The Project Manager may waive the requirement for abrasive blast cleaning where the Contractor performed concrete removal with high-pressure water blasting and the prepared surface is free of residual slurry or other Material detrimental to an Acceptable shotcrete bond.

The Contractor shall install reinforcement in slope blankets that do not contain steel reinforcement. Unless otherwise specified, the reinforcement will consist of No. 4 steel reinforcing bars placed with maximum spacing of 12 inch for vertical and horizontal bars. The Contractor shall rigidly attach this reinforcement to the underlying forms or concrete Structure. The Contractor shall remove dust, debris, or laitance generated by this process in accordance with these abrasive blast cleaning procedures.

519.3.2.4.2 Repair or Replacement of Steel Reinforcement

If the Contractor exposes corroded reinforcing steel during concrete removal, the Contractor shall remove corrosion using abrasive grit blasting.

The Contractor shall remove and replace reinforcing steel displaying deep pitting or loss of more than 20% of cross-sectional area as directed by the Project Manager.

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If pitting is isolated, the Contractor shall reinforce the steel by adding appropriately placed reinforcing bars of suitable length (the existing reinforcing steel need not be cut).

519.3.2.4.3 Steel Reinforcement

The Contractor shall use a minimum lap splice length of reinforcing steel that is in accordance with the AASHTO *LRFD Bridge Design Specification*. The Contractor shall place these bars in accordance with ACI 506R, Sections 5.4 and 5.5. In particular, the Contractor shall not bundle bars in lapped splices; place them so the minimum spacing around each bar is three (3) times the maximum aggregate size to allow for proper shotcrete encapsulation.

The Contractor shall tightly secure intersecting reinforcing steel bars to each other using 12 gauge or heavier tie wire and adequately support them to minimize vibration during shotcrete placement.

The Contractor shall place welded wire mesh fabric in accordance with the Contract. The Contractor shall lap sheets of adjoining mesh by at least two (2) spaces in both directions at intersections, and securely fasten.

The Contractor shall fasten mesh to preset or existing anchors and reinforce using 12 gauge or heavier tie wire on a grid not less than 12 inch². The Contractor shall avoid large knots of tie wire that could result in sand pockets and voids during shotcreting.

The Contractor shall provide a minimum clearance of 3/4 inch behind installed reinforcing steel or mesh and existing concrete forms or bare rock.

519.3.2.4.4 Structural Anchors

Unless otherwise specified in the Contract, the Contractor shall place anchor bars (for structural applications) at a maximum spacing of 24 inches on a grid pattern over the entire area.

The Contractor shall provide the types of anchors in accordance with the Contract and either mechanically set or grout, as specified.

The Contractor shall ensure anchors develop the minimum pullout force in accordance with the Contract. The Contractor shall randomly test anchors at a frequency in accordance with the Contract to verify pullout force. The Department will not accept a pull out force less than 150 lb. If anchors fail to meet the minimum acceptable pullout value, the Contractor shall remove and replace immediately and take corrective action. Also, the Contractor shall test the anchors in the same relative location as those that failed. The Project Manager will determine the area for corrective measures.

519.3.2.4.5 Non-Structural Anchors

For non-structural applications (slope blankets, etc.), the Contractor shall install anchor bars at ten (10) foot centers on a grid pattern over the entire area in one (1) inch diameter holes drilled into the rock or soil approximately 24 inches deep.

The Contractor shall completely fill the drilled hole with neat cement grout using a grout tube extending to the bottom of the hole.

The Contractor shall push the anchor bar into the grout-filled hole and center it such that the short leg of the "L"-shaped bar points upward and parallel to the slope and is located

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approximately 1 1/2 inches from the rock or soil surface.

519.3.2.4.6 Weep Holes

For slope blankets, the Contractor shall provide weep holes throughout the shotcrete mat on maximum ten (10) foot centers, horizontally and vertically.

The weep hole drains will consist of two (2) inch diameter Schedule 40 PVC slotted drainpipe, two (2) feet in length, placed within predrilled holes and sloped five percent (5%) to drain. The exposed end will extend from one (1) inch to three (3) inch outside the slope.

The Department will not allow pre-drilled holes with diameters larger than three (3) inches.

The Contractor shall install the slotted drainpipe before placing shotcrete. During placement of shotcrete, the Contractor shall protect weep holes and drainpipes against contamination.

519.3.2.4.7 Alignment Control and Cover

The Contractor shall implement alignment control (to establish control over line and grade), and maintain the minimum specified shotcrete thickness and cover of reinforcing steel.

The Contractor shall perform alignment control with shooting wires (also called ground wires), guide strips, depth gauges, or forms. The Contractor shall submit the proposed means of alignment control to the Project Manager for review and approval.

The Contractor shall use shooting wires that are at least "piano wire"-sized high-strength steel wire combined with a turnbuckle and spring coil. The Contractor shall remove shooting wires after completion of shotcreting and screeding operations.

The Contractor shall not let guide strips and forms impede the ability of the nozzle operator to produce uniform, dense, properly consolidated shotcrete. The Contractor shall not use alignment control Material that causes the formation of sand-pockets and voids.

If using depth gauges for alignment control, the Contractor shall space no greater than four (4) ft in a grid pattern. The Contractor shall cut back metal depth gauges to 1/4 inch below the finished surface.

The Contractor shall cover reinforcing steel in accordance with Section 540, "Steel Reinforcement."

519.3.3 Quality Assurance and Quality Control Testing

519.3.3.1 Quality Assurance

The Department will implement a Quality Assurance Program for the shotcrete Work. The program will include the following:

- 1. Review of Contractor submittals;
- Review of the approval of Contractor-proposed Materials, supply, Equipment, and crew. In particular, evaluation in the pre-construction testing program of shotcrete nozzle operator and strike-off person proposed for use on the Project; the Department will allow only nozzle operators and strike-off persons approved in writing by the State Materials Bureau to perform Work;

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- 3. Examination and approval (before application of any shotcrete) of areas prepared for shotcreting, including installation of anchors, reinforcement, and alignment control devices;
- 4. Provision of Inspectors to monitor shotcrete installation and authority to require removal and replacement of defective shotcrete while still plastic;
- 5. Regular monitoring of Quality Control testing results;
- 6. Implementation of a program for in-place evaluation and Acceptance or rejection, if test results indicate shotcrete is unacceptable; and
- 7. Implementation of a program of remedial Work, if the Quality Assurance Program deems it necessary.

519.3.3.2 Quality Control Testing

The Contractor shall provide an independent testing Laboratory to establish and maintain a Quality Control program for the shotcrete Work to ensure compliance with Section 519, "Shotcrete." Such a program will include, but not be limited to, the following:

- 1. Maintenance of test records for Quality Control operations; and
- 2. Physical testing in accordance with Section 519.2.6.1, "Production Testing" for the confirmation of compliance with the specified hardened shotcrete properties.

519.3.3.3 Safety and Cleanup

519.3.3.3.1 Preparation

The Contractor shall implement a safety program during preparation for shotcreting to do the following:

- 1. Protect the structural integrity of structural elements (by shoring or other suitable means) during concrete and reinforcing steel removal operations.
- 2. Protect personnel from falling debris, blasting grit, and high-pressure water jets during concrete removal processes.

The Contractor shall dispose of debris, blasting grit, and hydro-demolition and waterjetting slurry in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public."

519.3.3.3.2 Shotcrete Operations

The Contractor shall implement a safety program using hoarding, shrouds, screens, or other appropriate measures to protect personnel and surrounding property from pneumatically applied shotcrete over-spray and rebound Materials during the shotcrete application process.

Personnel working near the shotcreting operation, including nozzle operator, strike-off persons, nozzle operator's helpers, supervisors, and Inspectors, shall wear appropriate protective Equipment. Such Equipment includes, but is not limited to, safety helmet, safety boots, gloves, appropriate clothing, safety glasses with side enclosures, and dust masks.

Nozzle operator's helpers shall keep a supply of water, cloth or towel, and backup safety glasses available for the nozzle operator so satisfactory vision can be maintained during shooting operations. The Contractor shall provide sufficient lighting so the nozzle operator has a clear view of the Work.

The Contractor shall provide readily available eyebaths and wash facilities in the

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immediate vicinity of the shotcrete application. The shotcrete crew shall apply appropriate skin protection and adopt Work hygiene to protect against cement or accelerator alkali burn.

The Contractor shall install sufficient lighting and ventilation to provide the nozzle operator and helpers with clear, unhindered view of the shooting area. The Contractor shall terminate Work and adopt corrective measures if, in the opinion of the Project Manager, visibility is unsuitable for the safe application of quality shotcrete.

519.3.4 Shotcrete Application and Finishing

519.3.4.1 Shotcrete Application

The Project Manager will review and approve areas prepared for shotcrete application before application of shotcrete.

The Contractor shall flush surfaces with water at least one (1) hour before application of shotcrete. The Contractor shall allow flushed surfaces to dry back to saturated surface-dry condition before application of shotcrete. If necessary, the Contractor shall use a blowpipe with oil-free compressed air to facilitate removal of surface water. For very porous and dry substrates, the Contractor shall saturate the substrate the Day before shotcreting and then rewet before shooting as described above.

The Contractor shall apply shotcrete in accordance with ACI 506R, except that if using silica-fume modified shotcrete; the Contractor may apply the full thickness of shotcrete in a single layer. The Contractor shall use the minimum number of layers required to build up the full thickness of shotcrete without sagging, separation, or sloughing. Wherever possible, the Contractor shall apply shotcrete to the full thickness in a single layer.

If using multiple-layer shotcrete construction, the Contractor shall prepare the first layer with one (1) of the following methods before applying a subsequent layer:

- 1. Broom the stiffening layer with a stiff bristle broom to remove loose Material, rebound, over-spray, or glaze, before the shotcrete attains initial set.
- 2. If the shotcrete has set, Delay surface preparation at least 24 h, then prepare the surface by sandblasting or high-pressure water blasting to remove loose Material, rebound, hardened over-spray, glaze, or other Material detrimental to good bond.

When successive layers of shotcrete are necessary to build up full shotcrete thickness, the Contractor shall prevent the first layer from drying out with fogging or wetting. The Contractor shall only use curing compound with the approval of the Project Manager. If using a curing compound, the Contractor shall remove it by abrasive blast cleaning or high-pressure water blasting, before application of the next layer of shotcrete. The Contractor shall clean the first layer of shotcrete of surface water and ensure it is in a saturated surface-dry condition when applying the next shotcrete layer.

The Contractor shall exercise care to protect adjacent surfaces from buildup of rebound and over-spray. The Department will not allow rebound and over-spray on the completed Work. The Contractor shall remove rebound and over-spray from surfaces to receive shotcrete while the Material is still plastic, using blowpipes, scrapers, wire brushes, or other suitable tools. The Contractor shall remove hardened rebound and overspray with abrasive blast cleaning, chipping hammers, high-pressure water blasting or other suitable techniques before applying additional shotcrete.

The Contractor shall provide scaffolding or other devices so the nozzle operator and helpers have free, unhindered access to the Work area.

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The Contractor shall apply shotcrete from the nozzle in accordance with ACI 506R.

The Contractor shall not apply shotcrete during periods of rain or high wind, unless suitable protection is provided.

The Contractor shall apply shotcrete in accordance with the Contract using shooting wires, depth gauges, guide strips, forms, or other suitable devices. The Contractor shall apply the minimum cover of shotcrete to reinforcing steel in accordance with the Plans. The Contractor shall cut back metal depth gauges to within 1/4 inch of the shotcrete surface, to prevent corrosion staining of the surface.

When applying a 3/8 inch maximum aggregate size shotcrete, the Department will allow a final flash coat layer ($\frac{1}{4}$ inch to $\frac{3}{4}$ inch thick) using $\frac{1}{4}$ inch aggregate shotcrete.

519.3.4.2 Shotcrete Finishing

The Contractor shall leave shotcrete in the natural gun finish unless otherwise specified in the Contract.

If the Contract requires finishing, the Contractor shall cut back shotcrete to line and grade using cutting rods, screeds, or other suitable devices. The Contractor shall allow shotcrete to stiffen sufficiently before cutting and trimming, to prevent the formation of tears, cracks, and delaminations. The Contractor shall remove shooting wires on completion of cutting and trimming.

The Contractor shall apply one (1) or more of the following finishes if required:

- 1. Wood float finish, either as a preliminary finish for other surface treatments, or as a granular texture finish.
- 2. Rubber float finish, applied to either a flash coat or wood float finish, to produce a finer textured granular finish.
- 3. Brush finish, a fine hairbrush float finish that leaves a finely textured, sandy finish.
- 4. Steel trowel finish that leaves a dense, smooth hard finish.

The Contractor shall trim back shotcrete and over-spray from adjacent non-prepared concrete surfaces. The Contractor shall provide the edges of shotcrete repairs with a minimum square saw-cut edge 3/4 inch deep; finish shotcrete up to this edge. The Contractor shall not featheredge shotcrete (including flash coats).

519.3.4.3 Curing and Protection

On completion of finishing, the Contractor shall immediately prevent shotcrete from drying out by fogging or wetting.

If the Contract requires leaving shotcrete with a natural gun finish, the Contractor shall apply curing compounds at twice the application rate normally specified for smooth concrete finishes. The Contractor shall completely remove curing compounds by abrasive blasting or water blasting (with a pressure of 3,000 psi) before application of subsequent sealers.

Once the shotcrete achieves its final set, the Contractor shall keep it continuously moist for at least seven (7) Days. The Contractor shall perform moist curing using one (1) or both of the following procedures:

1. Wrap the elements in wet burlap presoaked in water for 24 h before installation;

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wrap the wet burlap in plastic sheet to slow the drying rate of the burlap.

2. Install sprinklers, soaker hoses, or other devices that keep the shotcrete continuously wet. Do not use intermittent wetting procedures that allow the shotcrete to undergo cycles of wetting and drying during the curing period.

519.3.4.4 Hot and Cold Weather Protection

The Contractor shall apply shotcrete during periods of hot and cold weather in accordance with ACI 305R and ACI 306R.

If it is anticipated that shotcrete will be placed when the ambient temperature will fall below 35 $^{\circ}$ F, a Cold-Weather Shotcrete Plan must be prepared and submitted to the Project Manager at least 30 Days before the intended application. The Cold Weather Shotcreting Plan must be reviewed and approved by the State Concrete Engineer before shotcrete is permitted to be placed at temperatures below 35 $^{\circ}$ F.

The Contractor shall monitor the Surface Evaporation of the Shotcrete in accordance with Section 512, "Superstructure Concrete." The Contractor shall not proceed with shotcrete application if the average rate of surface evaporation of the shotcrete over any ten (10) minute period exceeds 0.2 lb per square foot per hour, in accordance with Section 512, "Superstructure Concrete." The Contractor shall not allow the prevailing ambient conditions (relative humidity, wind speed, air temperature, and direct exposure to sunlight) to cause either plastic shrinkage or early drying shrinkage cracking.

All cracked Structural shotcrete, regardless of the cause, shall be removed and replaced at no cost to the Department.

Subsequent efforts to prevent further cracking problems shall include, but not be limited

- 1. Rescheduling of the Work to a time when more favorable ambient conditions prevail; and
- 2. Adopt corrective measures, such as installation of sunscreens, windbreaks, or fogging devices to protect the Work.

During periods of cold weather, shotcreting may only proceed if the substrate to which the shotcrete is applied and the air temperature in contact with the shotcrete surfaces are both above 50 $^\circ$ F.

The Contractor shall maintain the air temperature in contact with the shotcrete surfaces at 60 °F or greater for at least four (4) Days after application of shotcrete. The Contractor shall submit the means of maintaining the air temperature to the Project Manager for approval. The Contractor shall not use unvented heaters.

The Contractor shall apply shotcrete at a temperature of between 50 °F and 90 °F. The Contractor shall use cooler mix temperatures during hot-weather shotcrete operations and warmer mix temperatures during cold-weather shotcrete operations.

519.3.4.5 Inspection and Remedial Work

The Contractor shall sound the surface of the cured shotcrete with a hammer to locate unsound areas.

The Contractor shall provide Equipment, hardware, and means necessary to perform the inspection operations. The inspection accommodations are subject to the approval of the

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to.

Project Manager.

The Contractor shall cut out and replace sags or other defects with another layer. If welded wire mesh reinforcement is damaged or destroyed by such repairs, the Contractor shall repair the damaged area by overlapping and tying additional wire mesh in accordance with Subsection 519.3.2.4.3, "Steel Reinforcement."

519.4 METHOD OF MEASUREMENT

The Department will measure shotcrete using the dimensions shown in the Contract or approved modifications.

519.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Structural Shotcrete	Square Yard
Non-structural Shotcrete	Square Yard

519.5.1 Work Included in Payment

The following Work and item(s) will be considered as included in the payment for shotcrete and will not be measured or paid for separately:

- 1. Reinforcement;
- 2. Anchors;
- 3. Slotted pipe;
- 4. Ties;
- 5. Test molds;
- 6. Test samples;
- 7. Submittals;
- 8. Boring;
- 9. Cores; and
- 10. Grouting.

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541.1 DESCRIPTION

This Work consists of providing, fabricating, erecting, and coating Structural Steel.

Structural Steel includes forged or cast steel, bolts, tie rods, other ferrous or nonferrous Materials, and miscellaneous steel. Steel shall be divided into the following categories:

Tier 1 – rolled steel beams, plate girders, diaphragms and cross frames for steel Bridges, and overhead sign Structures.

Tier 2 – metal Bridge barrier rails, diaphragms for concrete Bridges, and steel bearing components.

Tier 3 – drop inlets, safety grates, cattle and game guards, pedestrian rails, gates, access panels, and other miscellaneous steel.

For welding of driven pile splices, see Section 541.3.6.4, "Field Welding."

541.2 MATERIALS

541.2.1 Structural Steel

The Contractor shall provide Structural Steel in accordance with AASHTO M270, Grade 50, unless otherwise designated in the Contract. The Contractor shall provide steel for anchor bolts, sole plates, minor Bridge components, inlet grates, and cattle guards in accordance with AASHTO M270, Grade 36 or Grade 50.

541.2.1.1 Impact Testing Requirements for Non-Fracture-Critical Structures

For Materials requiring impact testing, the Contractor shall not weld repair the base metal at the producing mill. The Department will consider Structures to be non-fracture-critical, unless otherwise designated in the Contract. The Contractor shall fabricate the following in accordance with AASHTO M270, Table 10 when subject to tensile stresses:

- 1. Wide flange beams used as main load carrying members;
- 2. Flanges and web plates used in plate girders;
- 3. Flange cover plates;
- 4. Flange and web splice plates; and
- 5. Other components designated in the Contract.

The Contractor shall conduct Charpy V-notch (CVN) impact "H" or "P" frequency testing in accordance with AASHTO T243.

The Contractor shall ensure that Structural Steel meets requirements for minimum service temperatures as described for Zone 2 of the AASHTO's *Standard Specifications for Highway Bridges* (negative one degrees $(-1^\circ)F - 30^\circ F$).

The Contractor shall conduct plate-frequency testing instead of hat-lot testing for plate Material thicker than 1-1/2inch.

541.2.1.2 Impact Testing Requirements for Fracture-Critical Bridge Components

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The Contract will specify the CVN requirements for fracture-critical Bridge components.

541.2.2 Shear Connector Studs

The Contractor shall provide shear connector studs fabricated from cold-drawn bars, grades 1015, 1018, or 1020, either semi-killed or fully-killed in accordance with AASHTO M169.

