2024
CITY OF PHOENIX SUPPLEMENTS TO THE

2023 EDITION
MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

City of Phoenix

(Updated March 2, 2026)

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2024 CITY OF PHOENIX SUPPLEMENTS
TO THE
2023 EDITION MARICOPA ASSOCIATION OF GOVERNMENTS
UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

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2026 Changes to the 2024 Supplements

New Specification Sections Supplemented:

No new Specifications

Existing Supplemented Sections with major updates:

No Specifications with major updates

Existing Supplemented Sections with minor changes:

FOREWARD – Updated FOREWARD

TABLE OF CONTENTS – Revised Section 342 title to match MAG Specifications section title.

Section 106 CONTROL OF MATERIALS – Updated link to the City of Phoenix Materials Lab website.

Section 301 SUBGRADE PREPARATION – Updated the Supplements for RELATIVE COMPACTION.

Section 321 PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT – Updated Table 321-3A & 321-3B. Clarified intent for coring only to identify removal and replacement limits.

Section 326 PLACEMENT AND CONSTRUCTION OF POLYMER MODIFIED ASPHALT CONCRETE – Updated Table 326-5. Clarified intent for coring only to identify removal and replacement limits.

Section 342 INTERLOCKING CONCRETE PAVER INSTALLATIONS – Revised title to match MAG Specifications section title.

Section 345 ADJUSTING FRAMES, COVERS AND VALVE BOXES – Updated Supplement GENERAL section.

Section 702 BASE MATERIALS – Added **702.2.2 Acceptance** to Supplement.

Section 710 ASPHALT CONCRETE – Updated Supplement **Subsection 710.3.1**. Updated Table 710-3 & 710-5.

Section 719 POLYMER MODIFIED ASPHALT CONCRETE – Updated Supplement **Subsection 719.3.1**.

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City of Phoenix

(Updated March 2, 2026)

2024 CITY OF PHOENIX SUPPLEMENTS TO THE 2023 MAG
UNIFORM STANDARD, SPECIFICATIONS AND DETAILS FOR PUBLIC WORKS CONSTRUCTION

This **2024 updated edition** of the City of Phoenix Supplements to the 2023 Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction is effective March 2026. The **2024 updated edition** supersede all previous editions, but includes all revisions contained within the original **2024 edition** (effective January 2025) except as modified with this document.

All public works construction contracts advertised and all permits issued on or after March 2, 2026 shall be governed by the **2024 updated edition**.

A copy of the **2024 update edition** is available for review and download on the City of Phoenix Website at the following address:

https://www.phoenix.gov/administration/departments/city-engineer.html

For more information, or a copy of this publication in an alternate format, contact Street Transportation Department at 602-262-6284 (Voice) and 7-1-1 (FRIENDLY) (TTY).

FOREWARD

Forward: Delete the FORWARD in its entirety and replace with the following:

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) provides an integrated document that utilizes a specific city-adopted edition of the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction, and the corresponding adopted edition of the City of Phoenix Supplement, to provide a clear compilation of the information within a single document. In the interest of maintaining consistency of established procedures, standards, specifications, and other documents used, the city has elected to periodically adopt a complete, specific edition of the Specifications. In the interest of promoting countywide standardization to the greatest extent possible, the city has established a standing Specifications Committee to periodically develop each edition of the Specifications utilizing that year's Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction and Standard Details as its basis. The Delegates to the Committee represent interested city departments, the consulting engineering community, the engineering contracting community, the home building community and the Design Advisory Board.

A complete, integrated Specifications, in continual review, with periodically issued editions, will enhance this document's usability by engineers, architects, contractors, inspectors and others. The integrated format will reduce misinterpretations and conflicting language and provide improved clarity of the construction documents.

These Specifications are developed for public works construction within the City of Phoenix and include construction of improvements that will be owned and/or maintained by the City of Phoenix. These improvements may be located on city-owned property, public right-of-way, public right-of-way easements or any other type of easement dedicated to the City of Phoenix. These Specifications are not intended to supersede the City of Phoenix Construction Code or any other applicable law or ordinance.

The Specifications should be thoroughly reviewed by the professional engineers and architects in responsible charge prior to incorporating them into project plans and specifications. The Specifications are not a substitute for good engineering judgment. Unique conditions will arise that are outside of the scope of this document. Professional engineers and architects are required to use their judgment to develop special provisions to properly adjust the Specifications to best meet site-specific needs. Professional engineers and architects are required to provide professional services in accordance with the statutes of the State of Arizona and the rules of the Arizona State Board of Technical Registration. Not all specifications contained herein will apply to all projects.

The City of Phoenix Standard Specifications and Details for Public Works Construction (Specifications) are revised periodically to allow for current trends in the construction industry and to promote countywide standardization to the greatest extent possible. For more information on the standing Specifications Committee, or the process for submitting a *Request for Change of the Specifications*, please contact:

City of Phoenix
Office of the City Engineer
200 West Washington Street, 6th Floor
Phoenix, Arizona, 85003
602-262-6284

A copy of the currently adopted City of Phoenix Standard Specifications and Details for Public Works Construction is available for review and download on the City of Phoenix Website at the following address:

https://www.phoenix.gov/administration/departments/city-engineer.html

Eric J. Froberg, P.E.
City Engineer

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PART 100
GENERAL CONDITIONS

SECTION 101
ABBREVIATIONS AND DEFINITIONS

Subsection 101.1 ABBREVIATIONS: Add the following to this subsection:

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Subsection 101.2 DEFINITIONS AND TERMS: Delete the definition for "Haunching" in its entirety and replace with the following:

The material placed in a trench from the bottom of the pipe or conduit to the springline of the pipe or conduit.

Subsection 101.2 DEFINITIONS AND TERMS: Delete the definition for "Initial Backfill" in its entirety and replace with the following:

The material placed in a trench above the springline of the pipe or conduit and the bottom of the Final Backfill. The height above the crown of the pipe or conduit is dependent on the pipe material and the type of facility.

SECTION 102
BIDDING REQUIREMENTS AND CONDITIONS

Subsection 102.10 WITHDRAWAL OR REVISION OF PROPOSAL: Add the following paragraph to the end of this Subsection:

Pursuant to the provisions of Section 2-188 of the City Code, the low bidder may file a request to withdraw his or her bid with the city clerk.

SECTION 106
CONTROL OF MATERIALS

Subsection 106.1 SOURCE MATERIALS AND QUALITY: Add the following after the first paragraph:

The City of Phoenix Materials Lab shall review all construction material utilized within the City of Phoenix Right-of-Way (ROW). The City of Phoenix Materials Lab shall review submittals for all construction material identified on the Acceptance Sampling and Testing Requirements, located on the Materials Lab website. All other project related submittals shall be reviewed by the City of Phoenix Project Manager or authorized representative.

All material on the City of Phoenix Materials Lab Approved Supplier's Lists (Aggregate Base Course, Cementitious, and Asphaltic Concrete Materials) shall be electronically submitted using the Approved Materials Submittal (AMS) Form. The AMS Form includes direction for filling out the form and do not require submission of mix designs, test data, or additional material information.

All current City of Phoenix Approved Suppliers Lists, AMS Form, and Acceptance Sampling and Testing Requirements are located on the City of Phoenix Materials Lab website at:

https://www.phoenix.gov/streetssite/Pages/COP-MaterialsLab.aspx

Subsection 106.2 SAMPLES AND TESTS OF MATERIALS: Delete the third paragraph in its entirety and replace with the following:

The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with the following: The City of Phoenix Exhibit A - Acceptance Sampling/Testing Requirements, located on the City of Phoenix Materials Lab website at: https://www.phoenix.gov/streetssite/Pages/COP-MaterialsLab.aspx and the standard test methods of Arizona, AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

Subsection 106.5 STORAGE OF MATERIALS: Add the following paragraph to the end of this Subsection:

No placement or storage of construction materials or storage bins, trash bins or trash receptacles is permitted on final surface pavement of arterial and collector streets.

Subsection 106.7 UNACCEPTABLE MATERIALS: Add the following paragraphs to the end of this Subsection:

Materials containing asbestos and/or lead in any form are unacceptable to incorporate into the project unless formally accepted in writing by the City of Phoenix. This written approval shall take place prior to the material being incorporated into the project and/or brought to the site.

Repair kits or touch-up materials or materials that include asbestos and/or lead introduced into the product at the factory or applied at the assembly plant are all unacceptable. Any and all field-applied products that are comprised of asbestos and/or lead containing materials are also unacceptable.

If asbestos and/or lead are installed without written approval by the City of Phoenix, the Contractor will remove these materials at his expense and dispose of these materials in accordance with all state and federal laws and pay for the supervision and reporting costs in addition to the cost to properly remove them.

SECTION 107
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

Subsection 107.5 SAFETY, HEALTH AND SANITATION PROVISIONS: Add the following Subsection:

107.5.3 Hoist Certification: Prior to the final acceptance (MAG Section 105), the Contractor shall schedule a hoist, crane acceptance inspection through the Engineer. This inspection and load test will be performed by an agency approved by the Engineer. This inspection and acceptance will not relieve the Contractor from his contractual responsibility nor from his warranty for this installation.

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.1 Contractor's Marshalling Yard in its entirety.

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.1.1 Contractor's Marshaling Yard when the Agency is the Contracting Party in its entirety.

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Add the following Subsection to this Subsection:

107.6.1 Contractor's Marshaling Yard: Contractors shall obtain approval of the city engineer when using vacant property to park and service equipment and store material for use on city construction contracts. The following standards shall be applied before use of the vacant property:

(A) The Contractor shall notify adjacent property owners/residents of this proposed use.

(B) Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing of material will require the Contractor to obtain written approval from the property owner. This approval shall contain any requirements which are a condition of this approval.

(C) A copy of the property owner's approval shall be submitted along with the Contractor's request to the city engineer for approval for the use of the marshaling yard in connection with the project. An appropriate distance from adjacent property will be set by the city engineer based on the size and type of equipment to be used on the project.

(D) The yard shall be fenced and adequately dust-proofed in a manner such as to preclude tracking of mud onto paved city streets.

(E) Work in the yard shall be scheduled so as to comply with the City Noise Ordinance.

(F) Equipment, materials, etc., shall be located so as to minimize impact on adjacent properties. A sound barrier may be required if deemed necessary by the city engineer.

(G) The Contractor shall clean up property promptly upon completion of use.

Subsection 107.6.1.2 Contractor's Marshaling Yard when the Agency is not the Contracting Party (Private Development, Utility Work, Subdivision Construction, Etc.): Delete the Subsection number and replace with the following:

107.6.2

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Delete Subsection 107.6.2 in its entirety.

Subsection 107.6 PUBLIC CONVENIENCE AND SAFETY: Add the following Subsection to this Subsection:

107.6.3 City Code Section 23-14 (h): The Contractor shall comply with the City Code concerning work hours and noise level during construction.

SECTION 110
NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

Subsection 110.3.3 Process: Delete Subsection (B) Dispute Review Board/Arbitration in its entirety and replace with the following:

(B) Dispute Review Board: The decision of the Level III Representative in relation to the claim shall be final. The Contractor reserves the right to initiate litigation pursuant to Section 12-821 et. seg. of the Arizona Revised Statues, or if mutually agreed upon, the parties may choose to resolve the controversy utilizing the Dispute Review Board as prescribed in Subsection 110.4.

Subsection 110.3.4 Amount of Dispute: Delete Subsection in its entirety.

Subsection 110.4 ARBITRATION: Delete Subsection in its entirety.

SECTION 110 NOTIFICATION OF CHANGED CONDITIONSAND DISPUTE RESOLUTION: Add the following Subsection to this section:

110.4 DISPUTE REVIEW BOARD

If the Dispute Review Board is utilized as prescribed in Subsection 110.3.3(B), the Engineer shall be notified within 30 days after the Level III Representative decision. The Dispute Review Board is a three-member board independent of the parties involved in the issue. The agency and Contractor shall each select a member for this board. The third member shall be mutually agreed upon independent member. This Review Board must be selected within 14 calendar days after notice to the Level III Representative. Each member shall agree to impartially serve the agency and the Contractor. The Dispute Review Board shall meet within 30 days of the selection of the board, unless, by mutual agreement, another date is selected. The scope of the Dispute Review Board shall be restricted and limited to the matters originally presented to the Level III Representative for decision or determination and shall include no other matters. The Board shall consider and evaluate the dispute and render a written decision that assigns responsibilities and allocates adjustments in the Contract time, if applicable, within 7 calendar days after the meeting.

Subsection 110.5 DISPUTE REVIEW BOARD: Delete Subsection in its entirety.

Subsection 110.6 FINAL DOCUMENTATION AND PAYMENT: Delete the Subsection number and replace with the following:

110.5

PART 200
EARTHWORK

SECTION 206
STRUCTURE EXCAVATION AND BACKFILL

Subsection 206.1 DESCRIPTION: Delete the word "manholes" in the first sentence of the first paragraph.

Section 206.4.1 Preparation for Structure Backfill: Add the following to the end of the second the last sentence:

and within +/- 2% of optimum moisture.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete the word "concrete" from the first paragraph.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete Subparagraph (A) in its entirety and replace with the following:

(A) Shall conform to the material and the gradation requirements for Select Material, Type A, Type B, or Aggregate Base Course in Table 702-1 unless otherwise approved by the Engineer.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete Subparagraph (D) in its entirety and replace with the following:

(D) Shall be uniformly compacted to at least 95 percent of maximum density within +/- 2% of optimum moisture content.

Subsection 206.4.2 Structure Backfill for Earth Retaining Structures: Delete last paragraph in its entirety.

Subsection 206.4.3 Structure Backfill for Structures Other Than Earth Retaining: Replace Subparagraph (B) in its entirety and replace with the following:

(B) Shall be uniformly compacted to at least 95 percent of maximum density within +/- 2% of optimum moisture content.

Subsection 206.4.4 Structure Backfill for Structures within Paved Areas: **Delete this Subsection in its entirety and replace with the following:**

Where a structure is located within an existing street, proposed street or paved area:

(A) Backfill within 2 feet of the surface shall be compacted to the minimum density specified in Section 601 for Type I compaction or shall be filled with controlled low strength material as specified in Sections 604 and 728.

(B) All other structure backfill shall be compacted to the minimum density specified in Section 601 for Type III compaction or shall be filled with controlled low-strength material as specified in Sections 604 and 728.

Subsection 206.4.3 Structure Backfill for Precast Minor Structures: Replace third sentence of first paragraph and replace with the following:

The Structure Backfill shall be within +/- 2% of optimum moisture content, as approved by the Engineer.

SECTION 211
FILL CONSTRUCTION

Subsection 211.3 COMPACTING: Replace first five paragraphs in their entirety and replace with the following:

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.

Where fills are to be constructed across low, swampy ground that will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable materials in a uniformly distributed layer of 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.

Unless specified herein, or in the special provisions, the construction of dikes; the placing and compacting of approved material within the right-of-way where unsuitable material has been removed; and the filling of holes, pits and other depressions within the right-of-way shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of 6 inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95% and within +/- 2% of optimum moisture content.

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. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than 90%, except that where a new or widened roadway and appurtenances are required, density of the upper 2 feet and when the fill is within 2 feet of the above shall be not less than 95% and within +/- 2% of optimum moisture content.