If using flux-retaining caps, the Contractor shall use the low carbon grade steel for the caps that is suitable for welding and in accordance with ASTM A109. The Contractor shall produce the finish by cold drawing, cold rolling, or machining.

The Contractor shall ensure stud tensile properties are in accordance with Table 541.2.2:1, "Tensile Properties of Shear Connector Studs," as determined by tests of bar stock (after drawing) or finished studs, in accordance with ASTM A370.

Table 544 0.0.4

Tensile Properties of Shear Connector Studs						
Property Minimum Requirement						
Tensile strength	60,000 psi					
Yield strength @ 0.2% offset	50,000 psi					
Elongation in two (2) inch	20%					
Reduction of area	50%					

The Contractor shall weld studs with automatic stud welding guns that shall be used to weld studs to girders. The operator shall be qualified per AWS D1.5 Subsection 7.7.4. The base metal where the stud is to be welded shall be ground to bright metal immediately prior to the weld being made. Manual welding will not be allowed except to make repairs. Repairs shall be in accordance with AWS D1.5 Subsection 12.6. Repair fillet size shall be a minimum of 5/16 inch.

541.2.3 Aluminum

The Contractor shall provide aluminum and aluminum alloy Materials in accordance with ASTM aluminum alloy designation and in accordance with the Plans.

541.2.4 Bolts

The Contractor shall provide high-strength bolts in accordance with Section 542, "High-Strength Bolts." The Contractor shall provide other bolts in accordance with ASTM A307, Grade A.

541.2.4.1 Unfinished Bolts

The Contractor shall provide unfinished ASTM A307 bolts. The Contractor shall provide thread bolts so that not more than two (2) threads are within the grip of the connected parts. The Contractor shall use bolts that will extend beyond the nut at least two (2) threads, but not more than 1/2 inch.

541.2.5 Structural Steel Coating

The Contractor shall provide coated Structural Steel in accordance with Table 541.2.5:1, "Coating of Structural Steel."

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Table 541.2.5:1 Coating of Structural Steel

Item	Coating Requirement
Galvanizing, Hot-Dip Galvanizing, or Zinc Coating	Section 541.2.5.1
Structural Steel for Steel Bridges	Section 544, "Protective Coating of New Structural Steel"
Structural Steel for Concrete Bridges	Section 544, "Protective Coating of New Structural Steel"
Structural Steel for Miscellaneous Structures	Section 545, "Protective Coating of Miscellaneous Structural Steel"
Metal Bridge Railing	Section 545, "Protective Coating of Miscellaneous Structural Steel"
New Exposed Steel Bridge Piling and Similar Applications	Section 545, "Protective Coating of Miscellaneous Structural Steel"
Recoating Bridges	Section 546, "Recoating Structures"

541.2.5.1 Galvanizing or Zinc Coating

If the Contract requires a galvanized coating, the Contractor shall coat steel after fabrication in accordance with AASHTO M111.

Bolts, washers, nuts, and position dowels used in the assembly and erection of galvanized railing and posts or where specified, shall be galvanized in accordance with AASHTO M232 Class C or shall be zinc coated in accordance with ASTM B695.

After erecting the steel, the Contractor shall coat the galvanized hardware with a product meeting ASTM A780, Type 2.

541.2.5.1.1 Quality Control and Repair of Galvanizing

Uncleaned slag lines, bare spots, blisters, flux spots or inclusions, dross, acid, or black spots that exceed one (1) square inch or occur on more than five percent (5%) of the exposed surface area shall be cause for rejection of the lot. The Materials may be stripped, regalvanized, and again submitted for inspection; otherwise the entire lot shall be rejected.

Pieces with damage to less than five percent (5%) of the exposed surface area may, with the approval of the Project Manager, be repaired in accordance with ASTM A780 Type 1 - zinc-based solders which includes low melting point zinc alloy repair rods or powders or Type 3 - metallizing.

With the approval of the Project Manager, on areas that are concealed from direct weathering and on areas that are not aesthetically visible to the travelling public, ASTM A780 Type 2 (paints containing zinc dust, commonly referred to as "cold galvanizing") may be used on areas less than one square inch and less than five percent (5%) of the exposed surface area. The dried film must contain no less than 90% pure zinc. Surface preparation and application shall be in accordance with the manufacturer's requirements.

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In any case, galvanizing repair shall not compromise the aesthetic Acceptability of the Project as determined by the Project Manager.

541.3 CONSTRUCTION REQUIREMENTS

541.3.1 Applicable Codes and Documents

The Contractor shall fabricate and erect steel Structures in accordance with the current edition of the following codes and documents:

- 1. AASHTO/AWS D1.5 Bridge Welding Code;
- 2. AASHTO/AWS D1.1 Structural Welding Code;
- 3. AWS D1.4 Structural Welding Code Reinforcing Steel;
- 4. AISC 204 AISC Certification Program for Bridge and Highway Metal Component Manufacturers; and
- 5. The following AASHTO/NSBA Steel Collaboration documents:
 - 5.1. S2.1 Steel Bridge Fabrication Guide Specification;
 - 5.2. S 4.1 Steel Bridge Fabrication QC/QA Guide Specification;
 - 5.3. S10.1 Steel Bridge Erection Guide Specification;
 - 5.4. G 1.1 Shop Detail Drawing Review / Approval Guidelines;
 - 5.5. G 1.3 Shop Detail Drawing Presentation Guidelines; and
 - 5.6. G12.1 Guidelines to Design for Constructability.

Although the AASHTO/AWS Steel Collaboration documents are titled "Guidelines" or "Guide Specifications," 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., 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.

In AASHTO/NSBA Steel Bridge Collaboration S 4.1, all references to Quality Assurance Inspector (QAI) shall be equivalent to referencing the Project Manager.

541.3.2 Quality Control and Quality Assurance (Contractor)

Quality Control and Quality Assurance shall be in accordance with the following:

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification.

Tier 2 – NMDOT Approval of fabrication shop is required, AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition shall be used as the basis for approval (AISC Certification is not required).

Tier 3 – NMDOT Approval of fabrication shop is required, AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition shall be used as the basis for approval (AISC Certification is not required).

Fabricators shall contact the State Bridge Engineer to request shop inspection and approval.

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541.3.2.1 Qualification of QA Inspector (NMDOT Representative)

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification, Part C is superseded by the following requirement: current AWS Welding Inspector Certification.

Tier 2 - Licensed Professional Engineer or a certified AWS Welding Inspector.

Tier 3 – Project Manager or a certified AWS Welding Inspector.

The individual qualified for steel inspection shall also perform coating inspections with no further qualification with the exception of Tier 2 which may be performed by the Project Manager or certified AWS Welding Inspector. AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification 3.2 and 8.1.2 shall not apply to the QAI inspector of coatings.

541.3.3 Submittals

For Tier 1, prior to installation, the Contractor shall provide all submittals in accordance with Section 106, "Control of Materials." Additional required submittals follow but are not limited to:

- 1. Structural Steel Mill Test Reports (MTRs);
- 2. Certificates of Compliance and other documentation for the protective coating;
- 3. The manufacturer's Certificate of Compliance for welding consumables;
- 4. QC inspection reports; and
- 5. A general Certificate of Compliance for the fabricated product.

The Contractor shall submit Certificates of Compliance instead of MTRs for Materials subjected to minimal stress levels, such as sole plates, shoe plates, anchor bolts, and fill plates.

541.3.3.1 Working Drawings

The Contractor shall allow 30 Days for review and Acceptance of Working Drawings and calculations. Any re-submittals will require an additional 14 Days for review. The Working Drawing submittal process must be complete prior to the Pre-Fabrication Conference (Section 541.3.5.1, "Pre-Fabrication Conference").

The Contractor shall prepare Working Drawings in accordance with AASHTO/NSBA G 1.3, Shop Detail Drawing Presentation Guidelines. The Department will review Working Drawings for Acceptance in accordance with AASHTO/NSBA G 1.1, Shop Detail Drawing Review / Approval Guidelines. The Working Drawing submittal shall include a detailed bill-of-Material in accordance with AASHTO/NSBA Steel Bridge Collaboration G 1.1 with the letter of intent to fabricate. The Contractor shall submit Working Drawings electronically in PDF format to the Project Manager.

The Contractor shall not make any changes to Accepted Working Drawings. If changes are made, the Contractor shall re-submit the Working Drawings for Acceptance.

The Contractor shall include the submittal and review time for its shop drawings and schedule for fabrication of the specialized structural steel components as a milestone per Section 108.3.1.1, "CPM Baseline Schedule" (bullet 5).

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541.3.3.2 Working Drawings for Structural Steel Items Detailed on Standard Drawings

The Contractor may submit standardized Working Drawings instead of Project-specific drawings for Structural Steel items such as cattle guard grills and drop inlet grates.

The Contractor shall include the Fabricator's name and address, drawing title, drawing number, drawing date, revision dates, and Standard Drawing number on Working Drawings.

541.3.3.3 Erection Plan

The Contractor shall submit an erection Plan for Tier 1 steel. Erection Plans are not required for OH Sign Structures.

The Contractor shall submit an Erection Plan conforming to Section 2 of the AASHTO/NSBA Steel Bridge Erection Guide Specification S10.1, 2014 Edition and the following Department requirements:

- The Erection Plan shall be prepared by a Professional Engineer licensed in the State of New Mexico and shall be accompanied by calculations verifying the safety of all aspects of erection;
- The Erection Plan shall consider the load-bearing capacities of any temporary or permanent Structures used in the erection of the new Bridge, including any need for shoring;
- 3. The Erection Plan shall be submitted no less than thirty (30) Days prior to any steel erection operations; and
- 4. All costs for the Erection Plan and shoring of any temporary or permanent Structure used for the erection of the new Bridge shall be considered included in Bid Item 541100 Structural Steel for Steel Bridges.

The Contractor shall allow 30 Days for review and Acceptance of the erection Plan. Any re-submittals will require an additional 14 Days for review. The erection Plan submittal process must be complete prior to the start of erection.

The Contractor shall include the submittal and review time for its erection Plan and schedule for erection of the specialized structural steel components as a milestone per Section 108.3.1.1, "CPM Baseline Schedule" (bullet 5).

541.3.4 Rolled Girders and Plate Girders

The Contractor shall provide girders to the full length shown in the Plans. Bolted or welded girder splices will not be permitted unless noted otherwise in the Plans.

541.3.5 Fabrication

The Contractor shall ensure that the fabrication shop for Tier 1 steel is certified in accordance with AASHTO/NSBA *Steel Collaboration S2.1*, *Steel Bridge Fabrication Guide Specification*. The Department will not require AISC certification for fabrication shops fabricating Tier 2 and Tier 3 steel items, but the Department must inspect and approve these shops before fabrication.

Steel will be fabricated in the shop unless otherwise approved by the Project Manager.

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S2.1 Steel Bridge Fabrication Guide

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Specification.

Tier 2 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition.

Tier 3 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition.

541.3.5.1 Pre-Fabrication Conference

A Pre-Fabrication Conference is required for Tier 1 steel (a Pre-Fabrication Conference is not required for OH Sign Structures). The Pre-Fabrication Conference shall be held in conjunction with the Pre-Construction Conference. The Pre-Fabrication Conference may be held on an alternate date at the discretion of the Project Manager. The agenda for the Pre-Fabrication Conference shall be based upon S2.1, "Steel Bridge Fabrication Guide Specification."

541.3.5.2 Attachment and Fit of Gussets and Stiffeners

Where welding of gusset plates, stiffeners or other secondary attachments to main structural members would otherwise result in intersections of welds, the Contractor shall clip back the corners of the attachments 1-1/4 inch minimum from the corner in each direction to avoid such intersections.

The Contractor shall terminate welds attaching secondary components to main members 1/4 inch short of the end of the attachments.

If the Plans require bearing stiffeners "finished to bear," the Contractor shall mill or grind the ends and obtain an even bearing against the flange the stiffeners will bear on.

If the Plans require "tight fit" stiffeners, the Contractor shall fit the stiffeners tight against the flange to exclude water after being coated.

541.3.5.3 Straightening of Flanges

At pier bearings, abutment bearings and splices, the Contractor shall straighten girder or beam flanges perpendicular to the webs. At bearings, the Contractor shall straighten flanges before fitting stiffeners. At splices, the Contractor shall straighten flanges before coating and shipment. The Contractor shall not cold bend.

541.3.5.4 Bearing Plates, Pins, and Rollers

541.3.5.4.1 Sole, Masonry, and Shoe Plates

The Contractor shall flatten the top and bottom surfaces of sole masonry and shoe plates to within \pm 1/32 inch.

The Contractor shall machine sole plate surfaces that will contact elastomeric bearing pads perpendicular to the direction of expansion.

The Contractor shall machine other expansion surfaces in the direction of expansion.

541.3.5.4.2 Pins and Rollers

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The Contractor shall accurately turn pins and rollers to dimensions and ensure that they are smooth, straight, and free of flaws.

541.3.5.4.3 Pin Holes

The Contractor shall bore a two (2) inch diameter hole longitudinally through the center of pins with an eight (8) inch diameter or larger.

The Contractor shall bore pinholes true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise required. The Contractor shall produce the final surface with a finishing cut.

The Contractor shall not vary the outside to outside distance of end holes in tension members and inside to inside distance of end holes in compression members by more than 1/32 inch. The Contractor shall bore holes in built-up members after shop assembly.

541.3.5.4.4 Threads

The Contractor shall ensure that bolt and pin threads are in accordance with Unified Standard Series UNC-ANSI B1.1, Class 2A for external threads and Class 2B for internal threads. The Contractor shall thread pin ends with a diameter of 1 3/8 inch or greater with six (6) threads per inch.

541.3.5.4.5 Surface Finish

The Contractor shall finish the surfaces of bearings, base plates, pins, rollers, and other bearing steel that will come into contact with each other or with concrete in accordance with ANSI B46.1, Surface Roughness, Waviness and Lay.

541.3.5.5 Connections

541.3.5.5.1 Welding

541.3.5.5.1.1 Welder Qualifications

The Contractor shall use annually certified welders or those who provide documentation demonstrating continuing experience in the process. Welder must be qualified for the position the weld is performed in. All welders shall be certified by AASHTO/AWS D1.1 or D1.5 unless otherwise noted in the Contract.

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S2.1 Steel Bridge Fabrication Guide Specification (Built-up plates and open rolled-shape structural elements AWS D1.5, welded tubular structural elements in accordance with D1.1)

Tier 2 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition. The welder shall be AWS D1.1 certified.

Tier 3 – The welder shall be AWS D1.1 certified.

541.3.5.5.1.2 Testing of Complete Penetration Welds

The Contractor shall conduct nondestructive QC radiographic testing on complete penetration welds in accordance with AWS D1.5 or D1.1 (as applicable).

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The Department may allow ultrasonic testing as a substitute for radiography. The Contractor shall submit an ultrasonic testing Plan for approval at least 30 Days before the start of fabrication. The Contractor shall provide detailed information about the Fabricator's previous experience with ultrasonic testing and resumes showing the training and experience of persons performing the testing. The Contractor shall not use ultrasonic testing for cases described in Section 6.7.1.1 of the AASHTO/AWS D1.5-Bridge Welding Code.

541.3.5.5.2 Bolted Connections

The Contractor shall bolt with high strength bolts in accordance with Section 542, "High-Strength Bolts."

The Contractor shall make bolt holes 1/16 inch larger than the nominal diameter of the connector, unless otherwise specified.

541.3.5.5.3 Gaps between Ends of Abutting Members

Where the Contract requires abutting milled joints, the Contractor shall ensure there are no gaps. The Contractor shall face the ends to provide a full and even bearing when assembled.

Where the Contract requires close joints, the Contractor shall not exceed 1/8 inch between the ends of abutting members. The Contractor shall not exceed 1/4 inch between abutting ends of girders at splices.

541.3.5.6 Camber Verification

The Contractor shall verify girder camber during the laydown operation. Unless assembling girders in the horizontal position, the Contractor shall meet the total camber dimensions less the deflections produced by the weight of the girder.

541.3.6 Erection Requirements

The Contractor shall erect the Structure in accordance with AASHTO/NSBA Steel Bridge Collaboration S10.1, *Steel Bridge Erection Guide Specification*.

If requested by the Project Manager, a Pre-Erection Conference shall be held prior to start of erection. The agenda shall be the review of the erection Plan.

541.3.6.1 Placement of Bearings

The Contractor shall ensure that column bases and bearing devices bear fully and uniformly on Substructures. The Contractor shall not place bearings on pier or abutment Bridge seat areas that are improperly finished or irregular. The Contractor shall grout to achieve uniform bearing only when the Contract allows grouting.

The Contractor shall place masonry plates and beam and girder span pedestals on impregnated fabric pads approved by the Project Manager at least 1/8 inch thick.

541.3.6.2 Anchor Bolt Holes

The Contractor shall core drill anchor bolt holes in accordance with Table 541.3.6.2:1, "Required Nominal Anchor Bolt Hole Diameters."

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Table 541.3.6.2:1 Required Nominal Anchor Bolt Hole Diameters

Required Nominal Anchor Bolt Hole Diameters					
Bolt diameter (inch)	Hole diameter (inch)				
3/4	1-1/2				
1	1-3/4				
1-1/4	2				

The Contractor shall set anchor bolts using non-shrink grout from the Department's Approved Products List. The Contractor shall remove excess mortar after the grout has set. The Contractor shall ensure that anchor bolt washers and nuts bear evenly against the steelbearing surface. The Contractor shall ensure anchor bolts at the expansion ends of spans allow the free movement of the span.

541.3.6.3 Field Bolting

The Contractor shall install high strength bolts in accordance with Section 542, "High-Strength Bolts."

The Contractor shall block main structural members to the desired camber before torqueing the bolted splice connections.

For skewed steel Bridges with diaphragms perpendicular to the longitudinal centerline, the Contractor shall finger tighten diaphragm attachment bolts before deck placement. The Contractor shall fully torque bolts after the deck slab is in place.

Following completion of the Superstructure and after priming, the Contractor shall fill open holes in exterior beams and girders with button head bolts before Final Acceptance.

541.3.6.4 Field Welding

Field welding of permanent steel elements will not be permitted unless shown in the Plans, with the following exceptions:

- 1. Field welds shown in the Plans;
- 2. Splices for driven pile;
- 3. Sole plate to girder shoe plate;
- 4. Pedestrian rails;
- 5. Shear studs installed in the field for construction means and methods; or
- 6. As approved by the Project Manager.

541.3.6.4.1 Field Welding Submittal and Qualifications

The Contractor shall submit a welding procedure and the welder's certification for the welder performing the Work. The welder certification must be consistent with the welding procedure and the welding position required to perform the Work. Qualifications of the welders shall be consistent with Section 541.3.5.5.1.1, "Welder Qualifications."

541.3.6.4.2 Field Welding Inspections

The Contractor shall provide a certified AWS Welding Inspector. This Inspector shall review and approve the welding procedure and the welder qualifications. This Inspector shall provide testing and documentation in accordance with Section 541.3.1, "Applicable Codes and

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Documents." Documentation shall be submitted to the Project Manager within Seven (7) Days of completion of the welding activity.