SECTION 215
EARTHWORK FOR OPEN CHANNELS

Subsection 215.3 EXCAVATION: Delete subsection in its entirety and replace with the following:

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation are firm and unyielding, are such as will stand or can be made to stand without sloughing, and are at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or sub-drainage material, shall be to the lines indicated on the plans, and excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90% and within +/- 2% of optimum moisture content or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over-excavation or material used for such backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer:

(A) When the void is below the subgrade for reinforced concrete channel, it shall be filled with suitable material, as approved by the Engineer, and compacted to a uniform density of not less than 95% and within +/- 2% of optimum moisture content. With the approval of the Engineer, concrete of the same mix as used in the concrete channel, may be used.

(B) When the void is in the side of the excavation, it shall be filled with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the contracting agency. The cost of such work shall be included in the prices bid for the various items of work.

If material is encountered during the progress of excavation, which in the opinion of the Engineer, is unsuitable for subgrade for the channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the pay lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load of the proposed channel and not upon the capacity to withstand the loads that may be placed upon it by the Contractor's equipment. Should the Contractor be directed to excavate beyond the pay lines shown on the plans, said pay lines will be extended to include such ordered excavation; and the pay lines for sub-drainage material, if used, will be adjusted accordingly.

Materials used or work performed by the Contractor to stabilize the subgrade so it will withstand loads that may be placed upon it by his equipment shall be accomplished by the Contractor at no additional cost to the contracting agency.

Subsection 215.4 FILL AND BACKFILL: Replace second paragraph in its entirely and replace with the following:

Unless otherwise specified in the special provisions, the density of fills and backfills shall be at least 90% and within +/- 2% of optimum moisture content.

PART 300
STREETS AND RELATED WORK

SECTION 301
SUBGRADE PREPARATION

Subsection 301.2 PREPARATION OF SUBGRADE: Add the following paragraphs after the second paragraph:

The Contractor's grading operations will proceed in an orderly sequence and shall be followed directly with the placement of base course. At no time shall the Contractor's total grading operations precede the placement of base course by more than 1200 feet without specific written approval of the Engineer. At the end of each day's operation, the first lift of base course shall have been placed to within a maximum distance of 300 feet behind the finished subgrade area. Drop-offs on opposite sides of the pavement at the same time will not be allowed.

Existing pavement under proposed median islands shall be removed. Payment for this work shall be considered incidental to the project.

When excavating for concrete work, such as curb and gutter and sidewalk, the Contractor shall place the excavated material in uniform windrows. The windrows shall not interfere with property access or traffic flow on the streets.

Subsection 301.3 RELATIVE COMPACTION: Delete the fourth sentence in the first paragraph and replace with the following:

The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having the following minimum compaction, measured as a percentage of maximum dry density when tested in accordance with AASHTO T-99 and T191 or ASTM D6938, with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, ARIZ-227c[1], to compensate for the rock content larger than that which will pass a ¾-inch sieve or a No. 4 sieve.

Subsection 301.3 RELATIVE COMPACTION: Delete Subparagraphs (A) and (B) in their entirety and add the following Subparagraphs to the end of this Subsection:

(A) Street Pavement Section	
(1) Top 6" Subgrade (under ABC)	100% for Arterial Streets/Major Streets
(2) Top 6" Subgrade (under ABC)	95% for Collector/Local Streets
(3) Top 6" Subgrade (under Asphalt / Concrete)	100%
(B) Sidewalks not subject to vehicular traffic	95%
(1) Refer to Subsection 340.3.1 for marginally expansive or expansive soils.	90%
(C) Curbs, Gutters, Curb Ramps, Driveways, Driveway Entrances, Sidewalks subject to vehicular traffic	95%

SECTION 310
PLACEMENT AND CONSTRUCTION OF AGGREGATE BASE COURSE

Subsection 310.3 COMPACTION: Delete the first sentence of the fourth paragraph in its entirety and replace with the following:

A rock correction, to compensate for rock content larger than the #4 sieve, shall be performed in accordance with Arizona Test Method 227.

Subsection 310.3 COMPACTION: Delete the sixth paragraph in its entirety and replace with the following:

Unless otherwise noted in the project plans or project specifications, the moisture content of the aggregate base course at the time of compaction shall be the optimum moisture content +/- 2%.

Subsection 310.3 COMPACTION: Delete Subparagraph (C) in its entirety and replace with the following:

(C) All other areas not subject to vehicular traffic 95%

Subsection 310.4 THICKNESS AND/OR PLASTICITY DEFICIENCY: Delete Type IV in Table 310-1 in its entirety and replace with the following:

IV	A plasticity index of 6 to 7 inclusive or gradation deficiency	(1) The Contractor may choose to reprocess or treat the existing material to bring it within specification limits or remove deficient material from affected area and replace with material complying with the specifications. (2) If grades allow, the Contractor may increase the thickness of asphalt concrete by ½ inch minimum at no additional cost to the Owner. The thickness must be approved by the Engineer prior to the placement of asphalt concrete.

SECTION 312
CEMENT TREATED BASE

Subsection 312.5 INVERTED SECTION: Delete this Subsection in its entirety and replace with the following:

Where the cement-treated base is to be covered with an aggregate base material, the minimum thickness of the aggregate base shall be 5 inches, unless otherwise specified in the special provision. In order to provide for free internal drainage of the aggregate base course overlaying the cement-treated material, it shall be ABC (reference Section 725). The cement treatment shall be held back approximately 1 foot from each curb line.

Subsection 312.6 CURING: Delete the first two paragraphs in their entirely.

Subsection 312.6 CURING: Delete the first sentence in the third paragraph entirely and replace with the following:

Keep the surface of the compacted cement-treated base course continuously moist until overlaid with the aggregate base course.

SECTION 321
PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

Subsection 321.3 WEATHER AND MOISTURE CONDITIONS: Delete this Subsection in its entirety and replace with the following:

Asphalt concrete shall be placed only when the surface is dry. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub-base on which the material is to be placed is unstable. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.

For any pavement courses the atmospheric temperature shall be a minimum of 50ºF and rising.

Subsection 321.5 MIX DESIGN: Delete the first three sentences of the first paragraph in their entirety and replace with the following:

Should a Contractor wish to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab at least fifteen (15) working days prior to the start of the asphalt placement. Included with the mix designs, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through bi-annual asphalt concrete supplier calibrations. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all the required information as outlined in Section 710.

Subsection 321.8.1 Placing: Add the following paragraphs after the third paragraph:

Ski-type device or string line as described in (A) or (B) above shall be used as directed by the Engineer.

In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-type device or string line as described in (C) above to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.

Subsection 321.10.1 Acceptance Criteria: **Delete this Subsection in its entirety and replace with the following:**

Asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 ton or fraction thereof. A City of Phoenix representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the asphalt concrete. The sampling frequency for hot asphalt concrete at the asphalt plant shall be 1 sample per 500 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix representative at the plant, asphalt concrete may be sampled at the same frequency taken from the project by a City of Phoenix designated representative or from the list of approved materials testing labs. The approved list is available through the City of Phoenix Materials Lab. The samples will be transported to the City of Phoenix Materials Lab or other designated laboratory for acceptance testing. All samples will be obtained according to the procedures of Arizona Test Method 104 or AASHTO T-168. Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 92.0% to 96.0% of the maximum theoretical density, determined in accordance with the requirements of AASHTO T-209.

For permit work, testing that does not strictly adhere to the sampling and testing methodology and requirements outlined in this section shall be disregarded and not considered in any acceptance determination. All required retesting shall be at the expense of the permittee.

Subsection 321.10.2 Gradation, Binder Content and Air Voids: Delete this Subsection in its entirety, including Tables 321-3A, 321-3B, 321-4 and 321-5, and replace with the following:

321.10.2 Gradation and Binder Content: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Arizona Test Methods 104 or AASHTO T-168 from each sublot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. Reports that do not include the correction factor, performed as stated in the previous sentences, shall be considered invalid and not allowed to be used for acceptance. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209. Effective voids of the laboratory compacted specimens will be determined for each sublot in accordance with the requirements of AASHTO T-269. Acceptance testing results will be furnished to those who request test results within 5 working days of receipt of samples by the acceptance laboratory.

During production, deviation from the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

TABLE 321-3A		
GRADATION ACCEPTANCE LIMITS FOR MARSHALL MIXES		
Sieve Size	D 1/2-inch Mix	C 3/4-inch Mix
3/4 inch	---	±7%
1/2 inch	±7%	---
3/8 inch	±6%	±6%
No. 8	±6%	±6%
No. 40	±4%	±4%
No. 200	±2%	±2%

TABLE 321-3B		
GRADATION ACCEPTANCE LIMITS FOR GYRATORY MIXES		
Sieve Size	1/2-inch Mix	3/4-inch Mix
3/4 inch	---	±7%
1/2 inch	±7%	±6%
3/8 inch	±6%	---
No. 8	±6%	±6%
No. 40	±4%	±4%
No. 200	±2%	±2%

If the results from a single acceptance sample fall outside of the acceptance limits in Table 321-3A or 321-3B as applicable, a second sample shall be taken, and if the second acceptance sample is also outside of the acceptance limits, the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table 321-3A or 321-3B as applicable.

If the asphalt binder content is within ± 0.40% of the mix design target value, the asphalt concrete will be paid for at the Contract unit price. If the asphalt binder content deviates by more than ± 0.40% from the mix design target value, the deficient area will be evaluated by coring at least two (2) 6-inch cores at one additional location at a maximum interval of 100 feet of each side within the deficient sublot. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the two additional core locations to determine compliance with the acceptance requirements.

If the resulting average of the asphalt binder content deviates by more than ± 0.40% from the mix design target value, then Table 321-4 shall apply to the sublot.

TABLE 321-4		
ASPHALT BINDER CONTENT PAYMENT REDUCTION (AC)		
Deviation from that permitted (Acceptance to the tenth of a percent)	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner (Permit Work): Corrective Action *See note Below**
Over/Under 0.0% to 0.1%	10%	Extended Warranty for two years with posted bond for the value of the taper mill and overlay
Over/Under 0.1% to 0.2%	25%	Extended Warranty for five years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift

*Additional permit and fee required for extended warranty.
** The Contractor shall remove and replace the entire sublot that is deficient.

If the laboratory air voids fall within a range of 2.8% to 6.2%, the asphalt concrete will be paid for at the Contract unit price. If the laboratory air voids are outside of this range, the deficient area will be evaluated within the sublot by coring at least two (2) 6-inch cores at one additional location at a maximum interval of 100 feet on each side of the deficient sample location, within the deficient sublot. The laboratory air voids of the original deficient sample will be averaged with the laboratory air voids obtained from each of the two additional cores to determine compliance with the acceptance requirements. If the resulting average of the laboratory air voids is outside the indicated range, then Table 321-5 shall apply to the entire sublot.

If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section 321.10, specifically Table 321-3A or 321-3B, as applicable, and Table 321-4 and 321-5, when determining the acceptance of the asphalt concrete with the material supplier.

TABLE 321-5		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	**When the Contracting Agency is the Owner: Payment Reduction**	**When Contracting Agency is Not Owner (Permit Work): Corrective Action** *See note Below
Less than 1.5%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift
1.5% to 2.0%	25%	Extended Warranty for 5 years with posted bond for the value of the taper mill and overlay
2.1% to 2.7%	10%	Extended Warranty for 2 years with posted bond for the value of the taper mill and overlay
2.8% to 6.2%	Full Payment	No Corrective Action
6.3% to 6.9%	10%	Extended Warranty for 2 years with posted bond for the value of the taper mill and overlay
7.0% to 8.0%	25%	Extended Warranty for 2 years with posted bond for the value of the taper mill and overlay
Greater than 8.0%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift

*Additional permit and fee required for extended warranty.
**The Contractor shall remove and replace the entire sublot that is deficient.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the first paragraph in its entirety and replace with the following:

Asphalt pavement thickness will be determined by methods based on sound inspection practices. Coring may be required at the request of the Engineer if the thickness is suspected to deviate from the specified thickness. Four-inch cores will be obtained for verification of lift thickness. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found in Section 321.14. Each core location will be patched by the party responsible for the coring.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete Subparagraph (1) in its entirety and replace with the following:

If the pavement thickness deviates from the target thickness by more than 0.25 inch but not more than 0.50 inch, Table 321-6 will apply and corrective action will be required. This corrective action shall consist of application of a Type II Slurry Seal or Micro-Surfacing coat in accordance with Section 715 or 714, as applicable.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the last three sentences of Subparagraph (2) in their entirety and replace with the following:

The indicated overlay shall be constructed by the Contractor at no additional cost to the Owner.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete the fourth paragraph in its entirety and replace with the following:

If the pavement thickness deficiency is greater than 0.25 inch, but less than 0.50 inch, Table 321-6 will apply.

Subsection 321.10.4 Asphalt Pavement Thickness: Delete Table 321-6 in its entirety and replace with the following Table 321-6:

TABLE 321-6

ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION
For Thickness Deficiency of More Than 0.25 inches and Less Than 0.50 inches

Specified Pavement Thickness	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner: (Permit Work)** *See Note Below
2.00 inches to 2.49 inches	50%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
2.50 inches to 2.99 inches	33%	Extended Warranty for three (3) years with posted bond for the value of the taper mill and overlay
3.00 inches and greater	25%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay

*Additional permit and fee required for extended warranty.

Subsection 321.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness: Delete this Subsection in its entirety, including Table 321-8, and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is between 92.0% and 96.0% of the maximum theoretical density, determined in accordance with the requirements of AASHTO T-209.

Density on the grade shall be determined by the nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A 4-inch core will be obtained at a minimum of four locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. Adjustments will subsequently be made to the nuclear gauge according to the manufacturer's procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. This correlation shall be utilized for the duration of paving if the same gauge is utilized throughout the paving schedule. If a different gauge or mix design is utilized, additional correlation testing shall be performed. Care shall be taken to ensure the same gauge is utilized throughout the paving schedule to ensure continuity throughout the paving process to reduce the amount of correlation cores taken from the roadway.

If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores shall be taken from 50 feet on either side of the deficient core location. An average of the three values shall be used to determine the amount of the deficiency, if any. Additional testing for density will be performed as necessary to determine the extent of the deficiency. Table 321-8 shall be used in determination of the payment reduction for the total deficient area(s).

The Contractor will provide the traffic control to facilitate any coring operations necessary for compaction acceptance. Cores will be taken per the Asphalt Concrete Coring Method. This method can be found in Section 321.14. Acceptance testing results will be furnished to the Contractor within 5 working days of receipt of samples by the acceptance laboratory.

TABLE 321-8

PAVEMENT DENSITY PAYMENT REDUCTION

Deviation from Specified Compaction Density (92.0% to 96.0%)	**When Contracting Agency Owner:** **Reduction in Payment**	**When Contracting Agency Not Owner (Permitted Work):** *See note below
91.0% to 91.9% or 96.1% to 96.3%	15%	Extended warranty for two (2) years with posted bond for the value of the taper mill and overlay
90.5% to 90.9% or 96.4% to 96.5%	20%	Extended warranty for three (3) years with posted bond for the value of the taper mill and overlay
90.0% to 90.4% or 96.6% to 96.9%	25%	Extended warranty for five (5) years with posted bond for the value of the taper mill and overlay
Below 90.0% or above 97.0%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant Lift

*Additional permit and fee required for extended warranty.
**The Contractor shall remove and replace the entire sublot that is deficient.