541.3.6.4.3 Field Installation of Shear Studs

Should the Contractor elect to install shear studs in the field, the Contractor shall field weld studs with automatic stud welding guns that shall be used to weld studs to girders. The operator shall be qualified per AWS D1.5 Subsection 7.7.4. The base metal where the stud is to be welded shall be ground to bright metal immediately prior to the weld being made. Manual welding will not be allowed except to make repairs. Repairs shall be in accordance with AWS D1.5 Subsection 12.6. Repair fillet size shall be a minimum of 5/16 inch.

Field welded studs shall be inspected in accordance with Section 541.3.6.4.2, "Field Welding Inspections."

541.3.6.5 Pilot and Driving Nuts

The Contractor shall use pilot and driving nuts in driving pins. The Contractor shall show details on the Working Drawings. The Contractor shall furnish one (1) pilot and one (1) driving nut for each size pin.

541.3.7—Reserved

541.3.8 Disposal of Steel Structures, Reinforcing Steel, Steel Debris or Steel Waste

The Contractor shall not reuse salvaged steel items from existing Structures on NMDOT Projects unless directed otherwise in the Plans. Salvaged steel shall be disposed of by Contractor as approved by the Project Manager.

541.3.9 Quality Assurance Inspection Frequency

541.3.9.1 Steel Inspections

The following Quality Assurance Inspections shall be performed by the Quality Assurance Inspector (QAI). Unless otherwise noted, the Inspections shall take place in the fabrication shop.

Tier 1 – Rolled steel beams – minimum of one (1) QA Inspections per Project; Plate girders – minimum of three (3) QA Inspections per Project; Diaphragms and cross frames – include with the above inspections; and Overhead sign structures – minimum of one (1) inspection per fabrication shop per year.

Tier 2 – Metal Bridge barrier rails – 40% of welds by length; Diaphragms for concrete Bridges – visual inspection upon delivery to site; and Steel bearing components – 40% of welds by length.

Tier 3 – Drop inlets – visual inspection upon delivery to site; Safety grates – visual inspection upon delivery to site; Cattle & game guards – visual inspection upon delivery to site; Pedestrian rails – visual inspection upon delivery to site; Gates – visual inspection upon delivery to site; Access panels – visual inspection upon delivery to site; and Miscellaneous steel – visual inspection upon delivery to site.

It is recommended that a QA Inspection be performed at or near the completion of

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erection; this is in addition to those listed above.

541.3.9.2 Coating Inspections for Paint and Powder Coating

The following Quality Assurance Inspections shall be performed by the Quality Assurance Inspector (QAI). Unless otherwise noted, the Inspections shall take place in the fabrication shop. The Project Manager may waive coating inspections.

Tier 1 – Rolled steel beams – one (1) inspection concurrent with a steel inspection;
Plate girders – one (1) inspection concurrent with a steel inspection;
Diaphragms and cross frames – no requirement; and
Overhead sign Structures – photos of coating process shall be provided to the QAI with QC traveler documentation, visual inspection upon delivery to site.
Tier 2 – Metal Bridge barrier rails – two (2) shop inspections are recommended per Project; this may be waived by the Project Manager.

Project; this may be waived by the Project Manager; Diaphragms for concrete Bridges – no requirement; and Steel bearing components – visual inspection upon delivery to site.

Tier 3 – Drop inlets – visual inspection upon delivery to site; Safety grates – visual inspection upon delivery to site; Cattle & game guards – visual inspection upon delivery to site; Pedestrian rails – visual inspection upon delivery to site; Gates – visual inspection upon delivery to site; Access panels – visual inspection upon delivery to site; and Miscellaneous steel – visual inspection upon delivery to site.

It is recommended that a QA inspection be performed at or near the completion of erection; this is in addition to those listed above.

541.3.9.3 Galvanized Elements

Galvanized elements shall be visually inspected upon delivery to the site by the Project Manager.

541.4 METHOD OF MEASUREMENT

If structural members are specified by a nominal unit weight, the Department will calculate weight based on the nominal weights and dimensions.

When structural members are not designated by a nominal unit weight, the Department will calculate weight using the unit weights listed in Table 541.4:1, "Metal Unit Weights for Measurement."

The Department will deduct the weight of copes, cuts, bevels, and open holes from the gross weight. The Department will not make deductions for bolt holes.

Table 541 4.1

Metal Unit Weights For Measurement					
Material Unit weight (lb./ft ³)					
Steel	490				
Cast iron	445				
Bronze	536				

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541.4.1 Bolts

The Department will pay the weight of fasteners as indicated on the Accepted Working Drawings.

541.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Structural Steel for Concrete Bridges	Pound
Structural Steel for Steel Bridges	Pound
Structural Steel for Miscellaneous Structures	Pound

541.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

- 1. Submittals including re-submittals;
- 2. Nondestructive testing;
- 3. Protective coatings;
- 4. Additional weight of heavier sections provided solely for the Contractor's convenience;
- 5. All Incidentals necessary for the completion of the Work;
- 6. Weld Material weight; and
- 7. All QC/QA requirements.

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SECTION 545: PROTECTIVE COATING OF MISCELLANEOUS STRUCTURAL STEEL

545.1 DESCRIPTION

This Work consists of coating new steel elements including Bridge railing, pedestrian railing, drop inlet grates and frames, cattle guard grates, field coating of new steel piling, CWB access panels, gates, headgates, and flapgates, I-beam posts, safety grates, sole plates, and bearing devices, and miscellaneous steel elements.

545.1.1 Terminology and Standards

The Contractor shall use terminology in accordance with the following standards:

- 1. Society for Protective Coatings (SSPC) Painting Manual Volume 2;
- 2. Surface Preparation Standards, Guides, and Specifications, Section 2 of the SSPC Painting Manual Volume 2 (SSPC-SP);
- 3. American Architectural Manufacturer's Association (AAMA);
- 4. American Association of State Highway and Transportation Official (AASHTO);
- 5. American Society for Testing and Materials (ASTM);
- 6. American Institute of Steel Construction (AISC); and
- 7. National Association of Corrosion Engineers (NACE).

545.2 MATERIALS

The Contractor shall apply the coating system specified within the Contract. If the Contract does not specify a specific coating system, the Contractor may select the coating system from Table 545.2:1, "Coating System Selection Matrix."

	Coating System						Color Comments		
	galvanize	3-Coat poly	2-Coat epoxy shop	2-Coat epoxy field	2-Coat acrylic	Powder Coat	3-Coat poly	2-Coat acrylic	if not galvanized, color (unless
	541	544	545	545	545	545	546	546	otherwise noted in
Specification Section	541.2.5.1	544.2.1	545.2.1	545.2.2	545.2.3	545.2.4	546.2.1	546.2.2	drawings)
Element									
structural steel	х	х					R		*
metal Bridge railing	х							R	*
metal Pedestria n railing	х							R	*
drop inlet grates & frames	х		x		х	х		R	*
cattle guard grates			х		х	х		R	safety yellow

Table 545.2:1 Coating System Selection Matrix

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Table 545.2:1 Coating System Selection Matrix

		Coating System							Color Comments	
	CWB Access Panels	х		x	x	x	x		R	×
	Gates	х		x	х	х	х		R	interstate green
	Headgate s & Flapgate s**			x	х	х	х		R	**
	I-Beam Posts	х		х	х	х	х		R	interstate green
	steel piling							XR		*
	sole plates & bearing devices			x					R	*
	safety grates	х		х	х	х	х		R	*
	Misc. steel	х		х	х	х	х		R	*
Co Co	ating mponent									
	Galvanizi ng	С								
	inorganic zinc primer		с	С		С				
	organic zinc primer				С	С		С	С	
	epoxy intermedi ate		с					с	***	
	polyureth ane topcoat		с					с		
	epoxy topcoat			с	с					
	acrylic topcoat					С			С	
	powder coating						с			

"X" denotes a coating system that is acceptable for each element. Specific coating systems noted in the Contract Documents supersede the information provided in this table.

"R" denotes the coating system that is allowable for recoating unless otherwise specified in the Contract Documents. Reference 546 "Recoating Structures" for additional information. All recoating is allowable as field applied.

"C" denotes the coating system component, reference specification section for details.

* If the Contract does not specify a color, the Contractor shall use the color Federal Standard 595A Color No. 22563 or approved equal.

** If purchased as an assembly, any corrosion inhibiting coating that is provided by the manufacturer is acceptable.

*** Intermediate or tie-coat to be provided if recommended by the manufacturer.

545.2.1 Coating System No. 1: Shop Applied 2-Coat with Epoxy Topcoat

The Contractor shall select a complete coating system comprised of products meeting all

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performance requirements as listed in Table 545.2.1:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products in each system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Inorganic Zinc-Rich Primer – Shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight.

Epoxy Topcoat Coat – Shall be a two (2)-component epoxy polyamide or polyamidoamine coating, including Phenalkamine coatings with minimum solids by volume of 65%.

			ACCEPTANCE	
TEST	REF. NO.	PRODUCT(S)	CRITERIA	COMMENTS
Slip	ASTM A	IOZ	Class B, Min. 0.5	
Coefficient	325,			
	Appendix			
0.11 5	A.			
Salt Fog	ASTMB	P/1 (IOZ)	(A) No Delamination	
Resistance	117		(P) Pust Max groop 4mm	
			(B) Rust – Max creep 41111, Avg. croop $2mm \otimes 5000$	
			Hrs	
			(C) Blister – Conversion #8	
			@ 4000 Hrs.	
Cyclic	ASTM D	P/T (IOZ)	(A) No Delamination	
Weathering	5894		Allowed	
Resistance			(B) Rust – Max creep 4mm,	
			Avg. creep 2mm @5040	
			Hrs.	
			(C) Blister – Conversion #9	
			@ 4032 Hrs.	
Adhesion	ASTM D	IOZ Alone	2.4 MPa (350 psi)	
Pull-Off Strongth	4541			
Suengui			2.4 MPa (350 psi)	
		T/T (IOZ)		
Freeze-Thaw	ASIMD	P/T (IOZ)	2.4 MPa (350 psi)	
	4541		4.1 MBa (600 pai)	
Strength			4.1 MFa (000 psi)	
Ouengui			2.4 MPa (350 psi)	
			4.1 MPa (600 psi)	
Field History	NA	P/T (IOZ)	Five (5) Bridges with	
			Minimum two (2) year	
			successful field history	

Table 545.2.1:1 Acceptable Product Requirements

P = Primer; T = Topcoat, IOZ = Inorganic Zinc Rich Primer

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Primer information for the use of organic zinc for touch-up and repair is included in Section 546, "Recoating Structures."

545.2.2 Coating System No. 2: Field Applied 2 Coat with Epoxy Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 546.2.2:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer (used to prime exposed bare steel areas only, spot prime) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight.

Epoxy Top Coat over existing finishes (applied over zinc primer and other sound existing coatings deemed suitable for over coating by the coating manufacturer's representative) shall be a two (2)-component, surface tolerant epoxy coating with minimum solids by volume of 65%.

TEST	REF. NO.	PRODUCT(S)		ACCEPTANCE CRITERIA	COMMENTS		
Salt Fog Resistance	ASTM B 117	P/T (OZ)		 (A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5000 Hrs. (C) Blister – Conversion #7 @ 4000 Hrs. 			
Cyclic Weathering Resistance	ASTM D 5894	P/T (OZ)		 (A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5040 Hrs. (C) Blister – Conversion #8 @ 4032 Hrs. 			
Adhesion Pull-Off Strength	ASTM D 4541	OZ Alone P/T (OZ)		4.1 MPa (600 psi) 4.1 MPa (600 psi)			
Freeze-Thaw Stability Pull-Off Strength	ASTM D 4541	P/T (OZ)		2.4 MPa (350 psi) 4.1 MPa (600 psi)	Requires same average as adhesion pull-off strength results, with no tests		

Table 545.2.2:1
Acceptable Product Requirements

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Acceptable Product Requirements						
TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS		
			2.4 MPa (350 psi)	measuring less than 60% of those results		
			4.1 MPa (600 psi)			
Field History	NA	P/T (OZ)	Five (5) Bridges with Minimum two (2) year successful field history			

Table 545.2.2:1 Acceptable Product Requiremen

P = Primer; T = Topcoat, OZ = Epoxy Organic Zinc Rich Primer

545.2.3 Coating System No. 3: Shop or Field Applied 2 - Coat with Acrylic Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 545.2.1:1, "Acceptable Product Requirements" above for Inorganic Zinc Rich Primer or Table 545.2.2:1, "Acceptable Product Requirements" for Organic Zinc Rich Primer and 545.2.3:1, "Acceptable Product Requirements" for Acrylic Top Coat below as applicable. It is Acceptable to use either inorganic or organic zinc rich primer for 545.2.3 Coating System 3. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer (used to prime exposed bare steel areas) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight (Table 545.2.2:1, "Acceptable Product Requirements"), or;

Inorganic Zinc-Rich Primer (used to prime exposed bare steel areas) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight (Table 545.2.1:1, "Acceptable Product Requirements"), and;

Acrylic Topcoat (applied as overcoat over sound existing coatings deemed suitable for over coating by the coating manufacturer's representative or for repair to the finish of certain items per Section 545, "Protective Coating of Miscellaneous Structural Steel;" miscellaneous steel shall be a high performance DTM acrylic coating with minimum solids by volume of 38%. Suitable for application over zinc rich primers (Table 545.2.1:1, "Acceptable Product Requirements").

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Adhesion Pull-Off Strength	ASTM D 4541	HPA	> 500 lbs.	One (1) coat applied over blasted steel
Flexibility	ASTM D 522	HPA	Pass: No cracking / flaking	1/8 " conical mandrel One coat applied over blasted steel

Table 545.2.3:1 Acceptable Product Requirements

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Table 545.2.3:1
Acceptable Product Requirements

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Hardness (Pencil)	ASTM D 3363	HPA	Final Cure: "F"	One (1) coat applied over blasted steel
Impact	ASTM D 2794	HPA	> 140 in. lbs.	One coat applied over blasted steel

HPA = High Performance Acrylic

545.2.4 Coating System No. 4 – Powder Coating

The Contractor shall obtain primer and topcoat from one (1) manufacturer. The Contractor shall select a coating system that meets the requirements of AAMA 2604.

545.2.5 Galvanizing or Zinc Coating

Reference Section 541.2.5.1, "Galvanizing or Zinc Coating."

545.2.6 Submittals

When the Contract requires painting more than 1,500 square feet of steel surface, the Contractor shall submit a coating Plan 30 Days prior to start of coating operations. The Project Manager shall have the option to waive the coating Plan requirement.

In addition to the submittals require per Section 106, "Control of Materials," the Contractor shall provide the following submittals to the Project Manager at least 30 Days before coating operations:

- 1. Product data and SDS for each product in the system;
- 2. Surface preparation requirements;
- 3. Application instructions:
 - a. Mixing and thinning directions;
 - b. Recommended spray nozzles and pressures;
 - c. Minimum / maximum drying times, including re-coat times for shop or field coatings;
 - d. Temperature requirements;
- Letter from the manufacturer detailing the coating system components and the compatibility of those components to adjacent Materials including but not limited to:
 - a. Every product in the system (primer, intermediate, topcoat, etc.);
 - b. Any pre-applied or preexisting products (such as existing coatings);
 - c. Any post applied products (such as anti-graffiti coating);
 - d. Any modifications to the surface preparation or application instructions related to the total system performance;
- 5. If the color varies from the specified color, the Contractor shall submit color samples on boards at least eight (8) inches by ten (10) inches for review and approval; and
- 6. Documentation related to Contractor Qualifications per Section 546.2.7, "Contractor

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Qualifications."

545.2.6.1 Certification

Prior to coating application, the Contractor shall submit:

- 1. Notarized manufacturer's Certificates of Compliance stating that the Materials are the same as those described in the manufacturer's product data sheets; and
- Certified test reports from an independent Laboratory performed in accordance with AASHTO R-31, showing Acceptable performance results as listed on the chart in Section 545, "Protective Coating of Miscellaneous Structural Steel."

545.2.6.2 Product Data Sheets

The Contractor shall provide manufacturer's product data sheets with each Submittal that shows the following:

- 1. Mixing and thinning directions;
- 2. Recommended spray nozzles and pressures;
- 3. Minimum/maximum drying time, including re-coat times, for shop or field applied coats; and
- 4. Manufacturer recommended application procedures, including surface preparation and temperature requirements.

545.2.7 Contractor Qualifications

When the Contract requires painting more than 1,500 sq ft of steel surface, the Contractor shall demonstrate qualification by one of the following two (2) methods:

Method 1

The Contractor shall obtain SSPC QP 1 certification for field painting or either SSPC-QP 3 certification or the AISC Sophisticated Paint Endorsement (SPE) for shop painting. The Contractor shall perform and document QA/QC inspections daily. QA/QC inspection documents shall be electronically submitted to the Project Manager on a weekly basis.

Method 2

The Contractor shall provide a coating Plan and provide for NACE certified inspection (Level 2 minimum). The inspection services shall include but not be limited to:

- 1. Surface preparation and cleanliness inspection verifying profile and appropriate surface preparation.
- 2. Confirm products match approved submittals and certification letters. Document the batch numbers of all coatings.
- 3. Inspection of primer coat to include dry film thickness readings. Review Contractor's QA/QC reports for environmental conditions and document.
- Observe application of stripe coat on the intermediate coat and document environmental readings during the start up of application. Review Contractor's QA/QC reports.
- 5. Inspect intermediate coat to include dry film thickness readings. Review Contractor's QA/QC reports.
- 6. Observe start up of finish coat application and document environmental conditions.
- 7. Final inspection to include visual inspection for runs, sags, and foreign Material in

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coating. Also perform final dry film thickness inspection.

- 8. Inspect members after transportation, prior to subsequent coating and / or Final Acceptance.
- 9. Electronically submit interim reports after each inspection to the Project Manager within three (3) Working Days.
- Electronically submit comprehensive final report including photos to the Project Manager within 14 Days of completion of inspection. Final report shall include QA/QC daily inspections performed by the Contractor.

Any deficiencies shall be corrected and reinspected by the NACE inspector prior to proceeding.

Samples of a coating Plan and QA/QC inspection documents are available on the NMDOT website.

Provisions for demonstration of qualifications are Incidental to the performance of the coating, no additional payment shall be made. NMDOT shall be granted open access to the coating operation to perform inspections and to review documentation of Contractor inspections.

The Project Manager shall have the option to waive the Contractor Qualification requirement for Miscellaneous Structural Steel scope.

545.3 CONSTRUCTION REQUIREMENTS

545.3.1 Liquid Coating Systems No. 1, No. 2, and No. 3

The Contractor shall apply coatings in conformance with SSPC – PA 1 "Shop, Field and Maintenance Painting of Steel" and with SSPC – PA Guide 13 "Guide Specification for Application of Coating Systems with Zinc-Rich Primers to Steel Bridges" (aka AASHTO/NSBA Steel Bridge Collaboration S 8.1) and the manufacturer's application instructions.

545.3.1.1 Surface Preparation

The Contractor shall remove contaminants in accordance with SSPC-SP I, or other methods approved by the Project Manager.

Surface preparation for all steel elements include in Section 545, "Protective Coating of Miscellaneous Structural Steel" shall be in accordance with SSPC-SP10 / NACE 2 Near White Blast Cleaning: When viewed without magnification shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 95% of each unit area. Staining shall be limited to no more than five percent (5%) of each unit area, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings. Unit area shall be approximately three (3) inch x three (3) inch (nine (9) sq. in.).

Prepared surfaces shall be evaluated using the SSPC-VIS 3 Guide and Reference Photographs. The Contractor shall provide a current copy of the SSPC-VIS 3 Guide and Standard to the Project Manager. It shall become the property of the Department.