Subsection 321.10.6 Engineering Analysis (EA): Delete this Subsection in its entirety, including Table 321-9:

Subsection 321.11 REFEREE: Delete the first paragraph in its entirety and replace with the following:

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, laboratory air voids, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Contractor will select an independent and accredited materials lab from the City of Phoenix Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

Subsection 321.11 REFEREE: Delete the first sentence of the second paragraph and replace with the following:

These tests may include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, maximum theoretical unit weight and laboratory air voids.

SECTION 324
PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

Subsection 324.3.3 Subgrade and Base Preparation: Delete first sentence of first paragraph and replace with the following:

Subgrade and base shall conform to the applicable compaction requirements and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and deleterious material when concrete is placed.

SECTION 325
PLACEMENT AND CONSTRUCTION OF ASPHALT-RUBBER ASPHALT CONCRETE

Subsection 325.7.2 Surface Preparation: Add this paragraph after Subparagraph (D):

In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-type device or string line as described in (C) above to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.

Subsection 325.8 QUALITY CONTROL: Add the following paragraphs after the first paragraph:

During production of the ARAC, the Contractor shall sample and test the mineral aggregate cold feed sample prior to the start of the day's production. An asphalt content test using an ignition furnace and gradation shall be required once per each 500 tons of ARAC produced. A Marshall, maximum theoretical density and effective voids of the laboratory compacted specimens will be determined once per shift.

Viscosities will be performed on the asphalt-rubber blend, either at the asphalt production plant or rubber-blend plant, by plant quality control personnel for each blend prior to delivery or introduction to the final product. All viscosities shall be performed with a City of Phoenix Materials Lab representative present.

Subsection 325.9.1 Acceptance Criteria: Add the following paragraph after the first paragraph:

During production, deviation from the specified mix design will not be allowed without prior approval from the City of Phoenix Materials Lab or their representatives.

Subsection 325.9.2 Gradation and Binder Content: Delete the subsection in its entirety, including Table 325-1, and replace with the following:

Acceptance testing for gradation and binder content will be performed in the following ways as directed by the Engineer:

(A) Plant-based testing of the mineral aggregate using cold feed samples and

(B) End-product testing of the ARAC using an ignition furnace with the gradation being performed on the resulting aggregate. The specifics of these methods are detailed in the following subsections.

During production, the allowable deviations from the mix design gradation targets are listed in Table 325-1 below. The allowable production tolerances may fall outside of the mix design gradation bands.

TABLE 325-1

GRADATION ACCEPTANCE LIMITS FOR ASPHALT-RUBBER MIXES

Sieve Size	1-Inch & 1 ½-Inch Lift Thickness	2-Inch Lift Thickness
1 inch	100%	100%
3/4 inch	100%	92% to 100%
1/2 inch	92% to 100%	±6%
3/8 inch	±6%	±6%
No. 4	±6%	±6%
No. 8	±6%	±6%
No. 30	±4%	±4%
No. 200	±2%	±2%

Subsection 325.9.2.1.2 Binder Content: Delete this Subsection in its entirety and replace with the following:

Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each sublot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. Reports that do not include the correction factor performed as stated in the previous sentences shall be considered invalid and not allowed to be used for acceptance.

When there is cause to question the ARB content being obtained via ignition furnace, the ARB content may be determined using inventory data provided by the supplier as detailed in the following paragraphs. This will only apply for plants providing ARAC exclusively for the subject project, or if an asphalt cement tank is dedicated for the shift of ARAC production.

The determination of the actual ARB content by inventory methods shall include weighing of asphalt cement deliveries, invoice quantities, volumetric tank measurements using a calibrated rod (tank stickings) corrected for temperature, computerized mass-flow meter and accounting for wasted materials. If a computerized mass-flow meter is used, documentation of its calibration shall be submitted to the Engineer prior to ARAC production. At any time during ARAC production, the Engineer may require that a new calibration of the mass-flow meter be performed. Production shall cease if the inventory method is differing from the ignition furnace testing method by greater than 0.2%. Production may continue once the supplier demonstrates consistent results between the inventory and ignition furnace methods.

Subsection 325.9.2.2.1 Mineral Aggregate Gradation and Binder Content: Replace the first sentence of the first paragraph with the following:

The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Arizona Test Methods 104 or AASHTO T-168 from each sublot.

Subsection 325.9.2.2.1 Mineral Aggregate Gradation and Binder Content: Replace second sentence of last paragraph with the following:

If the asphalt binder content deviates by more than ± 0.60% from the mix design target value, the deficient area will be evaluated within the sublot by coring at least two (2) 6-inch cores at maximum intervals of 100 feet from the deficient sample.

Subsection 325.9.2.2.1 Mineral Aggregate Gradation and Binder Content: Replace Table 325-2 with the following:

TABLE 325-2		
ASPHALT RUBBER BINDER CONTENT PAYMENT REDUCTION (ARAC)		
Deviation from that permitted (Acceptance to the tenth of a percent)	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner (Permit Work):** *See note below
Over/Under 0.0 to 0.1%	10%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay
Over/Under 0.1 to 0.2%	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift

*Additional permit and fee required for extended warranty
**The Contractor shall remove and replace the entire sublot that is deficient.

Subsection 325.9 ACCEPTANCE: Delete Subsection 325.9.3 Marshall Air Voids in its entirety, including Table 325-3, and replace with the following:

For purposes of determining Marshall air voids, the acceptance laboratory will designate one sample of the ARAC in accordance with the requirements of Arizona Test Methods 104 or AASHTO T-168 for each day's production or as directed by the Engineer's. The minimum weight of the sample shall be 45 pounds. The bulk density shall be tested in accordance with AASHTO T-245. The maximum theoretical density shall be tested in accordance with the requirements of AASHTO T-209. Effective voids determined on the laboratory compacted specimens will be determined in accordance with the requirements of AASHTO T-269. Should the testing for effective air voids not meet the "Full Payment" or "No Corrective Action" requirements of Table 325-3, additional testing for laboratory air voids on additional samples will be performed as necessary to determine the extent of the deficiency.

TABLE 325-3		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Marshall Air Voids (Measured at 75 blows) Deviation from Mix Design Target	**When Contracting Agency is Owner: Payment Reduction (Percent dollar per total day's production)**	**When Contracting Agency is Not Owner** (Permit Work)**:** *See note below
± 0% to 2.0%	Full Payment	No corrective action
± 2.1% to 2.5%	10%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay
± 2.6% to 3.0%	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
± Greater than 3.0%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift

*Additional permit and fee required for extended warranty.
**The Contractor shall remove and replace the entire sublot that is deficient.

Subsection 325.9.5 Density: Add the following paragraphs after the first paragraph:

The temperature of ARAC just prior to compaction shall be at least 275° F. The Engineer may change the rolling procedure if in the Engineer's judgment the change is necessary to prevent picking up of the ARAC. Density on the grade shall be determined by the thin lift capable nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A 4-inch core will be obtained at a minimum of four locations tested by nuclear method. The obtained cores will be tested for density by the laboratory performing the density testing. If a different gauge or mix design is utilized, additional correlation testing shall be performed. Care shall be taken to ensure the same gauge is utilized throughout the paving schedule to ensure continuity throughout the paving process to reduce the amount of correlation cores taken from the roadway. Adjustments will subsequently be made to the nuclear gauge according to the manufacturer's procedures. Correlation of the nuclear gauge will be performed for each mix or gauge utilized during compaction testing. If the required density is not achieved, then cores shall be taken to determine the density and the limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be obtained and used to determine the amount of the deficiency, if any.

Subsection 325.9.5.2.1 Pavement Lift Thickness 1 1/2 Inches or Less: Delete this Subsection in its entirety and replace with the following:

Compaction shall consist of a "Rolling Method Procedure" using an established sequence of coverage with specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used, and the number of coverages required shall be as shown in Table 321-7.

TABLE 325-4				
ROLLING SEQUENCE FOR LIFT THICKNESS 1½ INCH OR LESS				
Rolling	**Type of Compactor**		**No. of Coverages**	
Sequence	**Option No. 1**	**Option No. 2**	**Option No. 1**	**Option No. 2**
Initial	Static Steel	Vibrating Steel	1	1
Finish	Static Steel	Static Steel	1–3	1–3

Note: Based on the roller pattern that exhibits the best performance.

The Contractor shall select the option for compaction and, when pneumatic-tired compactors are used, will designate the tire pressure. Steel wheel compactors shall not be used in the vibratory mode for courses of 1 inch or less in thickness. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved. As many passes as are possible shall be made with the compactors before the temperature of the ARAC falls below 220° F.

Compaction will be deemed acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated as specified, and with the number of coverages of the compactors as specified.

At the Engineer's discretion, cores may be taken and used to evaluate thickness.

Subsection 325.9.5.2.2 Pavement Lift Thickness Greater than 1 1/2 Inches: Delete this Subsection in its entirety and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements. Initial breakdown rollers shall follow as closely behind the paving machine as practical. The roller(s) for final compaction shall follow as closely behind the initial breakdown as practical, such that a uniformly smooth surface is achieved.

Compaction will be determined using a correlated thin lift capable nuclear density gauge and will be monitored for acceptability continuously during construction. The density of the compacted mixture shall be between 92.0% and 96.0% of the maximum theoretical density, determined in accordance with the requirements of AASHTO T-209.

The outside 1 foot of each pass of the pavement course or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

Nuclear Density Gauge Correlation—During placement of the test strip or on the first day of paving, the pavement surface shall be tested with a nuclear density gauge at a minimum of four locations. These same locations shall then be cored using a 4-inch-diameter core barrel and tested for bulk density (AASHTO T-166A, or T-275), and a correlation value will be developed between the nuclear density gauge and the asphalt cores. Correlation of the nuclear gauge will be performed for each mix and gauge utilized during compaction testing. This correlation shall be utilized for the duration of paving if the same gauge is utilized throughout the paving schedule. If a different gauge or mix design is utilized, additional correlation testing shall be performed. Care shall be taken to ensure the same

gauge is utilized throughout the paving schedule to ensure continuity throughout the paving process to reduce the amount of correlation cores taken from the roadway.

At the Engineer's discretion, cores may be taken and used to evaluate density and/or thickness.

TABLE 325-3		
PAVEMENT DENSITY PAYMENT REDUCTION		
Deviation Below Specification (92.0% to 96.0%)	**When Contracting Agency Owner: Reduction in Payment**	**When Contracting Agency Not Owner** (Permitted Work)**: *See note below**
91.0% to 91.9% or 96.1% to 96.3%	15%	Extended Warranty for 2 years with posted bond for the value of the taper mill and overlay
90.5% to 90.9% or 96.4% to 96.5%	20%	Extended Warranty for 3 years with posted bond for the value of the taper mill and overlay
90.0% to 90.4% or 96.6% to 96.9%	25%	Extended Warranty for 5 years with posted bond for the value of the taper mill and overlay
Below 90.0% or above 97.0%	**Removal and replacement of non-compliant lift	**Removal and replacement of non-compliant lift

*Additional permit and fee required for extended warranty.
**The Contractor shall remove and replace the entire sublot that is deficient.

Subsection 325.9 ACCEPTANCE: Delete Subsection 325.9.6 Engineering Analysis (EA) in its entirety, including Table 325-4.

Subsection 325.10 REFEREE: Delete the first paragraph in its entirety and replace with the following:

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, laboratory air voids, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Engineer will select an independent and accredited materials lab from the City of Phoenix Contract Lab and Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

SECTION 326
PLACEMENT AND CONSTRUCTION OF POLYMER MODIFIED ASPHALT CONCRETE

Subsection 326.5 MIX DESIGN: Delete the first paragraph and replace with the following:

Should the Contractor wish to utilize a project-specific mix design or a mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab fifteen (15) working days prior to the start of the asphalt placement. Included with the mix designs, the Contractor shall also submit the appropriate asphalt concrete samples for mix design verification and laboratory calibration samples as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through bi-annual asphalt concrete supplier verifications. Mix designs provided by the agency may be utilized on projects at the Engineer's discretion. The Engineer will review and approve the mix design to assure it contains all the required information as outlined in Section 719. The target values for gradations, binder contents, and air voids will be established as the accepted Job Mix Formula (JMF) based upon the mix design. Mix designs not containing all the information will be returned within 5 working days of receipt of all mix design information for action and resubmission by the Contractor.

Subsection 326.8.1 Placing: Add the following after the third paragraph, listed item (d):

In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-type device or string line as described above in (C) to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.

Subsection 326.9 QUALITY CONTROL: Add the following after the first paragraph:

During production of the polymer modified asphalt concrete, the Contractor shall sample and test a calibration mineral aggregate sample prior to the day's production. An asphalt content test using an ignition furnace and gradation shall be required once per each 500 tons of asphalt concrete produced. A Marshall, maximum theoretical density and effective voids of the laboratory-compacted specimens will be determined once per shift. Additional quality control testing may be required during production.

Subsection 326.10.1 Acceptance Criteria: Delete subsection in its entirety and replace with the following:

Polymer modified asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 500 tons or fraction thereof. A City of Phoenix representative will be present at the asphalt supplier plant during production and will facilitate the inspections and sampling of the asphalt concrete. The sampling frequency for hot asphalt concrete at the asphalt plant shall be 1 sample per 500 tons, with a minimum of 1 sample per day, sampled randomly. In lieu of a City of Phoenix representative at the plant, asphalt concrete may be sampled at the same frequency taken from the project by a City of Phoenix designated representative or from the list of approved materials testing labs. The approved list is available through the City of Phoenix Materials Lab. All samples shall be obtained according to the procedures of Arizona Test Method 104 or AASHTO T-168. Each obtained sample will be taken to the City of Phoenix Materials Lab or other designated laboratories for acceptance testing.

The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is not less than 92.0% to 96.0% of the maximum theoretical density, determined in accordance with the requirements of AASHTO T-209.

For permit work, testing that does not strictly adhere to the sampling and testing methodology and requirements outlined in this section shall be disregarded and not considered in any acceptance determination. All required retesting shall be at the expense of the permittee.

Subsection 326.10.2 Gradation, Binder Content, and Air Voids: Replace the first paragraph in its entirety with the following:

The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Arizona Test Methods 104 or AASHTO T-168 from each sublot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T-308 using the ignition furnace for each sublot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T-308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. Reports that do not include the correction factor, performed as stated in the previous sentences, shall be considered invalid and not allowed to be used for acceptance. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T-245. The bulk density for Gyratory mix designs shall be determined in accordance with AASHTO T-312. The maximum theoretical density shall be determined in accordance with the requirements of AASHTO T-209. Effective voids of the laboratory-compacted specimens will be determined for each sublot in accordance with the requirements of AASHTO T-269. Acceptance testing results will be furnished to the Contractor and the supplier within 5 working days of receipt of samples by the acceptance laboratory.

Subsection 326.10.2 Gradation, Binder Content, and Air Voids: Delete paragraph before Table 326-4 in its entirety and replace with the following:

If the asphalt binder content is within ± 0.50% of the mix design target value, the asphalt concrete will be paid for at the Contract unit price. If the asphalt binder content deviates by more than ± 0.50% from the mix design target value, the deficient area will be evaluated by coring at least two 6-inch cores at one additional location at a maximum interval of 100 feet on each side of the deficient sample. The asphalt content of the original deficient sample will be averaged with the asphalt binder content of the two additional core locations to determine compliance with the acceptance requirements. If the resulting average of the asphalt binder content deviates by more than ± 0.50% from the mix design target value, then Table 326-4 shall apply to the sublot.