The Contractor shall maintain the steel dust free and prime within eight (8) hours after

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blast cleaning. The Contractor shall re-clean rusted or contaminated surfaces at no additional cost to the Department. The Contractor shall mask areas that require field welding before coating.

The Contractor shall clean again before applying each subsequent coat.

545.3.1.2 Coating

545.3.1.2.1 Mixing the Coating

The Contractor shall mix the coating with a power mixer to a smooth and lump-free consistency, in accordance with the coating manufacturer's Specifications.

The Contractor shall mix the coating as much as possible in the original containers and continue mixing until the metallic powder or pigment is in suspension. The Contractor shall keep mixed primers continuously agitated before and during application.

545.3.1.2.2 Thinning the Coating

The Contractor shall not thin the coatings without the approval of the Project Manager. If it is necessary to thin the coatings, the Contractor shall thin the Material in accordance with the manufacturer's recommendations.

545.3.1.2.3 Temperature and Weather Limitations

The Contractor shall only apply the coatings when the ambient air temperature and surface temperature of the steel are both above 50 $^{\circ}$ F and at least five (5) $^{\circ}$ F above the dew point.

The Contractor shall not apply the coatings when there is condensation or frost on the metal surfaces.

The Contractor shall not apply the coatings when the relative humidity is higher than 85 percent.

545.3.1.2.4 Coating Applications

The Contractor shall not apply coating until the Department approves the surface preparation. The Department may waive this inspection.

A stripe coat of primer and intermediate Material shall be applied to all edges, corners, seams, crevices, interior angles, junctions of joining members, rivets, bolt heads, nuts and threads, welds and similar irregularities. The stripe coats shall be of sufficient thickness to completely hide the surface being covered and shall be followed, as soon as practicable, by a full application of the appropriate coating to its specified thickness.

The Contractor shall repair coated areas where the primer or topcoat runs, sags or cracks.

The Contractor shall not apply any coating until the previous coat has fully cured or per the manufacturer's application requirements.

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The Contractor shall allow the manufacturer's minimum recommended cure time to lapse between coats. If more than 30 Days elapse between the primer application and the topcoat application, the Contractor shall contact the coating system manufacturer for surface preparation recommendations before applying subsequent coats.

The Department may Accept minor cosmetic defects in ground level miscellaneous Structural Steel components not in public view, if the defects will not affect durability.

545.3.1.2.5 Required Coating of Components

The Contractor shall apply the primer and topcoat to steel surfaces, except those that will contact elastomeric bearing pads or are subject to sliding and rotational movements.

The Contractor shall coat new steel piling from the bottoms of the pier caps to two (2) ft below the finished grade or streambed elevations.

545.3.1.2.6 Coating of Sole Plates for Concrete Bridges

The Contractor shall deliver sole plates to the Project with one (1) coat of primer applied to all surfaces except masked-off strips, where the sole plates will be welded to the shoe plates, and surfaces that will contact elastomeric bearing pads.

Before installation, the Contractor shall clean surfaces that will contact pads in accordance with SSPC-SP 6. The Contractor shall clean off all rust on sole plates prior to installing and welding.

After installing the pads and welding the sole plates to the shoe plates, the Contractor shall touch up the primer and apply topcoat to exposed surfaces.

545.3.1.2.7 Spray Equipment

The Contractor shall apply the coatings with spray nozzles at the manufacturer recommended pressures.

545.3.1.2.8 Film Thickness Requirements

The Contractor shall apply coatings in accordance with Table 545.3.1.2.8:1, "Required Film Thicknesses."

545.3.1.2.8:1

Required Film Thicknesses				
Coating Dry film thickness range (mils)				
Primer (IOZ)	2 – 4			
or				
Primer (OZ)	3 – 5			
Topcoat (epoxy) or	4 – 6			
Topcoat (acrylic)	2 - 4			

545.3.1.2.9 Field Repair of Liquid Coatings

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Field repair of liquid coatings shall be performed in accordance with Section 546, "Recoating Structures" and the manufacturer's recommendations. Field repair shall be accomplished with the same coating system used for the original application with the exception that organic zinc rich primer may always be used.

The Contractor shall field repair coated areas that are rusted or damaged. The Contractor shall prepare the surface in accordance with Section 546.3.1, "Surface Preparation of Existing Bridges and Structures" or with methods approved by the Project Manager.

The Contractor shall prime large areas using spray Equipment, brush, or roller. The Contractor shall prime small areas with a brush. The Contractor shall spray or brush the topcoat. Two (2) or more coats may be necessary to build up the required film thickness. The Contractor shall apply topcoat only to areas where the topcoat is damaged. Requirements of Section 546.3, "Construction Requirements" apply to field repairs.

545.3.2 Powder Coating System No. 3

545.3.2.1 Surface Preparation

The Contractor shall remove contaminants in accordance with SSPC-SP 1, or other methods approved by the Project Manager. The Contractor shall blast clean in accordance with SSPC-SP10 Near-White Metal Blast Cleaning. Additionally, for powder-coated surfaces, an iron or zinc phosphate wash shall be included to provide long-term corrosion protection.

545.3.2.2 Primer Application

The Contractor shall use a primer that is a zinc rich epoxy powder coating designed for use over ferrous metal substrates. The Contractor shall apply the zinc rich epoxy powder coat primer to a minimum of two (2) mils dry film thickness, above the peaks of any blast profile.

545.3.2.3 Topcoat Application

The Contractor shall use a topcoat that is a super durable polyester powder coating designed to provide for maximum UV exposure protection. The Contractor shall apply the polyester topcoat to a minimum of three (3) mils dry film thickness before the primer has cured or as recommended by the manufacturer.

Table 545.3.2.3:1 Required Film Thicknesses

Coating	Dry film thickness range (mils)
Zinc-rich epoxy primer	Min. 2 mils
Polyester topcoat	Min. 3 mils

The Contractor shall use a magnetic film thickness gage or an electronic film thickness detector to determine dry film thickness per SSPC – PA 2, "Procedure for Determining Conformance to Dry Coating Thickness Requirements."

545.3.2.4 Fixturing

The Contractor shall suspend the components by suitable metal hooks or fixtures to provide a sufficient electrical grounding path. The Contractor shall affix the components with a

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minimum of direct contact area with the fixture device.

545.3.2.5 Curing

The Contractor shall place the powder-coated components in a suitable oven and cure per the manufacturer's recommended cure cycle. The Contractor shall remove the components from the oven and allow cooling. The Contractor shall visually inspect the components to ensure a smooth continuous uniform finish, free from runs, sags, pinholes or other defects.

545.3.2.6 Touch-up Painting / Field Repair of Powder Coatings

Field repair of powder coatings shall be performed in accordance with Section 546, "Recoating Structures" and the manufacturer's recommendations. The Contractor shall use Coating System No. 2 from Section 546.2, using the inorganic zinc-rich primer only where bare metal is exposed.

Surface preparation shall be done in accordance with the manufacturer's recommendations. In the absence of manufacturer recommendations, the surface shall be prepared in accordance with SSPC-3 on the minimum surface area possible to accomplish the repair.

The Contractor shall field repair coated areas that are rusted or damaged.

545.3.3 Handling Steel

The Contractor shall handle or load newly coated Structural Steel only when the coating has fully cured.

The Contractor shall store coated components on pallets or in other approved ways so that the steel does not rest on soil.

The Contractor shall protect steel coatings from binding chains with approved softeners. The Contractor shall hoist with padded hooks and slings. The Contractor shall space parts during shipment to ensure that no rubbing occurs.

545.3.4 Provisions for Inspection

The Contractor will be responsible for performing and documenting Quality Control (QC) inspections of all shop / field surface preparation and coating activities. When the Contract requires painting more than 1,500 sq. ft. of steel surface, the Contractor shall reference Section 544.2.7, "Contractor Qualifications." When the Contract required painting less than 1,500 sq. ft. of steel surface, the Contractor shall document all QC inspection activities, measurements and observations on the Daily Inspection report. These reports shall be submitted to the Project Manager at a minimum on a weekly basis and shall account for all Work performed.

After completing erection, the Project Manager will inspect the surfaces to be embedded in concrete. The Contractor shall repair damaged or rusted surfaces before placing decks. After placing the deck and at an agreed upon time, the Project Manager will inspect the entire steel Structure for coating system damage. The Project Manager will mark damaged areas for repair and will re-inspect after repairs are complete.

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545.3.5 Protection of the Work and Public

During the coating operations, the Contractor shall protect the work and the public from blast cleaning operations, paint splatter, splashes and smirches with protective covering or other methods approved by the Project Manager.

When the protective devices or procedures are ineffective, the Project Manager may suspend the Work until corrections take place.

545.4 METHOD OF MEASUREMENT—Reserved

545.5 BASIS OF PAYMENT

The Department will pay for the coating system(s) as Incidental to the new Steel.

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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 602.2.2.2.9, "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.

Riprap Classifications and Gabion Requirements				
		Stone vol	Minimum	
Class	Description	Minimum	Maximum	dimension (in)ª
Α	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°

Table	602.2.1:1	
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Section 602: Slope and Erosion Protection Structures

Table 602.2.1:1				
Riprap Classifications and Gabion Requireme	nts			

	Stone vol	Minimum	
Description	Minimum	Maximum	dimension (in)ª
Wrapped rockfacing	_	—	1
Gabions			4–8°
-	Description Wrapped rockfacing Gabions	Description Minimum Wrapped rockfacing — Gabions —	Stone volume (ft*) Description Minimum Maximum Wrapped rockfacing — — Gabions — —

^aMinimum size in the least dimension.

^bClass B and C stone — at least two (2) Fractured Faces.

°70% 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

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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.

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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;
- Brittleness temperature no higher than 15° F, if tested in accordance with ASTM D 746;
- 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;
- 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

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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

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The Contractor shall use permeable, biodegradable sacks made of jute, cotton, or scrimreinforced 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-fiberscrim-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.

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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 \pm 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.

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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 selvedges or bind perimeter edges so the joints are as strong as the gabion body. 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.

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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 \pm 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

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Riprap Class	Cubic Yard
Riprap Class G	Square Yard
Sacked Concrete Revetment	Cubic Yard
Concrete Block Revetment	Square Yard
Gabions	Cubic Yard
Revetment Mattresses	Cubic Yard
Wrapped Rockfacing	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).

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632.1 DESCRIPTION

This revegetation Work consists of preparing the soil, seeding, mulching, crimping, and the application of tackifier to areas stripped of vegetation during construction operations and are required to be revegetated. For additional information refer to the US Clean Water Act as outlined in the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP). Construction staking and digital submittals are included in the scope of the revegetation Work. The Department and Subcontractor shall each have at least one (1) Section 632, "REVEGETATION" TTCP-certified person on the Project at all times.

632.2 MATERIALS

The Contractor shall provide submittals as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding," for all Materials to the Project Manager at a minimum of ten (10) working Days before revegetation Work commences. Submittals shall conform to the Specifications and the revegetation Plan, and shall be on the Approved Products List. After submittals have been approved as per procedures identified in Section 632.3.3, "Pre-Seeding Conference;" the Contractor may substitute products on the Approved Products List with prior approval as per the same process. Rock Mulch Material submittal shall be required and meet the Specification but does not need to be on the Approved Product List. Submittal shall be a full five (5) gallon bucket sample provided to the Project Manager for sieve analysis.

All bulk Materials delivered to the Project shall be accompanied by a certified weigh master ticket for Materials utilized per Project as per Section 109.1, "Measurement of Quantity." Split loads of fertilizer, seed, straw, tackifier, and bonded fiber matrix may be allowed with proper weigh master ticket and Contractor affidavit. Split loads shall not be allowed for compost mulch and rock mulch.

All packaged Materials delivered to the Project shall be wrapped or otherwise securely protected from weather which might affect their integrity. Materials in weather-damaged packaging shall be rejected for use on the Project.

Certification for bulk Materials shall comply with Section 106.4, "Certificates of Compliance." Notify Project Inspectors when bulk Materials are delivered so loads may be inspected and verified.

The Contractor shall ensure that straw bales stored on the Project shall not exceed 20% moisture content.

632.2.1 Temporary Soil Stabilant/Tackifiers for Class A Seeding

Temporary soil stabilant and tackifier shall be considered the same and the terms used interchangeably. Tackifiers shall have a blue or green dye lasting a minimum of 36 hours to aid in application and inspection, and be bio-degradable. When used as part of seeding operations it shall be applied at a rate of 200 pounds per acre.

Tackifiers shall be plant-derived and bio-degradable and be composed of either guar, psyllium (Plantago ovata), or starch.

Guar. Guar is a plant based product derived from the ground endosperm of the guar plant, treated with dispersant agents for easy mixing.

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Psyllium. Psyllium is composed of the finely ground muciloid coating of Plantago ovata seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but re-wettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires twelve (12) to eighteen (18) hours drying time.

Starch. Starch is non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. The Material is mixed with water. Approximate drying time is nine (9) to twelve (12) hours.

632.2.2 Seed for Class A and C Seeding

The Project seed list shall conform to the NMDOT Revegetation Zone and Seed List Maps at the NMDOT website or at the following link: <u>https://arcg.is/2peB6Cc</u>.

The list used shall be the year the Project was let. The Contract shall specify varieties of noxious weed-free seed in accordance with New Mexico Seed Law (NMSA 1978, § 76-10-11 et seq.).

Seed submittal shall be a list from a seed producer showing the common name, botanical name, pure live seed, total poundage, source locality (county and state), and NMDOT Project control number as per the revegetation/erosion control Plan.

All seed suppliers must be on the current Approved Products List and provide documentation that their regulating state agency belongs to the Association of Official Seed Certifying Agencies (AOSCA).

Seed mixtures shall be pre-mixed and bagged certifying the mixture quantity and percentage as noted in the Contract.

Substitutions for unavailable seeds shall be performed by adding the quantity of the unavailable seed to the quantity of the next seed species listed within that subcategory of the seed list. Before substitutions can be made the Contractor must provide proof of unavailability in letter form from three (3) seed suppliers listed on the NMDOT Approved Products List that the seed is not available.

All seed delivered to the Project shall be stored in a container protected from rodents and moisture and not subject to temperatures higher than 90°F.

632.2.2.1 Seed Labeling

The Contractor shall seal and label each bag in accordance with the Federal Seed Act (7 U.S.C. § 1551 et seq.) and NMDA seed labeling requirements (NMSA 1978, § 76-10-13). The Contractor shall provide the following information on each bag tag for each species:

- 1. Variety (specify if certified);
- 2. Kind of seed;
- 3. Lot number;
- 4. Purity;
- 5. Germination;
- Percentage crop seed, percentage inert, percentage noxious weeds, in accordance with New Mexico Seed Law (NMSA 1978, § 76-10-11. et seq);
- 7. Origin;
- 8. Test date; and
- 9. Weight (in pounds) of this species or percentage of total lot.

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The Contractor shall provide seed analysis results that are not older than twelve (12) months prior to use.

Seed suppliers shall provide one (1)-acre seed bags.

The Contractor shall provide to the Project Manager documentation of seed origin and pure live seed content from a certified testing Laboratory. Seed must arrive in the original sealed containers from the Supplier and the Revegetation Contractor must provide all tags and certifications to the Project Manager. Certification must be provided that the seed has been stored in appropriate conditions in the twelve (12) months before arriving at the Project. Each seed tag shall be affixed to the bag and have the project control number clearly identified. The certified seed Supplier shall maintain records of seed tag control numbers for a period of three (3) years.

632.2.3 Fertilizer for Class A and C Seeding

Fertilizer shall be organic, slow release with an N-P-K (nitrogen, phosphorous, potassium) analysis of either 3-6-3 or 3-7-2 and blended with endo-mycorhizza and humates. Application rate shall be 1,000 lbs. per acre. Humates must comprise a minimum of 15% by weight. Endo-mycorrhiza must be arbuscular with a minimum propagule of 1.33 propagules per gram. The Contractor shall provide fertilizer (specified type and formulation) and supplier's certification in accordance with the Contract. Each bag or tote of fertilizer shall have a visible, sealed, and un-altered analysis tag from the manufacturer that must be approved by an authorized Section 632, "Revegetation" certified Inspector prior to application of the Material. The tag must include the manufacturer's information, the N-P-K analysis of the product, and the weight of the bag or tote. NMDOT reserves the right to inspect any bill of ladings or packing slips from the supplier to verify quantity of Material on site.

632.2.4 Hydro-Mulch - Bonded Fiber Matrix (BFM) for Class C Seeding

Hydro-mulch shall be Bonded Fiber Matrix (BFM). BFM is a hydraulically-applied blanket that controls soil erosion and accelerates seed germination. BFM is a three (3)-dimensional composite of wood or paper fibers bonded by polymer tackifier that provides high performance erosion prevention on slopes. Dye and tackifier shall be included in the BFM formulation. BFM shall be applied at a rate of 2,000 lbs per acre. As a hydraulic erosion control product (HECP) as defined by the Erosion Control Technology Council, the BFM or its equivalent shall be Type 3 or higher in functional longevity as defined in Table 1 of the 2014 Standard Specifications for Hydraulic Erosion Control Products (HECPs) Part 2.01.

632.2.5 Rock Mulch for Class C Seeding

Rock Mulch shall be between one (1) inch and no greater than 1 $\frac{1}{2}$ inches in size. Rock shall have a minimum of two (2) Fractured Faces. Rock which is black in color will not be Acceptable. Pumice rock is not Acceptable.

632.2.6 Composted Mulch for Class A Seeding

The Contractor shall furnish and place composted mulch as shown on the revegetation Plan and in accordance with the criteria as described below. Composted mulch provider must be registered with or permitted by the New Mexico Environment Department Solid Waste Bureau and must be in compliance with 20 NMAC 9.1.

Composted mulch is defined as the product of a controlled aerobic thermophilic biological decomposition process that meets the quality requirements in Table 632.2.6:1, "Requirements

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of Compost Mulch." Raw Materials used in producing composted mulch may include green waste, animal manure, animal bedding, paper waste, food waste, biosolids or other non-toxic organic matter, but shall not include animal mortalities.

Material	Measure	Method	Criterion
	Moisture Content*	Evaporative loss at 105°C	Between 35 % and 60%
	Carbon/Nitrogen Ratio*	Nitrogen by AOAC 993.13, Carbon by ASTM D5373	Between 15:1 and 20:1
	Particle Size	Sieve	40% minimum to 100% maximum of Material may pass ¾ inch screen; 100% of pieces smaller than 4 inches in length and 2 inches in diameter
All Composted	Electrical Conductivity*	1:5 slurry (mass basis)	<10 mmho/cm
Mulches	pH*	1:5 slurry (mass basis)	рН 5.0 – рН 8.0
	Organic Matter*	Loss on ignition at 550°C	25% - 100% of dry weight
	Maturity	Germination test in 50:50 (volume basis) mixture of ¾ inch screened composted mulch and twice- rinsed nursery sand.	Minimum 50% germination to second set of leaves for marigold seeds
	Stability	By temperature and moisture content	Maximum core temperature of 110°F after 48 hours in 5 foot tall conical pile, with moisture adjusted to between 40% and 60%.
	Debris	By volume	Less than one percent (1%) inorganic debris, including but not limited to, glass, plastic, stones and metal.
Composted Mulches with	Trace Metals*	HNO₃ digestion	Complies with Table 3 of 40CFR503.13
Wastewater Biosolids	Fecal Coliforms*	MPN with A-1 broth	<1000 MPN/dry gram
*Tests marked with a tests may be perforn	asterisks must be perfo ned by the composted	ormed by a suitable analy mulch producer.	tical Laboratory; other

Table 632.2.6:1 Requirements of Compost Mulch

632.2.6.1 Acceptance

Compost mulch suppliers on the Approved Products List are approved for Project use.