Subsection 326.10.2 Gradation, Binder Content, and Air Voids: Delete Table 326-4 in its entirety and replace with the following:

TABLE 326-4

ASPHALT BINDER CONTENT ACCEPTANCE AND PENALTIES

Deviation from That Permitted (Acceptance to the tenth of a percent)	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner** (Permit Work)**: Payment Reduction** **See note Below
Over/Under 0.0% to 0.1%	10%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay
Over/Under 0.1% to 0.2%	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
Over/Under 0.2%	*Removal and replacement of non-compliant lift	*Removal and replacement of non-compliant lift

*The Contractor shall remove and replace the entire sublot that is deficient.
**Additional permit and fee required for extended warranty.

Subsection 326.10.2 Gradation, Binder Content, and Air Voids: Delete the paragraph before Table 326-5 in their entirety and replace with the following:

If the laboratory air voids fall within a range of -1.5% and +2% of the design target, the asphalt concrete will be paid for at the Contract unit price. If the laboratory air voids are outside of this range, the deficient area will be evaluated within the sublot by coring at least two (2) 6-inch cores at one additional location at a maximum interval of 100 feet on each side of the deficient sample location, within the deficient sublot. The laboratory air voids of the original

deficient sample will be averaged with the laboratory air voids obtained from each of the two additional cores to determine compliance with the acceptance requirements. If the resulting average of the laboratory air voids is outside the indicated range, then Table 326-5 shall apply to sublot.

Subsection 326.10.2 Gradation, Binder Content, and Air Voids: Delete Table 326-5 in its entirety and replace with the following:

TABLE 326-5		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Deviation from That Permitted (Acceptance to the tenth of a percent)	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner** (Permit Work)**: Payment Reduction** **See note Below
Greater than -2.7% from target	*Removal and replacement of non-compliant lift	*Removal and replacement of non-compliant lift
-2.7% to -2.1% from target	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
-2.0% to -1.6% from target	10%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay
-1.5% to +2% from target	Full Payment	Full Payment
+2.1% to +2.9% from target	10%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay
+3.0% to +4.0% from target	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
Greater than 4.0% from target	*Removal and replacement of non-compliant lift	*Removal and replacement of non-compliant lift

*The Contractor shall remove and replace the entire sublot that is deficient.
**Additional permit and fee required for extended warranty.

Subsection 326.10.4 Asphalt Pavement Thickness: Delete sentences (1) and (2) in its entirety and replace with the following:

(1) If the pavement thickness deviates from the target thickness by more than 0.25 inch but not more than 0.5 inch, Table 326-6 will apply and corrective action will be required. This corrective action shall consist of application of a Type II slurry seal Micro-Surfacing coat in accordance with Section 715 or 714, as applicable.

(2) If the pavement thickness deviates from the target thickness by more than 0.50 inch, corrective action will be required. The deficient area shall be overlaid with no less than a 1-inch-thick lift, for the full width of the pavement to meet or exceed the designed thickness, with appropriate end and edge milling, with a mixture approved by the Engineer. The indicated overlay shall be constructed by the Contractor at no additional cost to the Owner.

Subsection 326.10.4 Asphalt Pavement Thickness: Delete Table 326-6 in its entirety and replace with the following:

TABLE 326-6		
ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION For Thickness Deficiency of More Than 0.25 inches and Less Than 0.50 inches		
Total Specified Asphalt Pavement Thickness exclusive of ARAC (if any)	**When Contracting Agency is Owner: Payment Reduction**	**When Contracting Agency is Not Owner: (Permit Work)** *See Note Below
Less than 1.5 inches	50%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
1.50 to 1.99 inches	33%	Extended Warranty for four (4) years with posted bond for the value of the taper mill and overlay
2.00 to 2.49 inches	25%	Extended Warranty for three (3) years with posted bond for the value of the taper mill and overlay
2.50 to 2.99 inches	20%	Extended Warranty for three (3) years with posted bond for the value of the taper mill and overlay
3.00 inches and greater	17%	Extended Warranty for two (2) years with posted bond for the value of the taper mill and overlay

*Additional permit and fee required for extended warranty.

Subsection 326.10.5.2 Pavement Greater than 1-1/2 Inches in Nominal Thickness: Delete subsection in its entirety and replace with the following:

Achieving the required compaction is the responsibility of the Contractor. The number and types of rollers is the Contractor's responsibility and shall be sufficient to meet these requirements. The required density shall be obtained using a rolling pattern established by the Contractor and approved by the Engineer. Compaction efforts should continue until the specific gravity of the compacted mixture is between 92.0% and 96.0% of the maximum theoretical density, determined in accordance with the requirements of AASHTO T-209.

Density on the grade shall be determined by the thin lift capable nuclear gauge. This gauge must be recently correlated with actual densities of asphalt cores. This correlation will be accomplished on the first days of paving. A 4-inch core shall be obtained at a minimum of four locations tested by nuclear method. The obtained cores shall be tested for density by the laboratory performing the density testing. Adjustments shall be made to the nuclear gauge according to the manufacture's procedures. Correlation of the nuclear gauge shall be performed for each mix and gauge utilized during compaction testing. This correlation shall be utilized for the duration of paving if the same gauge is utilized throughout the paving schedule. If a different gauge or mix design is utilized, additional correlation testing shall be performed. Care shall be taken to ensure the same gauge is utilized throughout the paving schedule to ensure continuity throughout the paving process to reduce the amount of correlation cores taken from the roadway.

If the required density is not achieved, then cores shall be taken to determine the density and limits of the deficiency. One core in the deficient area and two additional cores 50 feet on either side of the deficient core location shall be taken. An average of the three values shall be used to determine the amount of the deficiency, if any. Additional testing for density will be performed as necessary to determine the extent of the deficiency. Table 321-8 shall be used in determination of the payment reduction for the total deficient area(s).

The Contractor shall provide the traffic control to facilitate any coring operations necessary for compaction acceptance. Cores will be taken per the Asphalt Concrete Coring Method. This method can be found in Section 321.14. Acceptance testing results will be furnished to the Contractor within 5 working days of receipt of samples by the acceptance laboratory.

TABLE 326-8		
PAVEMENT DENSITY PAYMENT REDUCTION		
Deviation from Specified Compaction Density (92.0%-96.0%)	**When Contracting Agency Owner: Reduction in Payment**	**When Contracting Agency Not Owner (Permitted Work):** **See note below
91.0% to 91.9% or 96.1% to 96.3%	15%	Extended warranty for two (2) years with posted bond for the value of the taper mill and overlay
90.5% to 90.9% or 96.4% to 96.5%	20%	Extended warranty for three (3) years with posted bond for the value of the taper mill and overlay
90.0% to 90.4% or 96.6% to 96.9%	25%	Extended Warranty for five (5) years with posted bond for the value of the taper mill and overlay
Below 90.0% or above 97.0%	*Removal and replacement of non-compliant Lift	*Removal and replacement of non-compliant lift

*The Contractor shall remove and replace the entire sublot that is deficient.
**Additional permit and fee required for extended warranty.

Subsection 326.10.6 Engineering Analysis (EA): Delete this Subsection in its entirety.

Subsection 326.11 REFEREE: Replace first paragraph with the following:

In the event the Contractor elects to question the acceptance test results for either asphalt binder content, thickness and density or a combination thereof for a deficient sample, the Contractor may make a written request for additional testing of that deficiency. The Contractor will select an independent and accredited materials lab from the City of Phoenix Approved Laboratory List (referee lab) to perform the additional testing. The Contractor will pay for the cost of all referee testing as a lump sum. Included with the set of samples, the appropriate calibration samples will also be submitted to the referee lab. Only one set of samples for referee testing will be considered for the deficient sample. The results of these determinations will be binding on both the Contractor and the agency.

Subsection 326.11 REFEREE: Replace the first sentence of the third paragraph with the following:

These tests may include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, maximum theoretical unit weight and laboratory air voids.

SECTION 329
TACK COAT

Subsection 329.1 DESCRIPTION: Add the following sentence to the end of this Subsection:

Tack coat shall be Type SS-1h per Section 713.

SECTION 336
PAVEMENT MATCHING AND SURFACING REPLACEMENT

Subsection 336.2.3 Temporary Pavement Replacement: Delete this Subsection in its entirety and replace with the following:

Temporary pavement replacement as required in Section 601 may be made using cold mix asphalt concrete. The cold mix shall be MC-70 or MC-250 liquid asphalt (6.0% +/- 0.4%) combined with the aggregate gradation shown below. Paving asphalt AC 2.5 (5.5%) may be substituted for the liquid asphalt. AC 2.5 must be heated for mixing.

TABLE 336-1

SIEVE SIZE	% PASSING	TOLERANCE
3/4 inch	97 to 100	+/- 7%
1/2 inch	88	+/- 7%
3/8 inch	78	+/- 7%
#4	60	+/- 7%
#8	47	+/- 5%
#30	25	+/- 5%
#200	0.5	+/- 2%

Temporary pavement shall be used in lieu of immediate placement of single-course permanent replacement or the first course of two-course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

The cold mix shall be placed in 2-inch increments and compacted with a roller that has not less than 60 psi contact pressure. Each layer shall be compacted to 96% of the laboratory compacted density for like materials. On small areas where the use of the equipment specified above is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained. The surface of the temporary pavement shall be flush with the adjacent pavement.

Subsection 336.2.4.2 Adjustments: Delete the first and second paragraphs in their entirety and replace with the following:

The Contractor shall be responsible for adjusting to grade all new and existing manholes, valves, survey monuments, clean outs, etc., as directed by the Engineer. The Contractor shall remove all asphalt material and aggregate from this or prior work from all metal lids and covers encountered using a method approved by the Engineer. Debris will not be allowed to enter sanitary or storm drains. All loose material shall be removed from the excavation site and the interiors of structures prior to resetting the frames.

The Contractor shall coordinate with the various utility companies regarding the adjustment and inspection of their facilities. Each utility company's specifications shall be adhered to during the adjustment. The Contractor shall be responsible for meeting any additional requirements of the utility companies.

Manhole frames shall be adjusted according to the MAG Standard Detail 422, except that the concrete collar shall extend up to the finished grade. Water valve, survey monument, and sewer clean out frames shall be adjusted in accordance with the COP Standard Details P1270 and P1391.

Subsection 336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT: Delete the title of this Subsection in its entirety and replace with the following:

TYPES AND LOCATION OF BACKFILL AND SURFACING REPLACEMENT

Subsection 336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT: Delete this Subsection in its entirety and replace with the following:

Normally, the type of pavement replacement and backfill required for the trench excavation will be noted on the plans or specified in the special provisions, and construction will be in accordance with COP Standard Detail P-1200.

(A) Unless otherwise specified, the "T" top as shown in COP Standard Detail P-1200 will not be required within the City of Phoenix. If the project extends into another municipality/county, the "T" top may be required for that portion of the project.

(B) When the trench excavation is not being accomplished in conjunction with a paving project, the following final backfill and pavement replacement requirements apply:

(1) When the trench is transverse (45 to 90 degrees to street centerline) the final backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.

(2) When the trench is parallel or less than 45 degrees to the street centerline, the final backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is required.

(3) When the trench crosses a major street, collector street or any other signalized intersection, the final backfill materials required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is required.

(C) When the trench excavation is being accomplished in conjunction with a paving project, the following final backfill and pavement replacement requirements apply:

(1) When the trench is transverse (45 to 90 degrees to street centerline), the final backfill material required by COP Standard Detail P-1200 for Type B will be used. Permanent pavement replacement is not required.

(2) When the trench is parallel or less than 45 degrees to the street centerline, the final backfill material required by COP Standard Detail P-1200 for Type A shall be used. Permanent trench pavement replacement is not required.

(3) When the trench crosses a major street, collector street or any other signalized intersection, the final backfill material required by COP Standard Detail P-1200 for Type B shall be used. Permanent trench pavement replacement is not required.

(4) Temporary pavement replacement (Subsection 336.2.3) will be required at intersections for traffic control and at existing partial paved areas when the total pavement is not scheduled for immediate removal and replacement. In addition to the above, the Engineer may require temporary pavement at any area where public safety and welfare warrants. This will be a non-pay item considered incidental to the project.

(5) If the excavation extends beyond the limits of the paving project, the Contractor shall provide permanent trench pavement replacement in accordance with Subparagraph (B) for this extension.

(D) When the trench excavation is made in Portland cement concrete pavement, COP Standard Detail P-1200 Type C final backfill and pavement replacement applies.

(E) When the condition of the existing pavement does not justify the use of COP Standard Detail P-1200, Type A or Type B final backfill, Type D final backfill and pavement replacement shall apply. Written approval from the Engineer shall be required.

(F) When the trench excavation is made in ABC or decomposed granite pavement, COP Standard Detail P-1200 Type E final backfill and pavement replacement shall apply.

(G) When the trench excavation is made in asphalt concrete pavement that has a soil cement base course, concrete treated base course or bituminous treated base course, the Contractor has the option of matching the existing pavement structure, including all courses, or replacing the pavement structure with equivalent full-depth asphalt concrete pavement. For computing the equivalent asphalt concrete pavement required, 1 inch of asphalt concrete is equivalent to 3.25 inches of ABC or 1.4 inches of soil cement, cement-treated base or bituminous-treated base. After computations are completed, the equivalent depth will be rounded off to the next higher 1/2 inch, i.e., 6.15 inches computed would be rounded to 6.5 inches.

Subsection 336.4 MEASUREMENT: Delete the first paragraph in its entirety and replace with the following:

Measurement and payment for permanent pavement replacement will be by the square yard, for the thickness specified. In computing the pay quantity, the field measurement along the centerline of the trench and the trench pay width as listed in COP Supplement 601 shall be used. When the longitudinal trench is only partially in the pavement, adjustments in the pay width will be made by the Engineer.

There will be no separate measurement for pipe bedding, haunching, initial backfill, final backfill and compaction. The cost of the pipe bedding, haunching, initial backfill, final backfill and compaction shall be considered incidental to the cost of the pipe.

Unless otherwise included in a separate pay item in the proposal, removal of obstructions shown on the plans shall be considered incidental to the cost of the pipe.

There will be no separate measurement for subgrade preparation or asphalt pavement removal. Subgrade preparation and asphalt pavement removal shall be considered incidental to the cost of the permanent pavement and surface replacement.

Subsection 336.4 MEASUREMENT: Delete Subparagraphs (A) and (B) in their entirety and replace with the following:

(A) In computing pay quantities for replacement Types A, B, C and E, pay widths will be based on the actual field measured width; however, the boundaries of the measurement will not extend further than ½ the distance, either side, from the centerline of the pipe as depicted on Table 601-1, Maximum Width at Top of Pipe Greater Than O.D. of Barrel.

(B) In computing pay quantities for replacement Types B-“T” Top and D, pay widths will be based on the actual field measured width; however, the boundaries of the measurement will not extend further than ½ the distance plus 12 inches, either side, from the centerline of the pipe as depicted on Table 601-1, Maximum Width At Top of Pipe Greater Than O.D. of Barrel. In all cases, the minimum pay width for replacement Types B-“T” Top and D shall be 48 inches.

Subsection 336.5 PAYMENT: Add the following paragraphs after the first paragraph:

Payment for bedding, haunching, initial backfill, final backfill and compaction shall be included in the cost of the pipe.

Payment for removal of obstructions shown on the plans, and not otherwise included in a separate pay item in the proposal, shall be included in the cost of the pipe.

Payment for subgrade preparation and asphalt pavement removal shall be included in the cost of the permanent pavement and surface replacement

SECTION 340
CONCRETE CURB, GUTTER, SIDEWALK, CURB RAMPS, DRIVEWAY AND ALLEY ENTRANCE

Subsection 340.2 MATERIALS: Delete the first paragraph in its entirety and replace with the following:

Concrete class shall be as specified on the plans, special provisions and standard details. Concrete shall conform to the requirements of Section 725.

Subsection 340.2.1 Detectable Warnings: Delete this Subsection in its entirety and replace with the following:

Truncated dome dimensions and spacing for detectable warnings are defined by the Americans with Disabilities Act Accessibilities Guidelines (ADAAG) and, upon its adoption, the Public Right-of-Way Accessibility Guidelines (PROWAG) for optimal detectability and public safety.

Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the ADAAG and, upon its adoption, the PROWAG. Detectable warning edges shall be sized and installed so that dome spacing is maintained across adjoining edges. Each dome shall have a minimum static friction coefficient of 0.8 as tested per ASTM C1028.

Subsection 340.2.1.3 Attachment System: Delete this Subsection in its entirety and replace with the following:

Detectable warning tiles shall be back buttered with an approved, commercial-source, 5000 psi non-metallic non-shrink grout and wet-set in freshly placed concrete to assure complete and continuous contact of the detectable warning tile bottom surface with the concrete as it cures, thus rendering the ramp a single monolithic structure.

Repair and replacement of existing detectable warning tiles shall conform to a method recommended by the manufacturer and approved by the Engineer.

Subsection 340.3.4 Joints: Delete the last sentence in the fourth paragraph.

Subsection 340.3.4.1 Expansion Joints: Add the following to the end of the first sentence in the third paragraph:

, between intersecting sidewalks and at adjacent portland cement concrete slabs and driveways

Subsection 340.3.4.2 Contraction Joints: Delete this Subsection in its entirety and replace with the following:

Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the minimum finished depth of contraction joints shall be 3/4 inch.

Unless an expansion joint is required, a contraction joint shall coincide with each form joint.

Sidewalk score marks shall not exceed 1/2 inch width, shall be at least 1/2 inch deep and shall be placed midway between contraction joints.

Subsection 340.5 MEASUREMENT: Delete the fourth paragraph in its entirety and replace with the following:

Detectable warnings shall be measured by the square foot.

Subsection 340.5 MEASUREMENT: Delete the last sentence in the fifth paragraph and replace with the following:

The surface area of the curb ramps shall be included in the measured quantity for sidewalk.

Subsection 340.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment for the above-named items will be made at the unit price bid in the proposal. Such payment shall include full compensation for the necessary removal of asphalt pavement, subgrade preparation and for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the Contract documents.

Payment for detectable warnings will be made at the unit price bid in the proposal for detectable warning strip. Such payment shall include full compensation for furnishing all labor, material, tools and equipment and accomplishing all work in conformance with the Contract documents.

SECTION 342
INTERLOCKING CONCRETE PAVER INSTALLATIONS

Subsection 342.3.2 Aggregate Base Course: Delete this Subsection in its entirety.

Subsection 342.4 MEASUREMENT AND PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment for concrete pavers in areas subject to vehicle traffic will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the subgrade preparation, construction of the concrete base slab, and installation of concrete pavers.

Payment for concrete pavers in areas not subject to vehicle traffic will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the subgrade preparation, and concrete pavers.

Payment for each type of header will be at the contract unit price set forth in the proposal. Payment shall be full compensation for all labor, materials, tools and equipment required for the construction complete in place in conformance with the contract documents

SECTION 343
EXPOSED AGGREGATE PAVING

Subsection 343.3 CONSTRUCTION PROCEDURE: Add the following paragraph after the first paragraph:

Unless specified otherwise, the exposed aggregate may be seeded onto the surface of the finished slab and worked into the slab, or the exposed aggregate may be integral part of the concrete mix.

Subsection 343.3 CONSTRUCTION PROCEDURE: Delete the second paragraph and replace with the following:

If the exposed aggregate is to be seeded, the slab surface shall be screeded and darbied, the aggregate placed onto the surface to the desired pattern and the surface reworked to embed the aggregate into the slab and bring the cement paste over the aggregate. Cement paste shall completely surround the aggregate, leaving no holes or voids.

Subsection 343.3 CONSTRUCTION PROCEDURE: Delete the first sentence of the third paragraph and replace with the following:

A non-staining surface retarder shall be applied per the manufacturer's recommendations to provide an aggregate exposure of approximately 1/8 inch.

Subsection 343.3 CONSTRUCTION PROCEDURE: Add the following paragraph to the end of this Subsection:

The Contractor shall utilize a method that will collect and contain the wastewater and shall properly dispose the wastewater and concrete biproducts generated by exposing the aggregate. The Contractor shall submit the proposed method in writing to the Engineer for review prior to start of the exposed aggregate paving.

Subsection 343.4 MEASUREMENT AND PAYMENT: Delete this Subsection in its entirety and replace with the following:

Measurement will be by the square foot. Payment will be made at the unit bid price in the proposal. This price shall include subgrade preparation, construction and disposal of the sample panel, wastewater collection and disposal, concrete biproduct collection and disposal and be full compensation for all labor, material, tools and equipment required to complete the work.

SECTION 345
ADJUSTING FRAMES, COVERS AND VALVE BOXES

Delete the title of this SECTION in its entirety and replace with the following:

ADJUSTING MANHOLE FRAMES AND UTILITY BOXES

Delete SECTION 345 in its entirety and replace with the following:

345.1 GENERAL

This specification covers the work required to adjust manhole frames and utility boxes to established grades, including new and existing sewer manholes, storm drain manholes, other utility manholes, valve boxes, survey monument boxes, cleanout boxes, meter boxes and other utility boxes.

The Contractor shall furnish all labor, materials and equipment necessary to adjust all frames and boxes as indicated on the plans or as designated by the Engineer.

The Contractor may elect to remove old frames, covers and boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the contracting agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. At the request of the City, the contractor will provide access to all services under construction at no additional cost. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Missing or defective frames, covers and boxes shall be reported to the Engineer in writing during the initial locating process to allow for timely replacement. The Engineer shall furnish replacements for missing or defective items, reported by the Contractor, at no cost. Replacements for missing or defective items not reported to the Engineer during the initial locating process shall be furnished by the Contractor at no additional cost to the contracting agency.

The Contractor shall submit a written adjustment plan and schedule to the Engineer for approval prior to commencing the work. The adjustment plan will specify the locations of the adjustments to be completed each day and specify the expected timeframes for the work.

The Contractor shall submit a written method for cleaning manhole covers and box lids to the Engineer for approval prior to commencing the work. Cleaning shall be completed prior to starting the adjustment work.

Adjustment of existing manhole frames and existing utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course.

Adjustment of new manhole frames and new utility boxes within asphalt concrete paved areas shall commence AFTER the placement of the asphalt concrete pavement surface course, slurry seal materials and/or micro-surfacing materials.

The Contractor shall attempt to locate all unexposed water valve boxes within the project's limits shown on the quarter section maps and shall excavate to a maximum depth of 18 inches in the attempt. Unexposed water valve boxes found shall be adjusted to grade. Excavations for water valve boxes not found shall be backfilled and compacted with base material conforming to Section 702.

345.1.1 Quarter Section Maps for Water and Sewer Lines: For city projects, the Contractor may obtain up to three sets of waterline and sewer line quarter section maps for the project area, at no cost to the Contractor, after the Contract is awarded and issued. The city project manager shall email a Service Request Form (SERF) to Infrastructure Record Services at irspubliccounter.wsd@phoenix.gov. For permit projects, the Contractor may

purchase sets of waterline and sewer line quarter section maps for the project area. Maps can be obtained from the Water Services Department Infrastructure Record Services counter on the 8th floor of City Hall, 200 West Washington Street.

345.1.2 Water Valve As-Built Drawings: Upon completion of the water valve box adjustments, the Contractor shall provide one complete, accurate and clearly legible set of marked-up as-built waterline quarter section maps to the Engineer. The Contractor shall mark the set with symbols consistent to those that appear on the quarter section maps. The Contractor shall color code all water valves on the maps as follows:

Blue	All valves shown on the Q.S. map found and adjusted.
Yellow	All valves shown on the Q.S. map but not found in the field.
Red	All valves not shown on the Q.S. maps but discovered in the field and adjusted. (Draw the valve symbol at the appropriate location on the map and provide the offset and location dimensions for these valves.)

345.2 LOWERING PROCEDURE

If required, manholes and boxes located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging these facilities. Care shall be taken to prevent entrance of any debris into these facilities.

All manhole frames, boxes and related items removed by the Contractor during the lowering process shall be maintained in a secure area, and the Contractor shall bear full responsibility for the material. Sewer manhole frames and covers shall be matched, kept together, and replaced onto their original manholes. Any hardware items lost or damaged by the Contractor shall be replaced in kind, at no additional cost to the contracting agency.

Preparation for Milling: Compacted asphalt concrete shall be temporarily placed over the steel plate, filling the excavated area. Excavated areas that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement and the cost shall be incidental to the adjustment.

345.3 ADJUSTING MANHOLE FRAMES

Manhole frames shall be adjusted to the elevations indicated on the plans or established by the Engineer.

The Contractor shall loosen manhole frames in such a manner that existing facilities will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary sewers or storm drains. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system, the Contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked and grouted (or mortared) in place with masonry or metal supports per MAG Standard Detail 422. Spaces between the frame and the facility shall be sealed to prevent any concrete from entering the manhole. A Portland cement concrete collar shall be placed around the frame at the required elevation and slope.

Adjustment rings may be used to raise manhole covers in asphalt pavements when deemed acceptable by the Engineer. The amount of adjustment, thickness of seal or overlay, and cross slope will be considered when using adjustment rings. Each location where an adjustment ring is used must have sufficient depth of asphalt to assure the proper installation and operation of the ring. The rings shall be made of concrete or polymer material and installed per the manufacturer's specifications. The rings shall be approved by the Engineer.

Adjustments of 24 inches or more shall require a top-of-manhole rebuild. For existing precast concrete manholes, the cone shall be removed, the manhole shaft extended with the necessary precast concrete manhole sections and the existing precast concrete cone re-installed. The Engineer shall review the condition of each exposed precast concrete

cone and approve its reuse. Existing brick manholes shall be reconstructed with brick as necessary or as approved by the Engineer.

Existing sanitary sewer manholes adjusted to grade with concrete adjustment rings shall have corrosion coating or liner applied to the new portion to match the existing corrosion system in the manhole. No separate measurement or payment shall be made for the corrosion coating or liner and the cost shall be incidental to the adjustment.

Existing sanitary sewer manholes adjusted to grade shall be painted with insecticide on the new portion when applicable, per Section 627. No separate measurement or payment shall be made for painting with insecticide, and the cost shall be incidental to the adjustment.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement, and the cost shall be incidental to the adjustment.

345.4 ADJUSTING BOXES

Boxes shall be adjusted to the elevations indicated on the plans or established by the Engineer.

Boxes shall be adjusted per COP Standard Detail P1270. The top of the valve riser pipe shall be extended or shortened to conform to the dimension in COP Standard Detail P1270.

All areas of pavement removed for adjustments that will be subjected to traffic prior to placement of the Portland cement concrete collar ring shall be temporarily filled with Type D-1/2 asphalt concrete pavement and roller-compacted flush with the adjacent pavement. No separate measurement or payment shall be made for furnishing, placing and removing the temporary Type D-1/2 asphalt concrete pavement, and the cost shall be incidental to the adjustment.

A debris cap with locating coil shall be installed in water valve boxes adjusted to grade in conformance with COP Standard Detail P1165. Prior to installation of the debris cap, valve risers shall be thoroughly cleaned to fully expose the operating nut. Undamaged existing debris caps with locating coils may be reinstalled. For permit projects, the Contractor shall furnish and install debris caps with locating coils. For city projects, the Contractor shall install city-furnished debris caps with locating coils.

345.5 PORTLAND CEMENT CONCRETE COLLARS

The Portland cement concrete collar around the frame or box shall be circular and a minimum of 8 inches thick, placed flush with the adjacent new pavement surface per COP Standard Detail P1270 and MAG Standard Detail 422. Collar shall be a minimum of 12 inches wide and a maximum of 18 inches wide. Concrete shall be a minimum of Class AA. All concrete shall be obtained from plants approved by the Engineer.

A single No. 4 rebar hoop shall be placed centered vertically and horizontally in each concrete collar. The hoop diameter shall be such that its placement is centered between the edge of the manhole frame or valve box and the outer edge of the concrete collar. The depth of the hoop shall be centered in the thickness of the collar. Each concrete ring shall be scored radially at quarter-circle points. Score lines shall be ¼ inch wide by ½ inch deep. The concrete collar surface shall be medium broom finished.

Traffic shall not be allowed on the concrete collars until the concrete had reached a minimum compressive strength of 2500 psi on residential and 3000 psi on collector and major streets. On major streets, the Contractor shall use “high-early” in the concrete mix, approved by the Engineer, to minimize delay in reopening the street(s) to traffic.

345.6 MEASUREMENT

The quantities measured will be the actual number of existing frames adjusted and accepted.

The quantities measured will be the actual number of existing boxes of each type adjusted and accepted.

The quantities measured will be the actual number of attempts made to locate water valve boxes that are ultimately not found.

The quantities measured for rebuilding manhole tops will be the actual number of existing manhole tops rebuilt regardless of the utility served or the type of manhole construction.

No separate measurement will be made for adjusting frames of new manholes, adjusting new boxes or adjusting frames of manholes requiring the rebuilding of the manhole top.

345.7 PAYMENT

Payment for adjusting existing frames will be made at the Contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for adjusting existing boxes will be made at the Contract unit price for each type. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work.

Payment for attempts to locate water valve boxes that are ultimately not found shall be made at the contingent Contract unit price. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including excavation, backfill, compaction and permanent surface replacement.

Payment for top-of-manhole rebuilds will be made at the Contract unit price for each. Payment shall be compensation in full for all material, labor, equipment and incidentals necessary to complete the work, including adjusting the frame to grade.

No separate payment will be made for adjusting frames of new manholes or adjusting new boxes. The cost shall be considered incidental to the respective new manhole or box and shall be included in the Contract unit price for the new manhole or box.

SECTION 350
REMOVAL OF EXISTING IMPROVEMENTS

Subsection 350.2 CONSTRUCTION METHODS: Delete the title of this Subsection in its entirety and replace with the following:

REMOVALS

Subsection 350.2.1 Utilities: Delete the title of this Subsection in its entirety and replace with the following:

General

Subsection 350.2.1 Utilities: Delete this Subsection in its entirety and replace with the following:

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

Unless otherwise designated on the plans, sidewalks shall be removed to a distance required to maintain a 5% (1:20) maximum running slope for the replaced portion of sidewalk. All driveways shall be removed to a distance designated on the plans or as required by standard details.

Plans shall specify existing sidewalk removals for a distance that would provide a 5% (1:20) maximum running slope for the replaced portion of sidewalk unless the site's grade at that location makes it impractical to provide. All driveways shall be removed to a distance designated on the plans or as required by standard details.

Portland cement concrete pavements, driveways, driveway entrances, curbs and gutters, and sidewalks designated on the plans for removal, or as necessary for other work, shall be saw-cut at specified match lines or the nearest existing construction joint, and removed.