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The NMDOT Landscape Architect shall review lab analysis and submittals from the compost producers every 180 Days and confirm their listing on the Approved Products List.

Before delivering composted mulch, provider shall furnish documentation that includes the following:

- 1. The raw Materials, by percentage of volume, used in the production of the delivered composted mulch;
- Daily temperature records for at least 20% of the piles or batches used to produce the delivered composted mulch, illustrating attainment of at least 130°F for at least seven (7) consecutive Days;
- A Laboratory analysis for criteria shown in Table 632.2.6:1, "Requirements of Compost Mulch" performed on composted mulch no more than 180 Days prior to delivery; and
- 4. An affidavit, signed by a corporate officer, confirming that the composted mulch meets each requirement shown in Table 632.2.6:1, "Requirements of Compost Mulch."

632.2.6.2 Straw Mulch for Class A Seeding

The Contractor shall not use rotten or moldy straw. All straw mulch must be barley straw and is to be free of noxious weeds as certified by an industry-recognized forage certification authority. Certification twine must appear on all certified straw bales. The color of the certified twine for straw bales shall be listed on the certification submittal for identification purposes. The date on the straw certification provided to NMDOT may not be older than one (1) year from the date of purchase. Before Acceptance the Contractor shall provide to the Project Manager weigh tickets signed by a certified weighmaster as per Section 109.1, "Measurement of Quantity," which confirms that the amount of bulk Materials delivered to the Project equals tonnage required for the Project per the determined acreage.

632.3 CONSTRUCTION REQUIREMENTS

632.3.1 Equipment

All Equipment shall be inspected by the Contractor to confirm Equipment is in good working order prior to commencing Work. An Inspector shall witness the inspection and calibration.

To avoid the spread of noxious weeds, all revegetation Equipment (including but not limited to trucks, trailers, tractors, hydro-seeders, drill seeders, straw blasters, and disks) shall be pressure-washed to remove all visible mud, soil, and debris prior to entering the Project limits within the state right of way. If Equipment leaves the Project for any reason it shall be re-inspected when returned to the job site.

Disking attachments shall have a minimum six (6) foot carriage with front and rear discs.

Crimping Equipment shall have a minimum eight (8) foot wide carriage.

Skid steer attachments may only be used on confined areas for seeding operations.

Skid steers shall not be used for spreading compost unless in a confined area.

632.3.1.1 Drill Seeder

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Drill seeding Equipment shall be inspected so that drill seed drop tubes are not torn or clogged. All seed loaded into Equipment shall be verified by an Inspector to confirm correct application rates. An Inspector must verify that the auger in the seed bin is rotating and that seed is dropping through drop tubes.

The drill seeder must be inspected daily to prevent loss of seed or to prevent overseeding. Calibration is necessary to control rate and depth of seed distribution. Calibration procedure and demonstration shall be as per manufacturer's Specifications. The drill seeder shall be calibrated once per Project unless it is replaced on the Project. Drill seeders shall only be modified by manufacturer recommendation and documentation of the modification must be available.

The inspection shall ensure that the Equipment has the following:

- 1. Double disc openers with 'A' frames;
- 2. Depth bands;
- 3. Drop tubes;
- 4. Packer wheels or drag chains;
- 5. Rate control attachments;
- 6. Seed boxers with covers and agitators for trashy seed; and
- 7. Keyway holding auger to shaft.

632.3.1.2 Hydro-Seeder

The hydro-seeder cannons, hoses and agitators shall be in good working condition. The hydro-seeder shall be capable of applying Materials up to distances of 200 ft.

632.3.2 Materials and Sampling

Inspector must be present when Materials are to be loaded into Equipment or distributed on the areas to be seeded. Contractor shall provide all containers and bags to the Project Inspector for verification.

A one (1) quart sealed zip lock bag of seed Material labeled with the Material identification and the Project control number is to be provided to the NMDOT Landscape Architect for examination and testing. The Department may reject Materials not in accordance with the Contract.

632.3.3 Pre-Seeding Conference

A mandatory pre-seeding conference called by the Project Manager shall be held on the Project before revegetation Work begins. Attending will be the NMDOT Project Manager or representative, the NMDOT Landscape Architect or certified seeding Inspector, the General Contractor, and the Revegetation Contractor.

The purpose of the meeting is to inspect the Project, and off-site yards, pits, and borrow roads for confirmation of their revegetation requirements. The Project Manager shall have at the pre-seeding meeting documentation of all pits, Contractor yards, etc. approved for use on the Project. Per Section 632.3.12, "Seeding Operations for Class A and Class C Seeding," test strip location shall be verified following the Pre-seeding Conference. Construction staking must be completed and quantities must be verified by the Project Manager before test strip commences.

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Submittals must be provided to the Project Manager and Landscape Architect ten (10) Days prior to the proposed start of revegetation Work. Any revegetation Work done prior to this inspection shall be rejected.

All areas to be revegetated shall be measured and confirmed for each class of seeding in accordance with Section 801, "Construction Staking by the Contractor." The Project Manager and the Contractor shall field verify and agree on the acreage for each Class of seeding, including Modified Class A, before any Materials are ordered or delivered to the Project.

Construction staking shall also identify all areas which have less than four (4) inches of soil cover and qualify for Modified Class A seeding.

The Prime Contractor shall provide minutes of this meeting for review and approval by the Project Manager and Landscape Architect or representative.

There will be no change in Materials or the scope of revegetation Work after the Contractor begins seeding operations.

For revegetation Work areas to be considered ready for revegetation they shall be accessible, free of Equipment, and no further construction processes occurring which would interfere with seeding operations. No further revegetation Work or Equipment access shall occur on areas which have been revegetated.

The Prime Contractor shall maintain a minimum twelve (12) foot wide Equipment access to all revegetated areas for use by revegetation Subcontractor until revegetation Work is complete.

632.3.3.1 Weather Limitations

Revegetation Work shall not be performed when the ground is frozen or when temperatures are below 32°F. No revegetation Work shall be performed when wind speed exceeds fifteen (15) miles per hour as measured with a wind meter by the Inspector.

632.3.4 Seeding Classes

The Contractor shall provide the various classes and the Material and operations for each class in accordance with Table 632.3.4:1, "Operations Sequence for Classes of Seeding."

		Class	
Operation	Α	Mod A	С
Disk seed bed to four (4)"	х	Х	
Apply fertilizer by broadcast, then disk to four (4)"	Х	Х	
Apply one (1) inch compost mulch, disk to four (4)"	Х	Х	
Drill seed	Х	Х	
Straw crimp; apply tackifier, dye	х		
Track slopes with ridges horizontal and parallel to bottom of slope	х		Х
Hand rake or chain harrow surface horizontally			Х
Hydro apply seed, fertilizer, dye, tackifier		Х	Х

Table 632.3.4:1 Operations Sequence for Classes of Seeding

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Table 632.3.4:1 Operations Sequence for Classes of Seeding

	Class			
Operation	Α	Mod A	С	
Scarify seeded areas horizontally to slope		Х	х	
Hydro mulch; apply tackifier, dye			х	
Rock Mulch		Х	х	
Note: No seeding shall be applied on frozen ground				
Key: X = required; = not required				

632.3.5 Modified Class A Seeding for Narrow Areas or Areas Inaccessible to Drill Seeding Equipment

Any Project areas with slopes less than 3:1 requiring revegetation which are less than eight (8) ft wide, or are inaccessible to drill seeding Equipment, or are too rocky to disk to a four (4) inch depth, shall use the following procedure and payment is to be made at the Class A rate.

The Contractor shall disk soil to a four (4) inch depth with one (1) inch of incorporated compost mulch and fertilize as per Class A treatment. A skid steer with attachments may be used. If the seed bed is too rocky to disk to four (4) inches, the Contractor shall omit compost mulch and chain harrow or hand rake the entire area and proceed with Steps 1 and 2 below.

A hydro-seeder shall then be used to apply the seed, dye, tackifier, and hydro mulch in two (2) steps as described below.

Step 1. The Contractor shall apply seed and dye to the newly disked soil, rake or chain harrow so seed is covered with soil.

Step 2. The Contractor shall apply an approved bonded fiber mulch with tackifier applied in two (2) coats from opposing directions at rate of 2,000 lbs. per acre.

Seed in these areas shall be applied at twice the specified rates and no extra payment shall be made therefore.

632.3.6 Revegetation of Areas Outside the Project Limits

Revegetation of all disturbed off-site locations will be in accordance with Section 104.7, "Final Cleanup," and the appropriate class of seeding will be used for the terrain. Section 632, "Revegetation," procedures will be followed for all public lands and private lands that are required to be revegetated unless other seed lists and procedures are required in a resource agency permit. All revegetation Work done for permitted Contractor located activities shall be done at the Contractor's expense.

The Contractor must provide as part of submittals a letter of intent from landowners for off-site locations to be used as per Section 104.7, "Final Cleanup." The letter of intent must acknowledge the landowner's right to have revegetation performed as per our Specifications and if that revegetation right is waived the owner acknowledges that neither the Contractor nor NMDOT shall be responsible for any claims, including but not limited to fugitive dust, noxious weeds, and siltation of waterways, related to the owner's decision to forgo revegetation. When revegetation Work is being performed on private land, a right of access permit for

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inspection of the revegetation Work for that private land must be provided by the Contractor to Project Management and shall be considered Incidental to the Work.

The Contractor shall provide documentation of the treatment used and notify Project Manager when the revegetation Work is being performed so Inspectors may be present.

Table 632.3.6:1 Schedule of Materials for Class A Seeding							
CLASS A REVEGETATION MATERIALS PER ACRE							
TACKIFIER	COMPOST MULCH	STRAW	FERTILIZER				
200 lbs	134 cubic yards	Per revegetation zone list	2 tons	1000 lbs.			

Table 632.3.6.2 Schedule of Materials for Class A Modified Seeding								
CL	CLASS A MODIFIED REVEGETATION MATERIALS PER ACRE							
COMPOST MULCH	COMPOST SEED HYDRO MULCH WITH MULCH TACKIFIER							
134 cubic yards	Per revegetation zone list X2	2,000 lbs	1000 lbs.					

Table 632.3.6:3 Schedule of Materials for Class C Seeding

CLASS C REVEGETATION MATERIALS PER ACRE								
HYDRO MULCH WITH TACKIFIER	ROCK MULCH	FERTILIZER						
2,000 lbs.	Per revegetation zone list X2	300 tons	1,000 lbs.					

632.3.7 Materials Certifications

The Contractor shall provide all certifications for required Material to the Project Manager before the Project begins.

632.3.8 Seedbed Preparation for Class A Seeding

The Contractor shall till the seedbed with a disk, harrow, or chiseling tools to at least four (4) inches deep. Uproot competitive vegetation during seedbed preparation, and uniformly work the soil to a surface free of clods, large stones, or other Deleterious Material that would interfere with seeding Equipment. The Contractor shall ensure Inspector approves area that was disked before compost is added to the soil.

The Contractor shall add one (1) inch of compost mulch as specified by disc, harrow, or chisel to a depth of four (4) inches.

The same day as and preceding tilling compost mulch into the seedbed water shall be added to the compost mulch at a rate of 2,500 gallons per each 134 cubic yards. This is to aid

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in the incorporation of the mulch into the seedbed. All compost mulch must be incorporated into the seedbed before adding fertilizer and commencing drill seeding. The Contractor shall add fertilizer by broadcast and disc, harrow, or chisel to a depth of four (4) inches.

The Contractor shall till across the slope, along the contour. The Contractor shall not till the seedbed if the moisture content of the soil is outside the limits recommended by the seed Supplier for planting, or the ground is in a non-tillable condition.

The Contractor shall not prepare more seedbed area on which the entire seeding operation can be applied before the surface crusts or loses seed and fertilizer to erosion. If erosion or crusting occurs, perform seedbed preparation again.

After seed bed preparation and before drill seeding commences all rocks larger than four (4) inches in diameter shall be removed from the seed bed and no payment shall be made therefore.

632.3.9 Tracking and Scarification for Class C Seeding

Areas designated as Class C treatment shall be track-walked as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding" with tracks parallel to the toe of slope to compact and score the slopes within seven (7) working Days prior to the commencement of Class C operations.

Slopes which have eroded or otherwise degraded in the seven (7) working Day period before seeding may need to be re-graded before revegetation.

Competitive vegetation shall be uprooted before hydro-seeding so that seed has good adherence to the surface and soil cover and no payment shall be made therefore.

Following tracking slopes shall be scarified by hand raking or chain harrowing horizontally and parallel to the bottom of the slope.

Following tracking of the slopes all rocks larger than four (4) inches in diameter shall be removed from the hydro-seed bed and no payment shall be made therefore.

632.3.10 Fertilizer for Class A and Class C Seeding

Fertilizer bags shall be examined before use to confirm correct analysis and content. Notify Project Inspector when bags are to be loaded into machines and all bags shall be collected and counted confirming correct amounts used.

The Contractor shall apply the fertilizer uniformly to the prepared seedbed. Class A shall be broadcast and Class C shall be hydro-applied. The Contractor shall apply mix fertilizer in the hydro-seeder for a minimum of ten (10) minutes before applying.

632.3.11 Compost Mulch for Class A Seeding

The Contractor shall wet down compost mulch so that wind loss is kept to a minimum. Stockpiles shall be less than six (6) ft tall and oriented perpendicularly to the prevailing winds to prevent wind loss.

The compost mulch moisture content shall be indicated on the delivery ticket at the time of delivery and shall be within the 35-60 % range.

Regardless of the compost mulch moisture content, the Project Manager may require

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further wetting of compost mulch at delivery to prevent loss through wind. No extra payment shall be made therefore.

The certified Inspector shall verify the load is full before unloading to confirm the Material is up to the front of the trailer. Indications of a short load are gaps at the front of the truck, overloading at the back of the truck, and slip staining of the Material from the original loading line.

632.3.12 Seeding Operations for Class A and Class C Seeding

The Contractor shall uniformly apply the seed mix at a rate in accordance with the Contract. The Contractor shall not drive vehicles or other Equipment on seeded areas. The Contractor is responsible for protecting revegetation Work until Acceptance.

A test strip of each class of seeding shall be provided by Contractor before commencing general seeding. Each test strip shall measure no less than one (1) acre in a configuration which works for the Equipment and the site, shall be at a location of the Contractor's choosing within the Project, and shall be done as per Specifications with a certified Inspector and the Landscape Architect or representative present. Equipment calibration and a test strip are not required for Projects less than one (1) acre in size. The test strip is to verify Equipment functionality, proper adjustment, application rate, and the Contractor's ability to perform the Work as per Specification.

Upon Acceptance of the test plot the Contractor may proceed with seeding operations. If the test strip is not Accepted, the Contractor shall establish a new one (1) acre strip location and re-verify. The Contractor shall not proceed to full seeding operation until an Acceptable test strip has been produced. Payment will only be made for Accepted test strips and shall be made under appropriate class of seeding.

The Contractor shall coordinate with the Project Manager prior to starting seeding operations to ensure than an Inspector is present at all times. No revegetation Work shall be performed without the presence of a certified Inspector.

Once seed is installed on a given Project area all operations to complete that class of seeding for that area must be completed the same Day.

If rainfall or some other factor prevents the Contractor from seeding to the specified depth on prepared surfaces, the Contractor shall prepare the seedbed and apply seed again, at no additional cost to the Department.

Class C areas are to be seeded at twice the standard rate and no extra payment is to be made therefore.

The Contractor shall not perform seeding operations when wind velocity exceeds fifteen (15) mph. Disking may still be performed with winds exceeding 15 mph.

632.3.13 Drill Seeding for Class A Seeding

The Contractor shall plant seed 1/2 inch deep unless otherwise specified in the Contract. The Contractor shall ensure that the distance between the drilled furrows is no more than eight (8) inches. If the furrow openers on the drill exceed eight (8) inches, the Contractor shall redrill the area and no extra payment shall be made therefore.

632.3.14 Hydro-Seeding for Class C Seeding

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Seed shall be applied in a slurry with fertilizer and dye. All Materials loaded into Equipment shall be verified by NMDOT Project Inspectors to confirm correct application rates. The Contractor shall mix all Materials for a minimum of ten (10) minutes before application.

632.3.15 Hydro-Mulching for Class C Seeding

Hydro-mulching shall be applied in two (2) sweeps from opposing directions to ensure coverage is complete. The BFM must contain a tackifier when applied. A dye capable of lasting 36 hours shall be included in slurry so that Project Inspectors can confirm coverage. Mulch must be applied the same Day as the seed to protect seed. All Materials loaded into Equipment shall be verified by NMDOT Project Inspectors to confirm correct application rates. The Contractor shall mix all Materials for a minimum of ten (10) minutes before application.

The Contractor shall provide the Project Manager a laminated color reference card from the BFM manufacturer showing a close-up reference photograph of their product installed at the rate of 2,000 lbs. per acre.

632.3.16 Straw Mulching for Class A Seeding

The Contractor shall anchor straw mulch using a crimper with flat serrated discs at least one (1) inch thick with dull edges, spaced no more than nine (9) inches apart. The Contractor shall ensure that the disc diameter is large enough to prevent the frame of the Equipment from dragging in mulch.

The Contractor shall ensure that straw mulch crimping is at least two (2) inches deep and do not cover it with excessive amounts of soil. The Contractor shall perform mulch anchoring across the slope where practical, with no more than two (2) passes of the anchoring Equipment. Straw shall be evenly distributed over entire bedding area with no bare areas showing or areas with straw deeper than four (4) inches in depth before crimping.

The Contractor shall ensure that the rate of application of straw mulch is at least two (2) tons of air-dry straw per acre. The Inspector shall verify the total tons per acre of straw required per acre.

The Contractor shall ensure that straw mulch has at least 50% of fibers exceeding ten (10) inches long on the ground after application.

The Contractor shall spread straw mulch following drill seeding with a mechanical mulch spreader or by hand. If spreading by hand, the Contractor shall tear apart the bales of mulch and fluff it before spreading.

The Contractor shall anchor straw following crimping with an approved tackifier with green dye at a rate of 200 lbs. per acre. The tackifier shall be Incidental to the seeding.

When crimping the straw is impractical due to rocky areas it may be spread and not crimped. Tackifier will be applied as per Specification. This method shall be approved by the Project Manager for rocky areas only.

When the revegetation Work is being done the Contractor shall verify straw bale moisture content with a straw bale moisture meter with an eight (8) inch minimum length probe for the duration of the Project. An Inspector must be present and record this test. The moisture meter shall remain the property of the Contractor following Project completion and the testing shall be considered Incidental to the Project. Each bale must be tested to confirm that the bale interior moisture content is no greater than 20%. Any bales with moisture above this level shall be rejected and removed from the Project. Higher levels of moisture may indicate the

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presence of mold and the risk of spontaneous combustion.

632.3.17 Rock Mulch

The finished rock mulch surface must be smooth and uniform maintaining the original flow lines, slope gradients, and contours of the job. Rock mulch must be applied in a fashion not to tear up or damage the hydro-mulch when being placed. Methods and means of rock mulch installation are not specified and may vary as per access. Damaged hydro-mulch shall be replaced and no extra payment made therefore.

632.3.18 Class C Slopes with over 50' of Slope Length

Class C slopes in excess of 50' of slope length (measured along the slope face from toe to crest) shall have the following treatment.

Class G rip-rap shall be used for the lower portion of the slope from the toe upwards to the point where there will not be more than 50' of slope length covered with 3/4 inch to one (1) inch rock mulch described in 632.2.5, "Rock Mulch for Class C Seeding," and Table 632.3.4:1, "Operations Sequence for Classes of Seeding." The rip rap shall be placed over the hydroseeded and mulched surface in a way that does not damage the applied mulch treatment, shall be installed from the toe of the slope upwards and shall be one (1) layer of Class G rip-rap in thickness.

632.4 METHOD OF MEASUREMENT

The Contractor shall digitally provide for approval of a to-scale printable revegetation Plan as part of the submittals before the mandatory pre-seeding meeting. The Plan shall identify each area by station, numerical order, Project left, Project right, and is to indicate the class of seeding as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding." Quantities shall match those produced by construction staking and shall include all off-site areas.

The Contractor shall identify on the Plan all areas identified by Construction Staking which have less than four (4) inches of soil cover and qualify for Modified Class A treatment as per Section 632.3.5, "Modified Class A Seeding for Narrow Areas or Areas Inaccessible to Drill Seeding Equipment."

An accompanying table to the Plan shall be submitted showing the amount of each Material apportioned for each area on the Project and the acreage of that sub-area. Included in the Plan shall be all off-Project areas requiring revegetation as enumerated in Section 632.5, "Basis of Payment."

632.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Class A Seeding	Acre
Class C Seeding	Acre

632.5.1 Revegetation Work Included in Payment

The following revegetation Work items shall be considered as included in payment for the main items and shall not be measured or paid for separately:

1. Tackifier for straw mulch;

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- 2. All compost mulch, fertilizer Materials, and water added at tilling;
- 3. Rock for rock mulch;
- 4. Moisture probe for straw bales;
- 5. Weed removal and disposal prior to seed operations;
- 6. Revegetation Plan;
- 7. Right of access permit to be provided by Contractor for inspection of off-site locations located on private property;
- 8. Multiple mobilizations to meet NPDES requirements; and
- 9. Construction staking.

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Supplemental Specifications

General Requirements

SSCAFCA SUPPLEMENTAL TECHNICAL SPECIFICATIONS

SECTION 1503

MOBILIZATION

621.1 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.

621.2 MOBILIZATION ADMINISTRATION REQUIREMENTS

621.2.1 DEFINITIONS

The following definitions shall apply:

- a) Total original contract amount shall mean the total amount bid as compensation for the contract.
- b) Total original contract amount less mobilization and demobilization shall mean the total amount bid as compensation for the contract less the amounts bid for mobilization.

621.2.2 GENERAL

It is the intent of this specification to provide for the Contractor to:

a) Receive 100% of the amount bid for mobilization by the time the Contractor has performed 10% of the total original contract amount bid less the amount bid for mobilization.

621.2.3 PAYMENT PROCEDURES FOR MOBILIZATION

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.

621.2.4 PAYMENT CALCULATIONS

Рм	=	Mobilization Payment
Μ	=	Total amount bid for Mobilization
fм	=	Mobilization payment percentage factor
	=	0.25, or 0.50, or 1.0, as applicable
Рм	=	M x f _M

EXAMPLE 1 MOBILIZATION

Total Original Contract Amount Bid	\$1 ⁻	10,00	00
Amount Bid for Mobilization	\$	5,00	00
Total Original Contract Amount Less Mobilization	\$10)5,00	00

Percent of Work Completed f_M		М		Рм	
<5% of \$102,000	0.25	х	5,000	=	\$1,250
>5% to <10% of \$102,000	0.50	х	5,000	=	\$2,500*
≥10% of \$102,000	1.00	х	5,000	=	\$5,000*
*minus previously paid amounts					

621.3 METHOD OF MEASUREMENT

Mobilization will be measured by lump sum unit.

621.4 BASIS OF PAYMENT

Mobilization will be paid for at the contract price per Mobilization Bid Item. The amount Bid for Mobilization shall not exceed 5% of the Total Base Bid.

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.

SECTION 1504

NPDES COMPLIANCE

630.1 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. A Storm Water Pollution Prevention Plan (SWPPP). This work consists of developing and maintaining this plan to control erosion, pollution, sediment and runoff during the construction of the project.

630.2 MEASUREMENT AND PAYMENT

630.2.1 UNIT PRICE BID PROPOSALS: For Unit Price Bid Proposals, NPDES compliance shall be paid for as follows:

630.2.1.1 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, or a Low Erosivity Waiver (LEW) form, if applicable. A copy of the EPA acceptance of the NOI or LEW must be delivered to the Owner. 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 SWP3.

630.2.1.2 Payment for an additional sixty (60) percent 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 half 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 SWP3 and its Best Management Practices (BMPs), the payment will be withheld until the deficiencies are corrected.

630.2.1.3 The remaining twenty-five (25) percent of the Lump Sum unit price amount will be based on the completion and submittal to EPA 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 acceptance verification from EPA must be delivered to the Owner. BMPs must be removed as defined in the plan specifications or SWP3. 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

SECTION 1505

CONTROL OF STORM WATER AND NUISANCE FLOW

1505.1 DESCRIPTION

This work covers the control of storm and nuisance flow water in the vicinity of this project.

1505.2 CONSTRUCTION REQUIREMENTS

All permanent work shall be performed in areas free from water. The CONTRACTOR shall construct and maintain all dikes and drainage ditches necessary for the elimination of water from work areas and shall furnish, install, maintain, and operate all necessary pumping and other dewatering equipment required for dewatering the various work areas. Two (2) types of flow can be expected;

1) Continuous or intermittent flow through the main arroyo;

2) Local sheet flow from adjacent properties or adjacent streets.

The CONTRACTOR is responsible for adequacy of the scheme or plans, or for furnishing all equipment, labor and materials necessary for dewatering the work areas and breaking up and removing such ice or snow as may have formed or settled in the work area. The CONTRACTOR shall be fully responsible for all dewatering operations, and the cost of all dewatering operations shall be included in the lump sum price for this work. The CONTRACTOR shall also be responsible for removal of any sediment deposited by storm and nuisance water, and the cost of sediment removal work shall be included in the lump sum price for this work.

In the event that storm flow, snowmelt or other water flows overtop the Contractor's diversion method, the Contractor will be responsible for any and all damage, including damage to the existing channel and any damage to new work and is responsible for immediate resolution and repair in a manner acceptable to SSACFCA.

Diversion methods may be by use of sand bag diversion channels, sand bag dams, pumping or piping around or over the work areas, or any method or combination.

1505.3 BASIS OF PAYMENT

The bid item for this effort will be on a Lump Sum (LS) basis. Providing and maintaining the diversion and care of water, regardless of the amount of water actually handled, shall be paid for as follows:

Payment for protection of project from water will be made as a percentage of the dollar amount of work completed to date minus the Mobilization bid item and Protection of the Project From Water During Construction bid item.

Pay Item

Pay Unit

LS

Protection of Project from Water During Construction

END OF SECTION

SECTION 1506

CONSTRUCTION STAKING

1506.1 DESCRIPTION

This work consists of 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.

1506.2 MATERIALS

The 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 Engineer, points shall be referenced so that they may later be re-established.

1506.3 CONSTRUCTION REQUIREMENTS

Local Survey Control has been set for vertical and horizontal control throughout the construction area. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work.

The Contractor shall be responsible for all other control, slope stakes, cut stakes, offset stakes, bench marks, blue tops or other staking necessary for proper execution of the work, or as requested by the Project Manager, to assure compliance with the plans.

1506.4 CONSTRUCTION SURVEYS

The contractor shall obtain and pay for the services of a Professional Surveyor registered in the State of New Mexico to perform surveys of earthwork quantities, during and at the completion of the project construction. These surveys shall consist of the following phases.

- Phase 1: A cross section survey, with no greater than 50 foot spacing, to determine the location of existing ground prior to construction after clearing and grubbing and after removal of the trash and debris. Cross section data collected shall be of sufficient spacing, including all breaks in the terrain to be able to create an original ground digital terrain model (DTM). The "original ground" DTM shall be submitted to the Engineer for review and acceptance prior to proceeding with excavation, embankment or export of excess material. Cross section data must be sufficient to determine earthwork quantities.
- Phase 2: Cross-section and location surveys that may be made during the excavation and backfill construction for the purposes of verifying the contractor's work. Where shown, the excavation dimensions (pay limits for unclassified excavation, backfill and sub-excavation) shown on the plans shall be used to determine the excavation cross-section for payment to the contractor. The cross-section data must be sufficient to verify the limits of excavation.
- Phase 3: A cross-section survey, at the same locations as the cross-sections in Phase 1 to determine the location of the finish grade at the completion of construction.
- Phase 4: The Phase 4 Survey will be completed during construction to demonstrate compliance with

the design grades shown on the plan set. Phase 4 Survey will also include the update and completion of as-builts for the project and the submittal on a weekly basis of as-builts on a set of the construction drawings, to the satisfaction of the Project Manager.

All surveys must be certified by the Professional Surveyor and include complete documentation. Cross sections of the Phase 1, 2 and 3 surveys and the pay limit for excavation as shown on the plans must be used by the Professional Surveyor to compute the quantity of excavation, subject to the provisions for measurement in Section 203. Volume shall be based on the "average end area" computation. All computations of excavation and backfill must be submitted to the Engineer in sufficient detail. This submittal shall be such that methods and computations can be fully verified and are subject to approval by the Engineer. The Contractor shall also submit the electronic survey point files, including break lines, in a format compatible with Civil3D such that the Engineer can use the data for verification of cut/fill quantities.

At the end of the Project, RESPEC will transcribe the as-built information provided by the Contractor onto the mylar record drawing. The Contractor's Professional Surveyor will be required to stamp, sign and certify the information shown on the mylar As-Built drawings.

1506.5 METHOD OF MEASUREMENT

Submit a construction-staking schedule of values as part of Construction Progress Meetings or monthly progress schedule to the Project Manager for approval.

1506.6 BASIS OF PAYMENT

Pay Item Construction Staking by the Contractor Pay Unit Lump Sum

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

END OF SECTION

SECTION 1507

TESTING AND QUALITY ASSURANCE

1507.1 GENERAL

- A. This Section includes testing and quality control measures required on this project. The Section is additional to requirements specified for testing and quality assurance in the standard specifications and other supplemental specifications.
- B. Materials and equipment are subject to inspection, sampling, and testing before acceptance of the work.

1507.2 RELATED WORK

A. General and Supplemental General Conditions of the Contract.

1507.3 REFERENCES AND DEFINITIONS

- A. All materials and equipment shall be tested, by the CONTRACTOR, pursuant to their technical specification (unless otherwise specified herein) and the manufacturer's recommendations.
- B. 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 SUBMITTALS

- A. 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.
- B. 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

- A. Quality Assurance/Control of Installation The CONTRACTOR shall:
 - 1. Comply fully with manufacturers' instructions, including each step in sequence.

- 2. Request clarifications from ENGINEER before proceeding should manufacturers' instructions conflict with Contract Documents.
- Request clarification from ENGINEER before proceeding should 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.
- 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.
- 5. Make sure work is performed by qualified persons.
- 6. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- B. Testing Laboratory Services
 - 1. 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 for the project.

1507.7 EXECUTION

- A. Testing Laboratory Services
 - 1. The CONTRACTOR will employ and pay for services of an independent testing firm to perform testing.
 - 2. The independent firm will perform tests and other services specified in individual Specification Sections and as required by the OWNER.
 - 3. CONTRACTOR shall:
 - a) Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
 - b) Notify ENGINEER and independent firm 8 hours prior to expected time for operations requiring services.
 - c) Make arrangements with independent firm and pay for additional samples and tests required for CONTRACTOR'S use.

B. 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 retesting due to failing tests.

1507.8 TESTING FREQUENCY AND TYPE 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.D.

1507.9 MEASUREMENT AND PAYMENT

Testing shall be paid for as an allowance on a Lump Sum basis. The Contractor may request percent of LS cost 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.

Testing allowances are provided as part of the project and invoiced for testing will be paid for through this allowance.

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.

The CONTRACTOR shall submit two 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. The 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

SECTION 1508

PROJECT RECORD DOCUMENTS

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 construction observer on a regular basis, depending on the length of the contract. Immediately before inspection for Certificate of Substantial Completion, 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's 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 AND 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 AND 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

SECTION 1508

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END OF SECTION

SUPPLEMENTAL TECHNICAL SPECIFICATION SECTION 1511 TEMPORARY FENCE

DESCRIPTION

This work shall consist of furnishing, installing, and maintaining Temporary Plastic Barrier Fences of the type and at the locations shown in the plans or where directed by the Engineer.

MATERIALS

Materials for Temporary Plastic Barrier Fences shall meet the following requirements:

- **Fence**: High-density polyethylene mesh, ultraviolet-stabilized min. 2 years; minimum height 4.0 feet. Color: high-visibility orange or green. When used to protect trees or other vegetation, color shall be high-visibility orange.
- **Posts**: Rigid metal or wood posts, minimum length 6.0 feet.
- **Ties:** Steel wire, #14 gauge or nylon cable ties.
- Warning signs: Sheet metal, plastic or other rigid, waterproof material, 1.5 feet by 2.0 feet with 4 inch black letters on a white background. Text shall be: "Protected Site Keep Out" unless otherwise specified.

CONSTRUCTION DETAILS

Fences shall be erected prior to moving construction equipment onto any area designated for protection.

The line of fences as indicated on the plans shall be staked or marked out on the ground by the Contractor and approved by the Engineer before any fence is installed. Where used for protection of individual trees, fence shall be placed at the drip line (extent of canopy). If not possible, placement shall be as close to the drip line as possible and in no case less than 5.0 feet away from the tree trunk.

On approval of the stakeout, posts shall be securely driven on 6.0 foot-maximum centers, normal to the ground, to a depth 1/3 of the total post length. Plastic barrier fence shall be placed along the side of all posts. Ends of fencing segments shall overlap a distance of at least one half the fence height.

Fencing shall be secured to posts with wire or cable ties at top, middle and bottom of post. Fastener shall be tight enough to prevent the fencing from slipping down. Overlaps shall also be securely fastened.

Barrier fence which is not orange in color shall be flagged at 6.0 foot intervals with red or orange florescent tape. Warning signs shall be mounted on the fence at no more than 100 foot intervals.

Maintenance shall commence immediately after erection of the fence and continue until one week prior to acceptance of the contract, and shall consist of: replacing damaged post(s) and fencing; re-fastening and tightening fencing; and restoring fence to its intended height.

Fencing used for tree or other vegetation protection shall not be temporarily removed to allow equipment access over a protected area, except as required for items of work specifically shown on the plans and approved by the Engineer in writing.

METHOD OF MEASUREMENT

The quantity to be measured for payment will be the number of feet of Temporary Plastic Barrier Fence erected, measured along the top, to the nearest whole foot.

BASIS OF PAYMENT

The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Relocation of a fence from one location to another as directed by the Engineer shall be considered as a new location and will be separately paid.

ADS SANITITE® HP 12"-60" SANITARY PIPE SPECIFICATION

SCOPE

This specification describes 12- through 60-inch (300 to 1500 mm) ADS SaniTite HP pipe for use in gravity-flow sanitary sewer applications.

PIPE REQUIREMENTS

ADS 12" – 30" (300 to 750mm) SaniTite HP dual pipe shall have a smooth interior and annular exterior corrugations; 30"-60" SaniTite HP triplewall pipe shall have smooth interior and exterior surfaces with annular inner corrugations.

- 12- through 60-inch (300 to 1500 mm) pipe shall meet ASTM F2764*
- 12- through 60-inch (300 to 1500 mm) pipe shall have a minimum pipe
- stiffness of 46 pii when tested in accordance with ASTM D2412
- Manning's "n" value for use in design shall be 0.012.

JOINT PERFORMANCE

Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2764*.

12- through 60-inch (300 to 1500 mm) shall be watertight according to the requirements of ASTM D3212, with the addition of a 15 psi pressure requirement. Spigot shall have two gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

12- through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

FITTINGS

Fittings and connections shall provide a watertight connection according to the requirements of ASTM D3212. Gaskets, when present, shall meet ASTM F477.

FIELD PIPE AND JOINT PERFORMANCE

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material.

MATERIAL PROPERTIES

Polypropylene compound for pipe and fitting production shall be an impact modified copolymer meeting the material requirements of ASTM F2764*.

INSTALLATION

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60-inch (1500mm) diameters the minimum cover shall be 2-ft (0.6m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 or Class 2 (minimum 90% SPD) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.05.

PIPE DIMENSIONS

	12 (300)	15 (375)	18 (450)	21 (535)	24 (600)	30 (750)	36 (900)	42 (1050)	48 (1200)	60 (1500)	
	12.1 (307)	14.9 (378)	18.0 (457)	21.1 (536)	24.1 (612)	30.1 (765)	35.7 (907)	41.8 (1062)	47.3 (1201)	59.3 (1506)	
Average Pipe O.D. in. (mm)	14.5 (368)	17.6 (447)	21.2 (538)	24.8 (629)	28.0 (711)	35.4 (899)	41.1 (1044)	47.2 (1199)	53.8 (1367)	66.5 (1689)	

* ASTM F2736 has been incorporated into the latest version of ASTM F2764.



ADS WATERSTOP™ GASKET SPECIFICATION

Scope

This specification describes the ADS WaterStop gasket available in 12- to 60- inch (300 to 1500 mm) diameters and used for a field installed seal that prevents water infiltration or exfiltration at manhole connections.

Material Properties

The ADS WaterStop gasket is made of a polyisoprene compound which meets the physical property requirements of ASTM C923.

Installation

Installation shall be in accordance with ADS recommended installation instructions. Contact your local ADS representative or visit <u>www.ads-pipe.com</u> for a copy of the latest installation guidelines.



Pipe Size	Recommended Min. Hole, in.	Min. Distance Pipe Invert to Structure Invert, in
12	19.5	3.7
15	23	4
18	26.5	4.2
24	33.3	4.5
30	40.5	5.2
36	47	5.5
42	53	5.7
48	59	5.7
54*	65	6.4
60	72	6.4

* Check with Sales Representative for availability


pipe

StormRax[™] Installation Instructions

All StormRax trash racks are supplied pre-drilled, include concrete anchor bolts and all the necessary mounting hardware. NOTE: Installer must use the pre-drilled holes. Please call if you have any questions.

Concrete Riser Pipes and Boxes

The following instructions will guide the installer(s) through a quick and successful installation of concrete riser pipes and boxes.

Tools Required:

- Hammer drill
- 3/8" diameter masonry drill bit
- 1/2" wrench or adjustable wrench

STEP I: Lift trash rack onto concrete structure (typically can be done with 1-2 persons) Note: Top of structure must be sound and flat (within 118") around top of mounting surface. Mounting a trash rack to a structure that is not sound is not recommended.

STEP 2: Position (center) trash rack on structure and mark all mounting hole locations.

STEP 3: Remove trash rack from concrete structure.

STEP 4: Drill mounting holes using a 3/8" diameter masonry drill bit.

STEP 5: Install 3/8" X 3" anchor bolts (supplied).