Removal of trees, stumps, roots, rubbish and other objectionable materials in the right-of-way shall be done in accordance with Section 201 or as a miscellaneous removal item when not included otherwise in the proposal.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

Subsection 350.2.2 Others: Delete the title of this Subsection in its entirety and replace with the following:

Disposal of Surplus Materials

Subsection 350.2.2 Others: Delete this Subsection in its entirety and replace with the following:

350.2.2.1 Inert Materials: Surplus and/or waste material not containing asbestos or lead may be incorporated into the project when permitted by the construction documents and the Engineer.

The location for off-site disposal shall be at the Contractor's option, subject to the following conditions:

1. When the city landfills are used, the Contractor shall pay the normal fee.

2. When private property within the City of Phoenix city limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and stormwater requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the City of Phoenix Grading and Drainage Ordinance and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The contracting agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.

3. When private property outside the City of Phoenix city limits is used, the Contractor shall obtain written agreement from the property owner and submit a copy of the agreement to the Engineer prior to hauling and dumping. If the property is not a licensed disposal facility, the agreement shall specifically state that the property owner accepting the material shall be responsible for the cost and maintenance of all air quality and stormwater requirements as may be necessary by laws and ordinances. All disposal and grading shall be in strict conformance with the jurisdiction's laws and ordinances and all other applicable regulations, laws and ordinances. The Contractor shall obtain and pay for the necessary permits. The contracting agency is hereby held harmless by the Contractor of all liability when private property is used for disposal.

No separate measurement or payment will be made for hauling and disposal. The cost shall be incidental to the work in the proposal.

350.2.2.2 Non-Inert Materials: Surplus and/or waste material containing asbestos and/or lead in any form shall not be incorporated into the project unless formally accepted in writing by the Engineer prior to its incorporation.

Disposal of materials containing asbestos and/or lead shall be in conformance with all regulations, laws and ordinances.

No separate measurement or payment will be made for hauling and disposal of material containing asbestos and/or lead. The cost shall be incidental to the work in the proposal.

Subsection 350.2.3 Backfill and Disposal: Delete the title of this Subsection in its entirety and replace with the following:

Removal of Pipe

Subsection 350.2.3 Backfill and Disposal: Delete this Subsection in its entirety and replace with the following:

Pipe designated on the plans for removal shall include excavation; removal and disposal of paving, obstructions and encasement; removal, preparation and proper disposal of pipe and debris; and backfill and compaction per Section 336 and Section 601. Measurement and payment shall be by the linear foot.

Subsection 350.2 CONSTRUCTION METHODS: Add the following Subsections:

350.2.4 Removal of Structures

Structures designated on the plans for removal shall include the removal of irrigation structures and any other structures noted on the plans and not included otherwise in the proposal. Removal of structures shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structure and debris; and backfill and compaction per Section 336 and Section 601. Measurement and payment shall be by the lump sum.

350.2.5 Removal of Structural Concrete

Structural concrete designated on the plans for removal shall include the removal of sidewalk scuppers and any other reinforced concrete and masonry noted on the plans and not included otherwise in the proposal. Removal of structural concrete shall include excavation; removal and disposal of paving, obstructions and controlled low strength material fill; removal, preparation and proper disposal of the structural concrete and debris; and backfill and compaction per Section 336 and Section 601.

Measurement and payment shall be by the cubic yard of structural concrete removed.

350.2.6 Removal of Asphalt Outside of the Roadway Prism

Roadway prism is defined as the area within a roadway between the lip-of-gutter and the opposing lip-of-gutter or edge of pavement where gutters are not present.

Asphalt removal, in areas to be covered by new sidewalk, driveway, driveway entrance, curb and gutter and other improvements that include subgrade preparation, shall be incidental to those improvements. Other asphalt areas shall be included as miscellaneous removal, except where otherwise specified as incidental to an item by its specifications.

350.2.7 Removal, Salvage and Disposal of Street Lights

Street lights designated on the plans for removal shall include the removal of the light pole, arm and luminaire; removal and disposal of the junction box and conduit; removal and proper disposal of landscaping, paving, obstructions, concrete or other foundation fill material; necessary excavation; removal and proper disposal of concrete, or other foundation material, attached to the street light; proper disposal of other debris; backfill and compaction; and any restoration necessary and not included otherwise in the proposal with other work.

Payment shall be made for each light pole removed.

350.2.8 Abandonment and Removal of Utilities

The removal of existing improvements shall be conducted in such a manner as not to injure active utilities or any portion of the improvement that is to remain in place.

A utility may be abandoned in place below a new major structure that is part of the work only if approved by the city and shall be solidly filled with approved grout using methods approved by the city. All abandoned utilities to remain and the approved abandonment method shall be noted on the record drawings.

Utilities to be removed by the Contractor shall be disconnected and taken out in accordance with the requirements of the utility owner to the limits shown on the plans. Utility removal shall not be performed until a release has been obtained from the utility stating that their respective service connection and appurtenant equipment have been disconnected, removed or sealed and plugged in a safe manner.

The Engineer shall be notified when utilities are encountered that are not shown on the plans.

Subsection 350.3 MISCELLANEOUS REMOVAL AND OTHER WORK: Delete the first paragraph in its entirety and replace with the following:

Miscellaneous removal and other work shall include, but is not limited to, the following and as designated on the plans and not otherwise included in the proposal with other work. Existing improvements shown on the plans that may need removal, but are not specifically designated on the plans for removal and are not included otherwise in the proposal with other work, shall be removed and restored as miscellaneous removal. Payment shall be by the lump sum.

Subsection 350.3 MISCELLANEOUS REMOVAL AND OTHER WORK: Add the following paragraphs to this Subsection:

(I) Landscape Irrigation System Removal and Restoration: The Contractor shall remove the conflicting portion of all underground landscape irrigation systems that are within the right-of-way and/or easements that conflict with new work or any portion which may remain under proposed curb, gutter or sidewalk regardless of whether shown or not shown on the plans.

The Contractor shall restore all affected landscape irrigation systems to an operational condition at least as good as existed prior to removal. Bubbler and/or sprinkler heads shall be installed behind the new sidewalk in areas where watering was accomplished by landscape irrigation heads that were removed. Specifically, all areas behind the new sidewalk that were watered by the existing irrigation system before relocation shall be watered after relocation without any accumulation of water on the sidewalk or pavement.

The Contractor shall have the option of either providing all new materials or salvaging and reusing existing materials. Either new or salvaged irrigation heads shall be installed in a new location, as close as practical to the existing location. Either new or salvaged pipe shall be installed and all the necessary connections made to put the system back into operation.

In the event it is not feasible to reinstall removed irrigation heads, the Contractor shall then make all the necessary connections to make the remaining portion of the system operational. Irrigation heads and pipe not reinstalled shall be given to the Owner.

The Contractor shall furnish all new irrigation heads, new pipe and fittings, and pipe compound necessary to supplement salvaged materials.

The Contractor shall notify the affected property owners at least 14 days prior to removing and replacing underground landscape irrigation systems because some of the owners may desire to do this work themselves.

(J) Lawn Restoration: When any construction by the Contractor encroaches into an improved yard in or outside the right-of-way, the Contractor shall level any disturbed ground, resod all grass-covered areas and restore rock-covered areas with material to match the existing in type and quality.

(K) Precast Safety Curbs Inside the Right-of-Way: Existing precast concrete safety curbs inside the right-of-way and approximately parallel to the new curb line shall be reset by the Contractor directly opposite their existing location, with the back edge on the right-of-way line.

All other precast concrete safety cubs inside the right-of-way shall be salvaged and stockpiled by the Contractor at a location on the adjacent property agreeable to the property owner.

(L) Encroachments Inside the Right-of-Way: The Contractor shall notify property owners who have encroaching walls, fences, planters, plants, bushes, small-diameter trees and other improvements in the right-of-way that interfere with construction, at least 14 days before clearing is necessary.

Any encroaching items not timely removed by the Owner shall be removed and disposed of by the Contractor in accordance with the Contract Documents.

(M) Restoration of Temporary Construction Easements: The Contractor shall leave the easements in as good a condition or better after work is completed. Special care must be taken to replace any asphalt, trees, sprinklers, lights, walls, fences, etc., which were disturbed as a result of construction. Where grass such as a lawn is located within the easement, the Contractor shall remove the sod that would be in the path of any construction, store it, keep it moist and replace it immediately after construction is complete.

(N) Any removals called for on the Traffic Signal Plans and not otherwise included in a separate pay item.

(O) Any and all items not specifically set forth as a separate pay item.

Subsection 350.4 PAYMENT: Add the following to the end of the sentence in this Subsection:

to the satisfaction of the Engineer.

PART 400
RIGHT-OF-WAY AND TRAFFIC CONTROL

SECTION 401
TRAFFIC CONTROL

Delete the title of this SECTION in its entirety and replace with the following:

TEMPORARY TRAFFIC CONTROL

Delete SECTION 401 in its entirety and replace with the following:

401.1 DESCRIPTION

Temporary traffic control shall consist of traffic control devices and flagger or pilot cars deployed to protect and guide all modes of traffic (motor vehicle, bicycle and pedestrian) within the construction work zone areas.

The Manual on Uniform Traffic Control Devices 2009 (MUTCD) with Arizona Supplements and the City of Phoenix 2007 Traffic Barricade Manual (TBM), or the most recent adopted editions, take precedence over Section 401.

401.2 TRAFFIC CONTROL DEVICES

The Contractor may be required to submit a temporary traffic control plan to the Engineer to obtain a Temporary Restriction and Closure System permit (TRACS), as specified in Chapter 2 of the TBM.

The Contractor shall furnish, erect and maintain all temporary traffic control devices in conformance with the TRACS permit and as approved by the Engineer.

Traffic control devices shall consist of providing, erecting and maintaining the necessary and adequate devices for the protection of the work, the workers and the public.

(A) Temporary traffic control devices shall be used to guide all traffic modes through the construction area. They include, but are not limited to, traffic cones to channelize traffic, portable barricades for warning, water-filled barriers for pedestrian separation, vertical panel channelizing devices to divert traffic, concrete barriers to protect traffic from hazards and lighting devices between the hours of sunset and sunrise.

(B) Advance warning devices shall be used to alert all modes of traffic to the construction area. They include diamond-shaped signs, flags, and flasher-type high-level warning devices mounted 8 feet above the roadway.

401.3 FLAGGERS AND PILOT CARS

Flagging of traffic or pilot cars shall consist of providing a sufficient number of properly trained flaggers (with proper signing), uniformed off-duty law enforcement officers, or pilot cars to expedite the safe passage of traffic. Off-duty law enforcement officers shall be used at signalized intersections when one through lane is maintained in any direction.

401.4 TRAFFIC CONTROL MEASURES

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic; sufficient and adequate devices and measures shall be provided and erected in compliance with the TRACS permit. The Engineer reserves the right to require additional traffic control measures in any specific instance. These devices shall be immediately removed when no longer needed.

401.5 GENERAL TRAFFIC REGULATION

Requests for a TRACS permit shall be submitted to the Right-of-Way Management Agent (RMP Agent) through the Engineer or the Permit Inspector on permit work. Unless directed otherwise by the Engineer or RMP office, an advance notice of 72 hours for complete closures on major and collector streets, 48 hours for partial closures on major and collector streets and 24 hours for complete or partial closures on local streets and alleys is required.

A minimum 11-foot clear traffic lane shall be required for a safe motor vehicle operating speed of 35 miles per hour.

For the purpose of temporary traffic control, an intersection is defined as all of the area within the right-of-way of the intersecting streets plus 300 feet beyond the prolongation of the intersecting right-of-way line on each street.

Except during emergency conditions, or otherwise provided for in the special provisions or permit or approved by the RMP Agent, the following are minimum traffic control requirements for all traffic restrictions:

(A) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 8:30 a.m. and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on major or collector streets.

(B) During WEEKDAY PEAK TRAFFIC HOURS between 6:00 a.m. and 9:00 a.m. and between 4:00 p.m. and 7:00 p.m., TRAFFIC RESTRICTIONS ARE NOT PERMITTED on streets with reversible lanes.

(C) During WEEKDAY OFF-PEAK TRAFFIC HOURS, when one traffic lane is restricted at a multiple lane signalized intersection with left-turn lanes, the left-turn lanes may be used to provide a minimum of four through traffic lanes (two lanes for each direction).

(D) Except as provided for in items (A) and (C) above, a minimum of two traffic lanes (one for each direction) shall be maintained on all major and collector streets through the week nights and through the weekends.

(E) A minimum of two traffic lanes in the same direction shall be maintained on “one-way” streets at all times.

(F) A traffic lane shall not be considered as satisfactorily open to traffic unless it is paved with hot mix or cold mix asphalt.

(G) The Contractor, utility or other agency shall provide a City of Phoenix-approved uniformed off-duty police officer during OFF-PEAK traffic hours to assist with traffic control at multiple lane signalized intersections whenever traffic is reduced to one through lane in any one direction. This requirement may be waived by the Engineer when conditions, in his opinion, do not require it.

(H) Local streets may be closed except for local access when construction or maintenance requires.

(I) Local access shall be maintained to all properties on all streets (major, collector and local) at all possible times. When local access cannot be maintained, the Contractor, utility or other agency shall notify the affected property owner, resident or tenant a minimum of 72 hours in advance and restore access as soon as possible. Unless specifically authorized by the Engineer, access to businesses will not be closed during business hours.

(J) All Contractors doing work in the right-of-way shall promptly remove all traffic control devices when the closure or lane restrictions are no longer in effect. When no construction work is being done, all advance warning signs shall be turned so that they are not readable by drivers. All traffic control devices may be temporarily stored in cluster method behind the sidewalk for short periods of time. All temporary traffic control devices shall be collected and removed from the right-of-way within 24 hours of the expiration of the TRACS permit.

(K) Special Events: If there are special events scheduled to take place during the construction of any project, the Contractor shall coordinate the construction schedule with these events.

401.6 EXISTING TRAFFIC CONTROL DEVICES

During construction and maintenance operations, it is important that all existing traffic control devices be kept compatible with the traffic restrictions imposed. This includes existing signs, parking meters, traffic signals and pavement markings. Some devices will remain applicable to traffic and must be maintained. Other devices must be covered, relocated or removed. Requirements for each group of devices are detailed in this section.

(A) Traffic Signs:

The Contractor, utility or other agency shall maintain all existing STOP, YIELD and street name signs, verifying they are erect, clean and in full view of the intended traffic at all times. If these signs interfere with construction, the Contractor, utility or other agency shall temporarily relocate the signs to permit construction, but the devices must be kept in full view of the intended traffic. Portable signs shall be used to supplement the relocated permanent signs.

Other signs still applicable shall also be maintained erect, clean and in full view of the intended traffic by the Contractor, utility or other agency at all times. Existing signs, not applicable, shall be removed by the Contractor, utility or other agency without damage and salvaged on the adjacent property lines. The Streets Transportation Department shall be notified of all removals.

(B) Traffic Signals:

The Contractor, utility or other agency shall maintain all existing traffic signal equipment except in-pavement vehicle detector sensing devices, which shall be fully operational in the existing locations and in full view of the intended traffic at all times unless otherwise specified in the City of Phoenix Traffic Barricade Manual or in the Project or Permit Plans or specifications. All traffic signal work performed by a Contractor shall be in accordance with Section 404.

The Contractor, utility or other agency shall notify the Traffic Signal Shop (602-262-6021) 48 hours prior to the start of construction in the vicinity of signalized intersections. The Traffic Signal Shop will, in accordance with the Arizona Blue Stake regulations, provide the approximate locations of all underground traffic signal equipment (conduits, junction boxes, vehicle detector sensing devices, etc.). The exact location of this underground equipment shall be determined by the Contractor, utility or other agency prior to any excavating operations.

The Contractor, utility or other agency shall exercise care to prevent damage to all existing traffic signal equipment. Should damage occur, the Traffic Signal Shop will make the necessary temporary repairs to immediately restore traffic signal operation.

Responsibility for permanent repair or replacement of damaged equipment shall be as follows:

The cost for the permanent repair or replacement shall be at the Contractor's, utilities', or other agency's expense when the approximate location of the damaged equipment has been made known to them. They will also be charged by the Traffic Signal Shop for any temporary or permanent repairs made by City of Phoenix forces. Permanent repairs or replacements made by a Contractor shall be approved in advance by the Traffic Signal Shop Supervisor or his or her designee and constructed in accordance with Section 404.

All permanent repairs or replacement shall be at the city's expense when the approximate location of the damaged equipment has not been made known to the Contractor, utility or other agency, provided they have complied with the notification requirements of this section and requested underground locations.

When the existing traffic signal equipment cannot be maintained as provided for in the Arizona Supplemented MUTCD or in the Project or Permit Plans or specifications, the Contractor, utility or other agency shall, at their expense, have the Traffic Signal Shop or a qualified Contractor (as specified in Section 404) relocate said equipment to a temporary location and/or provide additional temporary equipment such that all functions and indications of the existing signal equipment, except in-pavement vehicle detector sensing devices, are operational and in full view of the intended traffic at all times. The location and type of all temporary signal equipment shall be approved by the Streets Transportation Department. All signal equipment relocations and/or installations of temporary signal equipment shall be coordinated by the Contractor, utility or other agency with the approval of the traffic signal engineer. Seventy-two (72) hours' advance notice is required.

When temporary equipment or new equipment is installed to replace existing equipment, the temporary or new equipment shall be fully operational before the existing equipment is removed.

The Contractor, utility or other agency shall restore all traffic signal control equipment to the original locations or new locations, if so specified, as soon as possible after all work in the immediate area is completed.

(C) Signalized Intersection Requirements:

The Contractor shall notify the Engineer and the Traffic Signal Shop (602-262-6021) at least 72 hours prior to the start of any construction in the vicinity of a signalized intersection where traffic signals may be affected.

The Contractor shall provide the Engineer and the Traffic Signal Shop a written schedule indicating days, times and specific locations where traffic signals will be interrupted or modified. **When work has been completed, the Contractor shall immediately notify the Traffic Signal Shop.**

The Contractor shall maintain the "cone of vision" for traffic signal heads in accordance with the Arizona Supplemented 2009 MUTCD Part 4 Section 4D.13 (see Figure 4D-4 on page 463) or most current version at all signalized intersections for full view of intended traffic and signal indication. Motorists driving through signalized intersections in a construction zone must always be able to see at least two (2) traffic signal heads within the "cone of vision." If the traffic control setup cannot provide the required "cone of vision," the Contractor shall contact the Engineer and the Traffic Signal Shop at (602-262-6021) for instructions.

(D) Pavement Markings:

Existing pavement markings that conflict with the vehicle path indicated by barricades and channelization and cause driver confusion shall be removed or obliterated by the Contractor, utility or other agency as directed by the Streets Transportation Dept.

Generally, pavement marking removal or obliteration is only required on long-term construction projects such as detours for bridge construction or similar fixed-location projects. However, removal or obliteration of existing pavement markings may be required at any location when visual inspection and/or accident history shows driver confusion caused by existing pavement markings.

Proper pavement marking removal or obliteration leaves a minimum of pavement scars and completely removes existing markings. Painting over existing markings with black paint or asphalt material is not satisfactory except in emergency conditions awaiting more permanent removal to immediately follow.

Final Signing and Striping of Roadway: The Contractor, through the city project inspector, shall notify the Street Transportation Department, Traffic Operations Division (602-262-6456) at least thirty (30) days prior to desired completion of final roadway signing and lane striping.

(E) Parking Meters:

The Contractor, utility or other agency shall maintain all metered parking spaces open for parking at all possible times. When parking meters must be hooded or removed, the Contractor, utility or other agency shall notify the Streets Transportation Department 2 business days in advance.

All parking meter post removals, relocations or installations shall be done by the Contractor, utility or other agency as provided for in the plans or as directed by the parking meter supervisor. The Street Transportation Department will provide the parking meter posts.

(F) Coordination with Other Agency Projects:

The Contractor shall coordinate and schedule work to minimize disruption or conflicts with any other agency projects.

Any work that may affect the project shall be coordinated with the appropriate agency contact at least fourteen (14) days in advance.

(G) Pedestrian Access Requirements:

The Contractor shall ensure that all sidewalks on this project remain in compliance with the ADAAG and, upon its adoption, the PROWAG. All open pedestrian walkway areas, paved or unpaved, shall be maintained and safely usable at all times. Such measures as backfilling or ramping to existing sidewalks or providing alternate sidewalk areas adjacent to existing sidewalks may be used. In high pedestrian use areas, the Engineer may request temporary hard-surface walkways, such as compacted stabilized decomposed granite, compacted cold-mix asphalt, CSLM or hot-mix asphalt.

In addition, diversions shall conform to Figure 401-1.

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

June 25, 2013

Dear City of Phoenix **Traffic Barricade Manual (TBM)** User:

RE: POLICY PERTAINING TO SIDEWALK BYPASS DESIGN AND IMPLEMENTATION OF 2009 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) RULES

Effective July 1, 2013, updated regulations specific to pedestrian diversions in Part 6 of the 2009 MUTCD will be phased into general use by the City of Phoenix, Street Transportation Department. These regulations change the required devices utilized for pedestrian diversions as well as how diversions are installed and maintained.

This addendum specifically addresses two portions of the existing TBM in Chapter 3 pertaining to pedestrian safety and Chapter 6 pertaining to traffic control devices.

In Chapter 3, "Pedestrian Safety and Service Considerations" on page 22 (Figure 1) of the existing TBM, both "In-Street" and "Out of Street" diagrams, shall be modified as follows:

IN-STREET DIVERSIONS

1) A continuous barrier shall be installed on the outside portion of the temporary pathway nearest traffic. Vertical panels with caution tape, pedestrian fencing, cones, and any other devices will no longer be accepted, except in cases where a designated spotter is utilized (SEE EXCEPTION BELOW). "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
2) The inner barrier of the constructed pathway may consist of any channelizing device accepted by the City of Phoenix.
3) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03,2009 MUTCD)
4) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
5) When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility. (Refer to 6H.28.01, 2009 MUTCD)

OUT-OF-STREET DIVERSIONS

1) A continuous detectable barrier shall be provided throughout the length of the affected facility. "Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision. The bottom of the bottom surface shall be no higher than 2" above the ground, and the top of the top surface shall be no lower than 32" above the ground. (Refer to Section 6F.63.04 and .05, 2009 MUTCD)
2) Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier shall be placed across the full width of the closed sidewalk; this barrier shall have the same dimensions and detectability as stated above. (Refer to 6D.02.03,2009 MUTCD)

FIGURE 401-1: ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL

3) EXCEPTION: If maintaining an alternate pedestrian route is NOT feasible during the project, a spotter may be assigned the responsibility to assist pedestrians with disabilities through the project limits. (6D.01.05, 2009 MUTCD)
4) The detectable barrier should be placed nearest to the work zone.

WHAT THIS MEANS TO CONTRACTORS, CITY CREWS, BARRICADE COMPANIES AND OTHER RIGHT-OF-WAY USERS

Contractors will have the option of selecting from a number of new products that will fulfill the specifications for the creation of detectable pathways. When a spotter is not utilized, the outer barrier closest to traffic must have detectable edging. The inner barrier of an on-street pathway does not have to comply with this rule at this time. There are no current changes to ramps, ramp elevation ratios, or signage.

When selecting an out-of-street pathway, the barrier nearest the work area should have the detectable edge, while the other side of the pathway can be constructed of acceptable devices.

Thank you again for your partnership with the City in maintaining mobility safety for all work activities in Phoenix right-of-way. If you have any questions, please contact John Morgan at 602-262-4483 or Luiz Moreno at 602-262-6565.

Sincerely,

Thomas L. Godbee, P.E.
Deputy Street Transportation Director

P: RMP Working Documents\TBM Addendums\Sidewalk Bypass Addendum 6-25-2013

C: Luiz Moreno
John Morgan
Lorena Hall
Rick Florian

FIGURE 401-1: ADDENDUM TO 2009 TRAFFIC BARRICADE MANUAL, CONT.

401.7 HOLIDAY SEASON TRAFFIC

During the holiday season from Thanksgiving Day through the 1st of January, it is imperative that traffic restrictions be minimized or eliminated to the greatest extent possible.

On all major streets adjacent to or serving as primary access to large regional shopping centers, work that restricts traffic should be minimized. In addition, work within the entire Central Phoenix area should be curtailed.

Careful planning of work schedules to avoid operations that restrict traffic flow can do much to benefit the traveling public and decrease traffic accidents.

401.8 FAILURE TO PROVIDE ADEQUATE MAINTENANCE OF TRAFFIC

If the Contractor fails to provide adequate temporary traffic control, the Engineer will have the work performed by other sources. The cost of having this work performed by other sources will be computed in accordance with Subsection 401.11. The total cost will be deducted from monies due to the Contractor.

401.9 TRAFFIC BARRICADE MANUAL – VIOLATIONS, CIVIL SANCTIONS

401.9.1 Authority and Administration: The city manager and the director of the Police Department are authorized to issue notices for violating the Traffic Barricade Manual and may take those measures necessary to promote, preserve and protect public health, safety and welfare within the public right-of-way.

401.9.2 Violations of Traffic Barricade Manual, Civil Sanctions: The following violations of the Traffic Barricade Manual may result in a Civil Sanction. The amount of the Civil Sanction listed is the minimum amount per day for a violation prior to the commencement of a Civil Action.

TABLE 401-1

SUMMARY OF VIOLATIONS AND PENALTIES

Violation	Description	Civil Sanction
#1	Creates imminent risk of injury to the public within the ROW.	$1,500
#2	Restricting ROW without proper certification or TRACS Permit.	$1,000
#3	Restricting traffic during peak hours as described in the TBM without authorization.	$1,000
#4	Failing to correct a violation, as listed, within the time period stated on the warning notice.	$1,000
#5	Restricting traffic at signal with no work occurring.	$1,000
#6	Closing sidewalk improperly, or without proper certification or TRACS permit.	$500
#7	Violating the restrictions, limits, times, and locations of the TRACS permit.	$500
#8	Missing or improper use of advance warning signs.	$500
#9	Missing or improper use barricades/channelizing devices.	$500
#10	Leaving advance warning signs facing traffic after restriction has been removed – per one traffic direction.	$250
#11	Leaving TTC devices in the ROW 24 hours after TRACS permit expires, unless a request for a permit extension is received prior to the expiration of permit.	$250
#12	Use of “unacceptable” quality traffic control devices as described in the TBM.	$250
#13	Rendering a bus stop inaccessible without relocating it or making other accommodations.	$250

401.10 MEASUREMENT

Off-duty law enforcement officers will be measured by the hour for each individual, including vehicle and equipment, required to perform traffic control. Minimum payment shall be 3 hours on any separate call out.

401.11 PAYMENT

Payment for complete temporary traffic control will be made at the unit bid price in the proposal item TRAFFIC CONTROL DEVICES.

Payment for the uniformed off-duty law enforcement officer will be made at the unit bid price in the proposal item ALLOWANCE FOR UNIFORMED, OFF-DUTY LAW ENFORCEMENT OFFICER. If the officer is utilized in excess of 8 hours in any calendar day or in excess of 40 hours in any calendar work week, payment shall be at the rate of 1-1/2 times the proposal price for all hours worked in excess in either of the above time periods.

SECTION 404
TRAFFIC SIGNALS

Add SECTION 404 in its entirety:

SECTION 404
TRAFFIC SIGNALS

404.1 GENERAL

The following specifications will outline the obligations of the private developer and/or private contractor constructing or relocating City of Phoenix traffic signal equipment. This includes private contractors working for ADOT, other agencies or other departments within the City of Phoenix. **Any deviations to these work responsibilities will need to be discussed with the City of Phoenix traffic engineering supervisor (602-262-4690) or authorized designee.** The term Engineer for this section shall mean traffic engineering supervisor or any of his or her authorized designees.

These specifications and approved, signed traffic signal plans are in addition to other applicable specifications and policies of the City of Phoenix, Maricopa Association of Governments and the Arizona Department of Transportation.

The Contractor shall notify the City of Phoenix, Traffic Signal Shop (602-262-6021) a minimum of fourteen (14) calendar days prior to beginning any traffic signal work.

404.2 PREPARATION

Before starting any traffic signal work under the project, **read and review** all project documents and general notes to make certain understanding and agreement is clear with all conditions stated.

Be sure that the traffic signal plans are the final approved plans. Final approved plans shall have the signatures of City of Phoenix, Street Transportation Department officials. An approved set of plan documents shall be present on the jobsite during construction.

Work to be done shall mean all labor, materials, equipment and other incidentals necessary to complete the work in accordance with the project plans. In the event an error or omission is discovered, it should be brought to the attention of the Engineer immediately. The Engineer shall make such corrections and interpretations as may be deemed necessary.

The Engineer also has the authority to suspend traffic signal work to correct conditions unsafe for the workers or the general public or for failure to carry out provisions of the Contract and/or to carry out orders.

The Contractor shall note that approval from the Engineer is required before ordering or installing any material that is to be used on the project. A list of materials and equipment that contains all items to be supplied on the project by the Contractor shall be submitted. The City of Phoenix reserves the right to reject an incomplete or unclear submittal. Contractor-supplied materials will be listed on the signal plans. The Engineer reserves the right to accept a partial list prior to full submission. This approval also includes the paint color for traffic signal equipment. The Engineer shall answer all questions that may arise as to quality and acceptability of materials furnished and work performed, interpretation of plans and specifications, and all questions related to acceptable completion of work. It is recommended that the Contractor invite the Engineer to a pre-construction meeting to discuss any traffic signal related questions and/or concerns. This meeting can be held in conjunction with other disciplines.

404.3 MAINTENANCE OF TRAFFIC

Traffic shall be protected in accordance with The City of Phoenix, Traffic Barricade Manual, the Manual on Uniform Traffic Control Devices and Section 401.

404.4 MATERIALS AND WORKMANSHIP

Materials and construction details shall conform to the latest City of Phoenix Standard Traffic Signal Drawings; the Arizona Department of Transportation, Highways Division, Supplemental Specifications to Standard Specifications for Road and Bridge Construction, latest edition; the latest edition of the Arizona Highway Department Traffic Signal and Highway Lighting Systems Standard Drawings and the current National Electrical Code Standards unless otherwise specified herein or on the plans.

All electrical materials and workmanship shall conform to the requirements of the current National Electric Code (NEC).

The Contractor shall be responsible for all work and materials as shown on the signal plans, the project-specific specifications and/or general provisions.

The Contractor shall call the Blue Stake Center at least 48 hours prior to excavation for information relative to the location of buried utilities. The Contractor shall also contact the City of Phoenix Traffic Signals Department at (602-262-6204 for traffic signal locates.