STEP 6: Lift trash rack over anchor bolts. Ensure trash rack is completely flush against concrete mounting surface and then secure using flat washers and nuts (supplied).

STEP 7: Ensure all anchor bolt nuts are tight and secure. DO NOT OVERTIGHTEN!



Corrugated Pipe

The following instructions will guide the installer(s) through a quick and successful installation on corrugated pipes.

STEP I: Locate the 4 mounting brackets on the crossbars and slide to the outside of the rack.

STEP 2: Lift trash rack onto corrugated riser, resting crossbars on top of riser. (Typically can be done with 1 or 2 persons) Top of riser should be sound and flat.

STEP 3: Center rack on top of riser, having equal distance between the outside of the riser and the outside of the trash rack.

STEP 4: Slide all 4 mounting brackets to the outside of the riser. With appropriate screw (for metal or plastic), attach the mounting brackets to the corrugated riser.

If you have any questions concerning installation, please contact your local sales engineer.



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Supplemental Specifications

Geotechnical Report



GEOTECHNICAL ENGINEERING SERVICES REPORT JOB NO. 1-10302

SOUTHERN SANDOVAL COUNTY ARROYO & FLOOD CONTROL AUTHORITY

HARLEY POND PROJECT

RIO RANCHO, NEW MEXICO

GEO-TEST, INC. 3204 RICHARDS LANE SANTA FE, NEW MEXICO 87507 (505) 471-1101 FAX (505) 471-2245

8528 CALLE ALAMEDA NE ALBUQUERQUE, NEW MEXICO 87113 (505) 857-0933 FAX (505) 857-0803

2805-A LAS VEGAS CT. LAS CRUCES, NEW MEXICO 88007 (575) 526-6260 FAX (575) 523-1660 PREPARED FOR:

RESPEC

SUPPLEMENTAL TECHNICAL SPECIFICATION SECTION 1511 TEMPORARY FENCE

DESCRIPTION

This work shall consist of furnishing, installing, and maintaining Temporary Plastic Barrier Fences of the type and at the locations shown in the plans or where directed by the Engineer.

MATERIALS

Materials for Temporary Plastic Barrier Fences shall meet the following requirements:

- Fence: High-density polyethylene mesh, ultraviolet-stabilized min. 2 years; minimum height 4.0 feet. Color: high-visibility orange or green. When used to protect trees or other vegetation, color shall be high-visibility orange.
- **Posts**: Rigid metal or wood posts, minimum length 6.0 feet.
- **Ties:** Steel wire, #14 gauge or nylon cable ties.
- **Warning signs**: Sheet metal, plastic or other rigid, waterproof material, 1.5 feet by 2.0 feet with 4 inch black letters on a white background. Text shall be: "Protected Site Keep Out" unless otherwise specified.

CONSTRUCTION DETAILS

Fences shall be erected prior to moving construction equipment onto any area designated for protection.

The line of fences as indicated on the plans shall be staked or marked out on the ground by the Contractor and approved by the Engineer before any fence is installed. Where used for protection of individual trees, fence shall be placed at the drip line (extent of canopy). If not possible, placement shall be as close to the drip line as possible and in no case less than 5.0 feet away from the tree trunk.

On approval of the stakeout, posts shall be securely driven on 6.0 foot-maximum centers, normal to the ground, to a depth 1/3 of the total post length. Plastic barrier fence shall be placed along the side of all posts. Ends of fencing segments shall overlap a distance of at least one half the fence height.

Fencing shall be secured to posts with wire or cable ties at top, middle and bottom of post. Fastener shall be tight enough to prevent the fencing from slipping down. Overlaps shall also be securely fastened.

Barrier fence which is not orange in color shall be flagged at 6.0 foot intervals with red or orange florescent tape. Warning signs shall be mounted on the fence at no more than 100 foot intervals.

Maintenance shall commence immediately after erection of the fence and continue until one week prior to acceptance of the contract, and shall consist of: replacing damaged post(s) and fencing; re-fastening and tightening fencing; and restoring fence to its intended height.

Fencing used for tree or other vegetation protection shall not be temporarily removed to allow equipment access over a protected area, except as required for items of work specifically shown on the plans and approved by the Engineer in writing.

ITEM 607.41010010 - TEMPORARY PLASTIC BARRIER FENCE

METHOD OF MEASUREMENT

The quantity to be measured for payment will be the number of feet of Temporary Plastic Barrier Fence erected, measured along the top, to the nearest whole foot.

BASIS OF PAYMENT

The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Relocation of a fence from one location to another as directed by the Engineer shall be considered as a new location and will be separately paid.

DEO-IEST

April 16, 2021 Job No. 1-10302

RESPEC 5971 Jefferson St. NE, Suite 101 Albuquerque, NM 87109

ATTN: E. Christian Naidu, PE

RE: Geotechnical Engineering Services Report SSCAFCA Harley Pond Project Rio Rancho, New Mexico

Dear Mr. Naidu:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation and laboratory testing as well as embankment foundation and construction, slope stability, excavation and site grading recommendations.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted: GEO-TEST, INC.

Patrick R. Whorton, PE

EN 2634 PROFESSIONAL

Reviewad By:

Robert D. Booth, PE

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INTRODUCTION

This report presents the results of geotechnical engineering services performed by this firm for the proposed new Harley Pond Project to be constructed in Rio Rancho, New Mexico.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the soils underlying the dam and pond site.
- 2) Provide recommendations for the design and construction of the detention pond including embankment foundation preparation and construction, considering slope stability, settlement, and seepage.

The investigation includes subsurface exploration, representative soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the construction of a flood control pond located south of the intersection of Vargas Rd. and Vicenza Dr. in Rio Rancho. The pond will be constructed by excavating the native soils on the west side of the site to a depth of approximately 10 feet below existing surface grades at a 3:1 slope. The excavated soils will be used to construct an embankment dam located on the east side of the site. The embankment dam will be 8 feet high with a 3:1 slope on the upstream side of the dam and sloped on the downstream side at a 4:1 slope to native grade approximately 18 feet below the crest of the dam which is 15 feet wide.

The primary outlet for the pond will be a drop inlet structure located on the southern side of the pond within the cut area. The drop inlet will feed into reinforced concrete pipes connected to the city storm sewer system. An emergency spillway weir will be constructed on the northern portion of the pond with an associated concrete lined channel. The inlet to the pond will be a concrete lined channel at the approximate location of an existing arroyo located at the northern portion of the pond. A conceptual site plan is included as Figure 1 in a later section of this report.

FIELD EXPLORATION

A total of ten (10) exploratory borings were drilled at the site. Five (5) borings were drilled to a depth of 25 feet below existing grades along the alignment of the proposed dam embankment while five (5) borings were drilled to a depth of 15 feet below existing grades within the detention pond area. The locations of the borings are shown on the attached Boring Location Maps, Figure 2. During the test drilling, the soils encountered in the borings were continuously examined, visually classified, and logged. The boring logs are presented in a following section of this report. Drilling was accomplished with a truck mounted

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drill rig using 5.5-inch diameter continuous flight hollow stem auger. Subsurface materials were sampled at five foot intervals or less utilizing an open tube split barrel sampler driven by a standard penetration test hammer. Bulk samples of auger cuttings were also collected.

LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits with depth. The results of these tests are presented on the boring logs.

Sieve analysis and Atterberg limits tests were performed on selected samples to aid in soil classification. In addition, moisture-density relationship tests were performed on composite bulk samples to determine the optimum moisture content and maximum dry density of blended onsite soils. Re-molded permeability testing was also performed on selected samples to determine hydraulic conductivity of the compacted soils. The results of these tests are presented in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SITE CONDITIONS

The Harley Pond site is located approximately 1,800 feet north of the intersection of Westside Blvd. and 10th St. SE in Rio Rancho. The area is generally undeveloped; 10th St. is rough cut through the site and a city water line was recently installed through the southern portion of this site, beyond these improvements, the site is in a native state. There are two arroyos which enter the site from the west (Viccenza Dr.) and currently exit the site along the east side (11th St.). The arroyos are in a general native state with no engineered improvements. Some garbage has been dumped on the site, particularly at the intersections of 10th St. and the arroyos. This garage appears to be household debris which appears to be recently deposited and limited to the surface.

The overall site slopes downward from southwest to northeast with a total grade change on the order of 25 feet. There are also localized elevation changes throughout. The site is populated with native shrubs and grasses.

SUBSURFACE SOIL CONDITIONS

As indicated by the exploratory borings, the subsurface profile underlying the Harley Pond site consists primarily of non-plastic silty and poorly graded sands which were encountered at the surface and extended to the full depths explored. Based on standard penetration testing, the relative density of these soils was found to be loose to medium dense near the surface becoming dense to very dense with depth. In half of the exploratory borings, a layer of cemented sand, commonly referred to as caliche, was encountered at depths ranging from 2.5 feet to 12.5 feet below surface grade. The degree of

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cementation and thickness of the caliche varied from each location tested. See boring logs included in a later section of this report for specific soil profiles.

No free groundwater was encountered in the borings and soil moisture contents were relatively low throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

The native soils encountered throughout the site are considered suitable for use as structural fill and may be used for the construction of the dam embankment. The density of near surface soils beneath the dam site are generally loose to medium dense and most soils were found to have a low moisture content and would be likely to experience settlement upon significant moisture increase. Therefore, in order to provide a stable and uniform surface for the construction of the dam, it is recommended that the subsurface soils beneath the dam, which will comprise the dam foundation, be overexcavated to such an extent as to provide for a minimum of 3 feet of properly compacted structural fill beneath the embankment. The limits of the overexcavation should also and extend a minimum distance of 3 feet beyond the perimeter of the dam. Detailed recommendations for dam embankment design and the required site grading are presented in the following sections of this report.

The native soils encountered at the pond area may be readily excavated using normal earthmoving equipment and may be reused as structural fill for the construction of the dam embankment, although some blending may be required to meet the specifications for structural fill. Cut slopes may be excavated at a maximum temporary slope of 1.5:1 (H:V) and permanent slopes should be graded or created at slopes as described in the Dam Embankment Construction section of this report.

DAM EMBANKMENT FOUNDATION

Clearing, grubbing and stripping will be required over the entire embankment foundation areas extending a distance of at least 3 feet horizontally beyond the limits of the embankment. The resulting foundation areas should then be overexcavated to such an extent as to provide for a minimum 3 feet of structural fill beneath the embankment. The overexcavation should also extend a minimum of 3 feet laterally from the embankment perimeter. Once the overexcavation has been completed, the native cut surface should be densified, and the embankment constructed in accordance with the Site Grading section of this report.

Total settlement of the embankment is a function of internal embankment settlement and foundation settlement. Maximum foundation settlements are estimated to be on the order of $1\frac{1}{2}$ inches, and internal embankment settlements are estimated to be on the order of 1 inch or less. However, since the vast majority of both foundation and embankment settlements will be elastic and occur during construction, only minor settlement, less than $\frac{3}{4}$ inch is anticipated upon completion of construction.

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DAM EMBANKMENT CONSTRUCTION

Embankments should meet the specifications and be constructed according to the method outlined within the Site Grading section of this report. Based on the results of this investigation; it is anticipated that the majority of native soils encountered throughout the site will be suitable for use as dam embankment fill, although some blending will be required to provide for a homogenous fill meeting the specifications outlined within the Site Grading section of this report.

The stability of constructed dam embankment slopes was analyzed using the two-dimensional limit equilibrium stability program STABLPRO by Ensoft. Bishop's Method of Slices was used to develop factors of safety against slip on a circular failure plane for both static and pseudo-static loading conditions for three anticipated slopes to be used in pond construction are presented below in terms of factors of safety with a factor of 1 being stable, less than 1 unstable, 2 recommended for static conditions and 1.3 recommended for pseudo-static conditions.

Slope (H:V)	Height (ft)	Static FS	Pseudo-Static FS
3:1	8	3.181	1.989
3:1 Cut	12	2.607	1.524
4:1	18	3.696	1.928

Embankments with a lesser height, wider crest and flatter slope will have factors of safety higher than those listed above such that they would also be deemed acceptable.

It is assumed that the native sands encountered will be the primary material utilized for the construction of the embankment slopes. The slope stability analysis was conducted using the soil characteristics of the sampled onsite material such that the calculated slope stability applies only to these materials. Should import material be required for embankment construction, the soils should conform to the structural fill requirements presented in the Site Grading section of this report and be approved by the geotechnical engineer.

For the purposes of this analysis, a horizontal pseudo-static coefficient of 0.20g was utilized in the analyses based on 100% of the predicted peak ground acceleration within 50 years with a 2 percent probability of exceedance.

Should alternative embankment configurations be considered which do not conform to the embankment configurations and dimensions discussed above, this firm should be notified, and additional slope stability analysis can be performed for the embankment design chosen.

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INLET AND OUTLET STRUCTURES

The principal outlet for Harley Pond will consist of a drop inlet structure connected to a 24-inch diameter reinforced concrete pipe that will discharge into a storm sewer system. The drop inlet structure and RCP will be placed within a cut area of the pond. As these structures will not be supported by the embankment foundation, it is recommended overexcavation be conducted to provide for a minimum of 3 feet of structural fill beneath the drop inlet structure. In addition, the excavation for the pipe should be overexcavated to provide a minimum of 3 feet of properly compacted structural fill surrounding the entire pipe. The pipe should then be backfilled with structural fill meeting the requirements presented in the Site Grading section of this report.

The inlet channel to the pond as well as the emergency spillway weir and rundown channel will be constructed with concrete or shotcrete slabs on grade. Prior to the placement of the concrete or shotcrete, the subgrade should be scarified to a depth of 12 inches, moisture conditioned to optimum moisture or above and compacted to 95 percent or greater of maximum density as determined by ASTM D-1557. Riprap to be used in energy dissipation areas should also be placed on a minimum of 12 inches of compacted subgrade as prepared for the concrete.

SEEPAGE AND INTERNAL DRAINAGE

The project consists of a flood control structure to be constructed on normally dry watercourse. Maximum storm water detention time is anticipated to be 24 hours or less. Based upon the results of the laboratory tests, this is not nearly enough time to develop steady state seepage. Accordingly, seepage analysis and internal drainage design is not considered necessary. In addition, filter/drain material around the principal spillway or within the embankment itself to control seepage is not considered necessary provided the embankment fill is carefully placed around the pipe as recommended in the Site Grading section of this report.

EROSION

The onsite soils anticipated to be used as dam embankment fill and which will comprise cut slopes throughout the project are low cohesive granular soils. As such, slopes constructed with these soils will be subject to both sheet and rill erosion. As a general rule the amount of erosion to be expected is directly related to how steep the slope in question is with steeper slopes experiencing more erosion that flatter slopes.

As stated in previous sections, permanent project slopes may be as steep as 3:1. Although stable, these steeper slopes will likely experience greater erosion than flatter slopes which may compromise the stability and integrity of the slopes. Therefore, the stability of all slopes recommended herein should be considered contingent upon the implementation of proper erosion protection.

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The area immediately surrounding the drop inlet structure of the primary outlet will be particularly susceptible to erosion which may compromise the adjacent cut slope. As such, it is recommended that riprap or other erosion protection be installed around the drop inlet and placed to protect the adjacent cut slope.

SITE GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

- 1) Clearing, grubbing and stripping will be required over the entire dam embankment foundation areas. Stumps, matted roots, or rocks larger than 2 inches in diameter should be removed from within 18 inches of the foundation areas. Stripping and preparation of dam embankment foundation areas should extend a minimum of 3 feet horizontally beyond embankment limits. Stripping should be achieved only by cutting, i.e., ground depressions or narrow sections of tributary arroyos should not be inadvertently filled during the foundation preparation.
- 2) After clearing, grubbing and required excavations, the existing site soils throughout the foundation areas should be overexcavated to such an extent as to provide for at least 3 feet of properly compacted structural fill beneath the dam embankments and outlet pipe. The overexcavation limits should extend laterally a minimum of 3 feet beyond the embankment and pipe perimeters. The soils exposed at the base of the overexcavation should be densified before placement of structural fill.
- 3) Densification of native cut surfaces shall consist of moisture conditioning to the optimum moisture content or above. The upper 12 inches should then be compacted to a minimum of 95 percent of the maximum dry density at or above the optimum moisture content as determined in accordance with ASTM D-1557.
- 4) The results of this investigation indicate that most of the native soils will be suitable for use as structural fill; however, some blending may be required to meet the specifications below. Should imported fill be required, it should also meet the specifications for structural fill.
- 5) All structural fill and backfill should be free of vegetation and debris and contain no rocks larger than 3 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

Size	Percent Passing
3 inch	100
No. 4	60 - 100
No. 200	10 - 35

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- 6) Fill or backfill, consisting of soil approved by the geotechnical engineer, should be placed in controlled compacted layers not exceeding 8 inches (compacted) with approved compaction equipment. All structural fill material should be blended as necessary to produce a homogeneous embankment. No lifts of high permeability material or material differing substantially from the lift below should be permitted. Sheepsfoot or vibratory sheepsfoot or segmented steel wheel type compactors should be used. If the compactors "walk out" during compaction, or if it is desired to use flat wheel compactors, the upper 1 to 2 inches of the lift should be scarified prior to placing a subsequent lift. The embankment should be raised uniformly. All compaction should be accomplished to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be at or 3 percent above the optimum moisture content. With any vibratory compactor, vibrations should be controlled or eliminated to avoid damage to adjacent structures or infrastructure.
- 7) Fill below and above the principal spillway pipe should be placed and compacted as outlined above. In the zone within 3 feet of the pipe, fill should be placed in maximum 6 inch lifts, moisture conditioned and compacted as outlined above, using manually controlled walk behind rolling compactors, vibratory plate compactors or jumping jacks capable of compacting the soil immediately adjacent to and beneath the haunches of the pipe. Continuous observation and testing should be performed by a representative of the geotechnical engineer during the backfilling process to verify proper placement and compaction around the pipes.
- 8) Tests for degree of compaction should be determined in accordance with ASTM D-1556 or ASTM D-6938. Continuous, full time observation and field tests should be conducted during fill and backfill placement by a representative of the geotechnical engineer to assist the contractor in evaluating the required degree of compaction. If less than the required compaction is required, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

EXCAVATIONS

The results of this investigation indicate that the surficial soils can be readily excavated using normal earth moving and excavation equipment. Temporary construction excavations should be maintained at slopes of 1.5:1 (H:V) or flatter. Surcharge loads including construction traffic and excavated spoil materials should be maintained at least 10 feet from the crest of any excavation slope. Surface water should 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 excavations should comply with all applicable safety regulations.

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Experience dictates shrinkage factors greater than calculated values. Stripping, subgrade preparation, hauling and wind losses, and ground compaction, both in the borrow (reservoir) areas and within the embankment foundation areas are all factors in shrinkage. We recommend using a shrinkage factor on the order of 25 percent.

REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform continuous observations and testing during the earthwork portion of this project. Observation and testing should be performed during construction to confirm that suitable fill and embankment soils are placed upon competent materials.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

- 1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.
- 2) Based upon an interpolation of soil conditions between and beyond the explorations.
- 3) Subject to confirmation of the conditions encountered during construction.
- 4) Based upon the assumption that sufficient observation will be provided during construction.
- 5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of RESPEC, specifically to aid in the design of the proposed Harley Pond Project in Rio Rancho, New Mexico, and not for use by any third parties without consent.

We make no other warranty, either expressed or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to

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Harley F	Pond Project
Job No.	1-10302

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the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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Geo-Test 1-10302



Figure 1

EXHIBIT A HARLEY'S POND CONCEPTUAL DESIGN

APRIL 16, 2021

POND STORAGE VOLUME = 39.9 AC-FT



STORM DRAIN

EMERGENCY SPILLWAY

PROPERTY ACCESS ROAD

POND MAINTENANCE ACCESS ROAD

SHOTCRETE

RIPRAP

 SEWER CONSTRUCTION NOTES

 I.D.#
 DESCRIPTION

 1
 5 STRAND BARBLESS WIRE FENCE

 2
 RE-SEEDING WITH 1" ROCK MULCH, 2" DEEP

 3
 RE-SEEDING WITH NATIVE SEEDING

 4
 48" MANHOLE WITH BEEHIVE GRATE INLET



Routing Summary TableDesign Pond Storage
volume from Grading
PlanPeak Stored
Volume for
Design
StormPeak Water
Surface
ElevationFreeboard to
Emergency
SpillwayFreeboard to
Top of Pond
Embankmentac-ftac-ftft.ftft39.924.95454.72.33.339.936.05457.3-0.30.7

BORING LOCATION MAP





Project: Harley Pond Project 04/02/2021 Date: Elevation: Type:

Project No: 1-10302 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 1

During Drilling: none

After 24 Hours:

				SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	DOL	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
-		\times	SS SS	1-5-8 13 6-8-7	5				
5			SS	15 7-6-5 11	3		SM	SILTY SAND, non-plastic, medium dense, dry, light brown	
- - 10 — -			SS	5-6-8 14	3		SM	Slightly Cemented SILTY SAND (Caliche), non-plastic, medium dense, dry, light brown/white	- . </td
- - 15 -			SS	6-9-10 19	2				
		\times	SS	15-19-24 43	1		SP	POORLY GRADED SAND, non-plastic, medium dense to dense, dry, gray	
		\mathbf{X}	SS	15-19-23 42	1			Stopped Auger @ 24 feet Stopped Sampler @ 25.5 feet	
	-								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



Project:Harley Pond ProjectDate:04/02/2021Project No:1-10302Elevation:Type:5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 2

During Drilling: none

After 24 Hours:

				SAI	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	DOG	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
-		\ge	SS	3-3-6	3				- ¶9. <u> </u> <u> </u> <u> </u> <u> </u>
-		\ge	SS	7-7-6 13	2		SP-SM	POORLY GRADED SAND with SILT,	
5		\geq	SS	5-6-7 13	2			light brown	- 13 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
-									
10		\ge	SS	9-12-17 29	2				
- - - 15 —		\ge	SS	13-12-22 34	3				
							SP	POORLY GRADED SAND, non-plastic, medium to very dense, dry, gray	
- 20 – 20 –		\ge	SS	11-17-23 40	3				
			SS	12-22-31	4				
				53	4			Stopped Auger @ 24 feet Stopped Sampler @ 25.5 feet	
21 - 	-								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.



Project:Harley Pond ProjectDate:04/02/2021Project No:1-10302Elevation:Type:5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 3

During Drilling: none

After 24 Hours:

				SAI	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	DOJ	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
-		\ge	SS	1-4-4 8	4				-¶8·└└
-		\ge	SS	6-10-10 20	2		SP-SM	non-plastic, loose to medium dense, dry, light brown	
5 —		\ge	SS	6-6-6 12	1				
-									
-			22	17-16-13	_				
10 -			00	29	2				
-	-								
15 —		\ge	SS	11-13-13 26	1		SP	POORLY GRADED SAND, non-plastic, medium dense to dense, dry, gray	
- 14/21									
			SS	13-18-22					
20 — 	-		00	40	2				$\begin{array}{c} - \cdot + - \cdot + 40 \cdot + - \cdot + - \cdot - \\ \cdot + - \cdot + - \cdot + - \cdot + - \cdot - \\ \cdot + - \cdot + - \cdot + - \cdot - + - \cdot - \\ \cdot + - \cdot + - \cdot + - \cdot - + - \cdot - \\ \cdot + \cdot + - \cdot + - \cdot - + - \cdot - \\ \cdot + \cdot + - \cdot + - \cdot - + - \cdot \\ \cdot + \cdot + - \cdot + - \cdot - + - \cdot \\ \cdot + \cdot + \cdot + - \cdot - + - \cdot \\ \cdot + + + +$
25 – 25 –		\ge	SS	11-22-22 44	2				┝ - · ┝ - · ₦ - · + - · + - · + - · - · └ - · └ • 44 ↓ - · ↓ - · - - · · └ · · · · · · · · · · · · · · · ·
	-							Stopped Auger @ 24 feet Stopped Sampler @ 25.5 feet	$\begin{vmatrix} - & \cdot & \vdots \\ - & \cdot & \vdots \\ 1 & \cdot & \vdots \\ 0 & \cdot & 0 \\ 0 $
- - -	-								
ğ <u>30</u> —	1								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.



Project:Harley Pond ProjectDate:04/02/2021Project No:1-10302Elevation:Type:5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 4

During Drilling: none

After 24 Hours:

					SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)		FOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
			\leq	SS	2-3-4 7	4		SM	SILTY SAND, non-plastic, loose, dry, light brown	
	-		\ge	SS	5-7-9 16	3				
5			\times	SS	5-8-7 15	3		SM	Slightly Cemented SILTY SAND (Caliche), non-plastic, medium dense, dry, light brown/white	
	-									
10	-		\times	SS	5-6-7	1				
	_				15					
	-									
15	-		\times	SS	12-14-18	2				$- \cdot + + \cdot + - \cdot + - \cdot + - \cdot + - \cdot - +$
5	_				32			SP	POORLY GRADED SAND, non-plastic,	
4/14/2									medium to very dense, dry, gray	
20	_		\times	SS	16-23-29	1				
	_				52					
2.GPJ 6	-									
25	-		\times	SS	18-24-23	1				
	-				47				Stopped Auger @ 24 feet	
	-								Stopped Sampler (# 23.3 leet	
- 10 - 10 - 10 - 10 - 10 - 10 - 10 - 10	_									

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/02/2021 Date: Elevation: Type:

Project No: 1-10302 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 5

During Drilling: none

After 24 Hours:

				SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	POG	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
	-	\ge	SS	3-6-8 14	3				
		\ge	SS	6-7-6 13	5		SM	SILTY SAND, non-plastic, medium dense to	
5 -		\ge	SS	5-4-4 8	3			loose, dry, light brown	
	-								
10 -		\ge	SS	20-34-34 68	3		SP-SM	Moderaltely Cemented POORLY GRADED SAND with SILT (Caliche), non-plastic, very dense, dry, light brown/white	
	-								
45			SS	9-16-14	4				
-				30	I				
4/14/2							SP	POORLY GRADED SAND, non-plastic,	·+-·+-·+-·+-·+
20 -		\ge	SS	12-19-21 40	2			medium to very dense, dry, gray	
	-								$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} $
1302.64	-								$\begin{array}{c} - & \cdot \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - \\ + & - & - & - & - \\ + & - & - & - & - \\ + & - & - & - & - \\ + & - & - & - & - \\ + & - & - & - & - \\ + & - &$
25 -		\mid	SS	13-18-33 51	2				
								Stopped Auger @ 24 teet Stopped Sampler @ 25.5 feet	
3	-								┝╼╵╆╼╵╈╼╵╅╾╵┥
30 -	_								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/12/2021 Project No: 1-10302 Date: 5.5" OD HSA Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 6

During Drilling: none

After 24 Hours:

				SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	DOJ	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
-		\ge	SS	4-4-3 7	3		SM	SILTY SAND, non-plastic, loose, dry, light brown	$- \begin{array}{c} \bullet \\ 7 \cdot \begin{array}{c} \bullet \\ i \end{array} $
-		\ge	SS	4-3-4 7	1				-••7·•++++
5 -		\ge	SS	4-3-6 9	2				
-									
-			SS	4-10-10	1		SP	POORLY GRADED SAND, non-plastic, loose to medium dense, dry, gray	
- 10				20	I				
-									
15 —		\boxtimes	SS	6-12-17 29	1				
								Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
	-								
5 20 – 5 -									
25 –									
30 -	-								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/02/2021 Project No: 1-10302 Date: 5.5" OD HSA Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 7

During Drilling: none

After 24 Hours:

Γ					SAI	MPLE		1	SUBSURFACE PROFILE	
	DEPTH (Ft)	POG	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
	- - - 5 -			SS SS SS	5-7-5 12 5-9-10 19 9-12-16 28	3 1 2		SP-SM	POORLY GRADED SAND with SILT, non-plastic, medium dense, dry, light brown	
	- 10 — - - - 15 —			SS	5-7-9 16 11-18-24	1		SP	POORLY GRADED SAND, non-plastic, medium densse to dense, dry, gray	
D TEST.GDT 4/14/21					42	I			Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
TEST BORING 1-10302.GPJ GE	- - 25 — - -									
OG OF	- 30 —	-								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/12/2021 Date: Elevation: Type:

Project No: 1-10302 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 8

During Drilling: none

After 24 Hours:

				SA	MPLE		1	SUBSURFACE PROFILE	
DEPTH (Ft)	DOJ	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
- - - 5 -			SS SS SS	3-3-4 7 6-7-5 12 2-3-3 6	3 4 3		SP-SM	POORLY GRADED SAND with SILT, non-plastic, loose to medium dense, dry, light brown	
- 			SS	4-9-10 19	2		SP	POORLY GRADED SAND, non-plastic, medium dense, dry, gray	
15 -		\times	SS	6-9-14 23	2			Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
20	-								
25 -	-								

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/12/2021 Project No: 1-10302 Date: 5.5" OD HSA Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 9

During Drilling: none

After 24 Hours:

Γ					SAM	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	DOJ	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
	-		XX	SS SS	8-10-15 25 9-12-16 28	5 4		SP-SM	SILTY SAND, non-plastic, medium dense, dry, light brown	
	- 5 — -		\ge	SS	14-13-36 49	9		SP-SM	Slightly Cemented POORLY GRADED SAND with SILT, non-plastic, dense, dry, brown/white	
	- - 10 — - -		\times	SS	15-17-25 42	3		SP	POORLY GRADED SAND, non-plastic, dense to very dense, dry, gray	
4/21	- 15 — -		\times	SS	14-21-31 52	4			Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
O TEST.GDT 4/1	- - 20 — -	-								
IG 1-10302.GPJ GE	- - 25 —									
OG OF TEST BORIN	- - - 30 —									

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project: Harley Pond Project 04/12/2021 Date: Elevation: Type:

Project No: 1-10302 5.5" ODHSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 10

During Drilling: none

After 24 Hours:

					SA	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
	-		\times	SS SS	5-6-5 11 4-3-5 8	4 3		SM	SILTY SAND, non-plastic, medium dense to loose, dry, light brown	• • 11 - · · · · · · · · · · · · · · · · ·
	5 — -		\ge	SS	3-8-33 41	4			Moderately Cemented SILTY SAND.	
	- 10 — -		\ge	SS	16-25-36 61	5		SM	non-plastic, very dense, dry, light brown/white	
	- - 15 —		\ge	SS	11-14-16 30	3		SP	POORLY GRADED SAND, non-plastic, medium dense, dry, gray	
L.GDT 4/14/21	-	-							Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
2.GPJ GEO TES'	20 — - -									
BORING 1-1030	- 25 — -									
-OG OF TEST	- - 30 —									

LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

											SIEVE ANALYSIS PERCENT PASSING								
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"		
1	1.0	SM	5.2	NP	NP	33	74	97	100										
1	3.0		4.7																
1	5.0		3.2																
1	10.0	SM	3.1	NP	NP	24	47	79	95	98	100								
1	15.0		1.7																
1	20.0		1.5																
1	25.0		1.2																
2	1.0		2.5																
2	3.0		2.2																
2	5.0	SP-SM	2.3	NP	NP	6	20	47	78	90	98	98	100						
2	10.0		2.1																
2	15.0		3.3																
4/14/21	20.0		2.8																
2 2	25.0	SP	3.8	NP	NP	4	30	84	98	99	100								
3 0 1 0 1 0 1 0	1.0		3.8																
6 GB 3	3.0	SP-SM	1.9	NP	NP	11	39	67	88	94	98	100							
-1-10302	5.0		1.1																
SULTS 3	10.0		1.5																
a ∠ 3	15.0	SP	1.5	NP	NP	3	12	51	89	96	99	100							
SUMMARY OF LABORA IC	DEO-IEST						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUEProject: Harley Pond Project Location: Rio Rancho, NM Number: 1-10302												

Sheet 1 of 4

											SIE PER	EVE ANA CENT P	ANALYSIS T PASSING						
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"		
3	20.0		2.0																
3	25.0		1.9																
4	1.0		3.8																
4	3.0		2.8																
4	5.0	SM	3.2	NP	NP	15	38	73	93	97	100								
4	10.0		1.5																
4	15.0		1.7																
4	20.0	SP	1.4	NP	NP	3	12	49	86	91	93	95	98	100					
4	25.0		1.2																
5	1.0	SM	3.4	NP	NP	18	62	95	100										
5	3.0		4.7																
5	5.0		2.7																
5/14/2	10.0	SP-SM	3.2	NP	NP	11	29	62	91	97	99	99	100						
2 5	15.0		1.2																
10 5	20.0		1.9																
0 Pag 5	25.0		1.9																
9 1-1030	1.0	SM	3.3	NP	NP	13	35	66	88	94	98	99	100						
6 6	3.0		1.4																
0RY RE	5.0	SP	1.7	NP	NP	3	12	46	80	87	93	99	100						
SUMMARY OF LABORAT	Geo-Iest						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE							Project: Harley Pond Project Location: Rio Rancho, NM Number: 1-10302					

Sheet 2 of 4

											SIE PER	VE ANALYSIS CENT PASSING							
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"		
6	10.0		1.4																
6	15.0		1.5																
7	1.0		2.9																
7	3.0		1.4																
7	5.0	SP-SM	1.6	NP	NP	6	17	38	66	81	89	92	94	100					
7	10.0		1.4																
7	15.0		1.5																
8	1.0		3.1																
8	3.0		3.6																
8	5.0	SP-SM	2.6	NP	NP	9	34	65	88	94	98	98	100						
8	10.0		2.1																
8	15.0		1.6																
6 4/14/2	1.0		4.6																
6 60T	3.0	SM	4.0	NP	NP	15	54	92	99	100									
9	5.0		8.5																
9 9	10.0	SP-SM	3.2	NP	NP	9	43	88	97	98	99	99	100						
9	15.0		4.0																
10	1.0	SM	3.9	NP	NP	20	58	93	99	100									
[₩] /200	3.0		3.0																
SUMMARY OF LABORAT	Geo-lest						LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE							Project: Harley Pond Project Location: Rio Rancho, NM Number: 1-10302					

Sheet 3 of 4

SIEVE ANALYSIS PERCENT PASSING UNIFIED LL ΡI 1" 4" (%) MOIST 3/8" 1/2" 3/4" 1 1/2" 2" TEST DEPTH NO NO NO NO NO HOLE (FEET) CLASS 200 100 40 10 4 10 5.0 3.7 10 10.0 SM 5.1 NP NP 33 59 88 97 99 100 10 15.0 3.4 LL = LIQUID LIMIT Project: Harley Pond Project **DEO-IEST** PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE Location: Rio Rancho, NM Number: 1-10302

1-10302.GPJ GEO TEST.GDT 4/14/21

SUMMARY OF LABORATORY RESULTS

Sheet 4 of 4





GEO T GPJ 1-10302 **GRAIN SIZE**










	Project:	Harley Pone						
	Job #:	1-10302						
Boring/	Location:	Composite						
Samp	le Depth:	0 - 15 feet						
Soil De	scription:	Silty Sand (
Rem	olded to:	Approx. 959						
			055.4	I			400	
Aparatus Weight Empty:			255.1	grams	Weight of S	ample:	422	grams
Aparartus Weight + Soil:		6/7.1	grams	weight of S	ample:	0.930335	2	
	Mole	d Diameter:	6.395	cm	Mole	d Area:	32.11966	cm
Pipe Diameter:			1.27	cm	Pipe	e Area:	1.266769	cm ²
Length of Sample			6.84	cm	Area	Factor:	0.039439	2
Pressure Head	Applied 1psi	= 70.34 cm:	0	cm	Volume of S	ample:	219.6985	cm³
		Can #:			Volume of S	ample:	0.007759	ft ³
	V	Vet Weight:	238.7	grams	Unit V	Veight:	119.9	lb/ft ³
	I	Dry Weight:	216.8	grams	Moisture Co	ontent:	10.1	%
					Dry Unit V	Veight:	108.9	lb/ft ³
Time		Trial 1		Trial 2	Tria	3		
Hour		0		0		0		
Minute		3		3		3		
Second		10		15		19		
Total (hr)		0.052778		0.054167	0.0)55278		
h _o		65	cm	65 cm		65	cm	
h ₁		10	cm	10 cm		10	cm	
1		= -						
$Head_0$		71.84	cm	71.84 cm		71.84	cm	
Head ₁		16.84	cm	16.84 cm		16.84	cm	
Ks (cm/hour)		7.41	cm/hr	7.22 cm,	/hr	7.08	cm/hr	
Ks (cm/sec)		2.06E-03	cm/s	2.01E-03 cm,	/s 1.	97E-03	cm/s	
Г	<u>د</u>	turated Uvd	raulic Cond		7 24 cm	/hr		
	56	питатей пуй	aune cono	uclivity, K _{s:}	7.24 UII	,		

Saturated Hydraulic Conductivity, K_s: **2.01E-03 cm/s**



Project: Job #: Boring/Location: Sample Depth: Soil Description: Romolded to:	Harley Pone 1-10302 Composite 0 - 15 feet Poorly Grad	d Project of Poorly G ded Sand (S	raded Sand - Eml P)	oankment Area	
Remolaed to:	Approx. 95	% of Maxim	ium Density		
Aparatus W Aparartus V	248.6	grams grams	Weight of Sample: Weight of Sample:	439.9 grams 0.969797 lb	
Mo	6.322	cm	Mold Area:	31.39055 cm ²	
Pi	1.27	cm	Pipe Area:	1.266769 cm^2	
Leng	6.87	cm	Area Factor:	0.040355	
Pressure Head Applied 1ps	i = 70.34 cm:	0	cm	Volume of Sample:	215.653 cm ³
			Volume of Sample:	0.007616 ft ³	
	Wet Weight:	247.5	grams	Unit Weight:	127.3 lb/ft ³
	Dry Weight:	228.8	grams	Moisture Content:	8.2 %
				Dry Unit Weight:	117.7 lb/ft ³
Time Hour Minute Second Total (hr)	Trial 1 0 1 7 0.018611		Trial 2 0 1 9 0.019167	Trial 3 0 1 9 0.019167	
h	65	cm	65 cm	65	cm
h ₁	10	cm	10 cm	10	cm
Head ₀	71.87	cm	71.87 cm	71.87	cm
Head ₁	16.87	cm	16.87 cm	16.87	cm
Ks (cm/hour)	21.59	cm/hr	20.96 cm/ł	nr 20.96	cm/hr
Ks (cm/sec)	6.00E-03	cm/s	5.82E-03 cm/s	5.82E-03	cm/s
5	Saturated Hyd	Iraulic Cond	luctivity, K _{s:}	21.17 cm/hr	

Saturated Hydraulic Conductivity, K_s: **5.88E-03 cm/s**