All underground conduits shall be schedule 40 rigid polyvinyl chloride (PVC) installed 24 inches to 30 inches below finished grade with the exception of loop lead-in conduits, which shall be schedule 40 rigid PVC installed in accordance with the latest City of Phoenix Standards. All conduits shall be installed in straight lines (unless otherwise shown on the plans) junction box to junction box or junction box to signal equipment foundation with one 90-degree sweep on each end as specified in the plans. All conduits entering junction boxes shall be vertical, with the top of the conduit 6 inches below the bottom of the cover.

Foundations shall conform in size, type, and location as shown on the plans. The foundation anchor bolts shall be supplied by the Contractor unless otherwise noted on the plans and installed square with the intersection. The top of the pole foundation shall be set at the finished grade and at the back of sidewalk for each location unless otherwise shown of the plans. Concrete for foundations shall be Class A, 3000 psi concrete with a 6-inch slump per Section 725. Minimum pole foundation curing times are A-Poles five (5) days, M-poles seven (7) days, Special M-poles (SM) and Special R-poles (SR) ten (10) days, NO EXCEPTIONS. With approval of the Engineer, high early-strength concrete may be used at no additional cost to the city. Testing is required to verify high early-strength concrete has attained a 3000 psi compressive strength per ASTM C39 and shall be performed at the Contractor's sole expense.

The Contractor shall have a Level II IMSA-certified Technician/Electrician on site at all times during construction/maintenance of traffic signal equipment. Conductor splices and terminations shall be made by a qualified Journeyman Electrician, who has successfully completed a recognized 4-year apprenticeship program or equivalent training, or by a person enrolled in a recognized 4-year apprenticeship program under the direct supervision of a Journeyman Electrician.

A separate loop lead-in circuit shall be supplied for each inductive loop. Inductive loop lead-in cable shall be continuous without splices from the loop stub-out junction box to the controller cabinet. A minimum of 5 feet of slack shall be provided in the controller cabinet, and a minimum of 3 feet of slack shall be provided in each junction box.

Detector loops shall be installed and tested ONLY in the presence of an authorized representative of the City of Phoenix Traffic Signal Shop. Detectors installed without said representative in attendance, for any reason, shall be removed from the pavement and new conductors installed, all at the Contractor's expense. Each detector shall be installed according to the latest Traffic Signal Standard Drawing. Installations shall be made permanent with approved sealant after successful testing. The loop conductor shall be temporarily spliced to the lead-in cables, as directed by the Inspector, and tested at the controller cabinet. Loop sealant shall be injected into all cuts and, before setting, surplus sealant shall be struck off flush with and removed from the roadway surface.

All traffic signal heads shall be covered until activation except for 12-inch mast arm heads, which will not be installed until the day of the activation. These coverings must be maintained in good repair.

The Contractor shall maintain the work and work site in an acceptable manner during the course of the project. Upon completion of the work all surplus earth, construction debris including abandoned foundations and/or remnant equipment shall be removed and properly discarded by the Contractor, and the work area shall be restored to a neat, orderly condition.

404.5 INSPECTION

The City of Phoenix traffic signal foreman or his designee shall inspect all work performed, including these critical components: all trenches and conduit runs including splices before being covered, wiring, junction box installations, loop layout, saw cuts, loop installation, and traffic signal pole foundations before being poured. The Contractor shall contact the appropriate traffic signal foreman forty-eight (48) hours in advance to request inspection or call 602-262-6733.

Inspections are typically at no cost to the Contractor. However, if the Contractor's performance results in the need for additional inspections or excessive inspection time for the traffic signal foreman or his designee, the Contractor will be put on notice and subsequent inspection costs shall become the Contractor's responsibility.

The traffic signal foreman, or his designee, are authorized to inspect and reject work and materials and shall refer rejected work not resolved in the field to the traffic signal engineer for resolution.

In the event the traffic signal engineer determines that the materials furnished, work performed, or the finished product are not in conformance with the plans and specifications, the non-conforming improvements shall be removed and replaced or otherwise brought into conformity at the sole expense of the Contractor.

The traffic signal engineer has the authority to reject defective material and to suspend any work that is improperly performed.

404.6 ACTIVATION OF TRAFFIC SIGNAL WORK

Notify the traffic signal shop prior to pulling conductors and activating the traffic signal system. Activation of new traffic signal intersections shall be scheduled through the traffic signal engineer. An off-duty police officer supplied by the Contractor is required to be present for the activation to provide traffic control.

404.7 SALVAGED MATERIALS

Any existing equipment identified by the Traffic Signal Shop foreman or his designee as salvageable shall be removed without damage, delivered to 2141 East Jefferson Street and unloaded where designated. Contact the Traffic Signal Shop (602-495-2083) 24 hours in advance for an appointment to return salvaged equipment.

Remnants of obsolete traffic signal equipment shall be delivered to the Traffic Signal Shop scrapyard by the Contractor. Contact the Traffic Signal Shop project inspector 24 hours in advance for an appointment to deliver obsolete equipment to the scrap yard.

404.8 WARRANTY

The warranty period will begin the day the work is accepted by the city.

There will be a 2-year warranty on all Contractor-supplied equipment and detector loops following final acceptance of the work except as noted herein. The Contractor will warranty workmanship supplied in association with the installation of city-supplied equipment for a 2-year period following acceptance of the work. All LED indication modules furnished by the Contractor will be warranted for 5 years following acceptance of the project.

404.9 MEASUREMENT

Measurement for foundations, junction boxes, and loops shall be of the number of units of each satisfactorily constructed.

Measurement for conduit shall be the linear feet of conduit satisfactorily installed as measured along the centerline of the conduit through fittings from end of conduit to end of conduit. Measurement shall be made to the nearest 0.5 feet.

Measurement for the temporary signal cable and the lead-in cable shall be the linear feet of cable satisfactorily installed as measured along the centerline of the cable from end to end. Measurement shall be to the nearest 0.5 feet. The temporary signal cable is a contingency item and may be eliminated without compensation by the Engineer.

404.10 PAYMENT

Payment for traffic signal work will be made at the unit prices in the applicable proposal items, the combination of which shall be full compensation for all material and labor required to complete the work, including incidentals not specified, but required, to complete the work, including temporary traffic signals as described and specified herein, on the plans and permits.

SECTION 424
PARKWAY GRADING

Subsection 424.2 ROUGH GRADING: Add the following Subparagraph to the end of this Subsection:

(C) The parkway area shall be graded at a variable slope from 1 inch below the back of sidewalk to meet the existing surface at the right-of-way line in accordance with the typical section shown on the plans. Material displaced in the grading of parkways shall not be allowed to be placed on base and surfacing material already in place on the roadway. No measurement or direct payment will be made for this work.

Subsection 424.3 FINE GRADING: Delete paragraph (B) in its entirety and replace with the following:

(B) Where existing parkways are planted in grass, flowers or shrubs and the level is somewhat above the top of the curb or sidewalk, the parkway shall be graded as per City of Phoenix Landscape Standards and Guideline Detail “Water Retention on Turf Installation” with the least possible damage to the planted area.

SECTION 429
TRAILS

Add SECTION 429 in its entirety:

SECTION 429
TRAILS

429.1 DEFINITION OF TERMS

(A) Multi-Use Trail (MUT): The MUT shall be a 10-foot-wide compacted decomposed granite (DG) surface stabilized to its full 3-inch depth and shall also have 2-foot DG shoulders allowing pedestrian, bicycle, equestrian and maintenance vehicle use. Switchbacks and clearances for obstacles, vegetation and plants will be measured from the edge of the MUT, excluding the 2-foot shoulders, where installed. All MUTs shall meet or exceed the Americans with Disabilities Act (ADA) requirements and shall be Barrier-Free Trails.

(B) Multi-Use Trail Easement (MUTE): The MUT shall be constructed within a dedicated 30-foot public MUTE.

(C) Shared-Use Path (SUP): The SUP is a non-equestrian 10-foot-wide concrete pathway providing recreation and educational experiences. All SUPs shall meet or exceed the ADA requirements.

(D) Private Trail (PT): The Trails Master Plan does not regulate the locations of PTs. Construction and maintenance of PTs is the responsibility of the private development. Construction of PTs should follow the MUT or SUP guidelines set forth in these specifications.

429.2 SPECIFICATIONS

(A) MULTI-USE TRAIL

(1) Users:

(a) Hikers, joggers, bicyclists, equestrians and the disabled.

(2) Multi-Use Trail Easements:

(a) Multi-Use Trails shall be located within an exclusive 30-foot minimum public trail easement.

(b) This easement is exclusive for the trail, landscaping and PUE unless modified by Development Services.

(c) Trail easements along an open space or wash corridor will be a minimum of 25 feet wide.

(3) Sub-Grade:

(a) The sub-grade shall be 90% compacted prior to the installation of the MUT.

(4) Grade:

(a) Maximum sustained longitudinal grade 5% (20:1).

(b) The cross slope shall not exceed 2%.

(5) Tread Surface:

(a) The tread surface shall be a minimum of 10 feet wide with a 2-foot shoulder on each side. No shoulder will be required for the MUT in turf area.

(b) The trail shall allow for side-by-side travel and ease of passing by horses and bicycles. Tread conditions must provide an adequate walking or riding surface free of obstacles or hazards.

(c) The MUT surface shall be ¼ inch minus DG of a color contrasting with the surrounding DG and shall be stabilized to its full 3-inch depth.

(d) When located in turf, the MUT shall have a 6- by 8-inch concrete header that meets or exceeds MAG Standards on each side. Shoulders shall not be required in turf.

(6) Path Locations:

(a) Public MUTs shall not be placed in retention basins, drainage ways, channels or naturally occurring or man-made washes, unless otherwise approved by the Parks and Recreation Department.

(b) There shall be a minimum 5-foot horizontal clearance between trails and other obstacles, i.e., fences, walls, utility boxes and other fixed objects. Safety rails or ADA railing are the exception to this requirement.

(c) Where the trail surface ties into another hardscape surface material, i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface.

(d) Trails shall feed directly into ADA ramps at all roads and driveway crossings.

(7) Switchbacks:

(a) The inside radius of a trail switchback shall be a minimum of 5 feet.

(8) Vegetation Clearance and Removal:

(a) Plant material shall not be planted or allowed to grow in the 2-foot shoulders.

(b) Plant material shall be cleared to a height of 10 feet measured from the trail surface.

(c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5 feet of the trail.

(9) Plants with Thorns and Poisonous Plants:

(a) Plants with thorns such as cacti, *Acacia greggi, Dasylirion* species, etc. shall not be planted or allowed to grow within 10 feet of the MUT.

(b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora, Euphorbia rigida,* etc. shall not be planted or allowed to grow within 10 feet of the MUT.

(B) SHARED-USE PATH

(1) Users:

(a) Hikers, joggers, bicyclists and the disabled.

(2) Easements:

(a) Trails shall be located within 20 feet public trail/sidewalk pedestrian easements.

(3) Sub-Grade:

(a) The sub-grade shall be 90% compacted.

(4) Grade:

(a) Maximum sustained longitudinal grade 5% (20:1).

(b) The cross slope shall be 2% maximum.

(5) Surface:

(a) The tread surface shall be 10 feet wide, standard. No SUP shall be less than 8 feet wide unless approved by the Parks and Recreation Department.

(b) The tread conditions shall provide an adequate walking surface free of obstacles or hazards and shall allow for side-by-side travel and ease of passing by pedestrians and bicycles.

(c) Concrete shall meet or exceed Section 725 requirements.

(d) Where the pathway surface ties into another hardscape surface material, i.e., sidewalk or curb, the trail shall meet and match the grade of the hardscape surface

(6) Path Locations:

(a) The SUP shall not be placed in retention basins, drainage ways, channels or in naturally occurring or man-made washes, unless otherwise approved.

(b) There shall be a minimum 5-foot horizontal clearance between sidewalks and trails and other obstacles, i.e., fences, walls, utility boxes and other fixed objects.

(7) Switchbacks:

(a) The inside radius of a pathway switchback shall be a minimum of 5 feet.

(8) Vegetation Clearance and Removal:

(a) Plant material shall not be planted or allowed to grow in the 2-foot shoulders.

(b) Plant material shall be cleared to a height of 10 feet measured from the trail surface.

(c) Dead vegetation will remain in place unless considered a hazard or obstruction. Tree and brush cuttings, broken limbs and other vegetative debris including fallen saguaros shall be removed from within 5 feet of the trail surface.

(9) Plants with Thorns and Poisonous Plants:

(a) Plants with thorns such as cacti, *Acacia greggi, Dasylirion* species, etc. shall not be planted or allowed to grow within 10 feet of the SUP.

(b) Poisonous plants such as *Nerium oleander*, *Sophora secundiflora, Euphorbia rigida,* etc. shall not be planted or allowed to grow within 10 feet of the SUP.

(C) GRADE-SEPARATED CROSSING (UNDERPASS FOR PEDESTRIAN/EQUESTRIAN USAGE)

(1) When major trails intersect streets or roads, a pedestrian and/or equestrian cell (a barrel within a culvert) or bridge shall be provided for user safety.

(2) The underpass/bridge shall have a minimum 12-foot vertical and 10-foot horizontal clearance, and unobstructed sight lines shall be maintained.

(3) Underpasses and bridges more than 50 feet in length shall be artificially lit to an average of 2 foot-candles minimum on the trail surface

(4) The underpass shall be connected to the MUT/SUP with a concrete tread surface, rough broom finished. The MUT shall receive a heavy broom finish to improve equestrian footing.

SECTION 430
LANDSCAPING AND PLANTING

Delete SECTION 430 in its entirety and replace with the following:

430.1 DESCRIPTION

This Section shall govern the preparation and planting of landscape areas required in the Plans or Specifications. Materials shall be in accordance with the Section 795.

Existing utilities and improvements not designated for removal shall be protected in place. The Contractor, at no additional cost to the contracting agency, will repair any damages.

Unless otherwise provided, walls, curbs, planter boxes, irrigation systems and other improvements shall be constructed after rough grading has been completed and prior to finish grading.

430.2 GENERAL

Furnish all labor, materials, equipment and incidental needs to install the landscape to the drawings, details and specifications shown in the plans.

Applicable publications listed below form a part of this specification to the extent referenced:

Arizona Nursery Association Growers Committee Recommended Tree Specification (latest edition)

American Society for Testing and Materials (ASTM) C136, Standard method for sieve analysis of fine- and coarse-grained aggregates;

(ASTM) F1632, Test methods for particle size analysis and sand grading of golf course greens and sports field root zone mixes;

(ASTM) D2974 Method B, Test moisture, ash and organic matter of peat and other organic soils;

(ASTM) F1647, Test methods for organic matter content of golf course greens and sports turf root zone mixes.

All landscaping and irrigation work shall be installed by a contractor licensed to perform this specialty work.

Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by federal, state and local authorities in furnishing, transporting and installing materials as shown or for completing the work identified herein.

430.2.1 Source Quality Control: Ship materials with Certificate of Inspection required by governing authorities.

Do not make substitutions: If specified material is not obtainable, submit proof of non-availability, together with proposal for use of equivalent material, similar in appearance, ultimate height, shape, habit of growth and general soil requirements. The Contractor may make substitution of a larger size of the same species with approval by the Engineer. However, any additional cost for these substitutions will be borne by the Contractor.

Before delivery of the following materials, a letter of compliance shall be submitted, certifying that materials meet the requirements for legal transportation of state and local government agricultural laws and are true to analysis as specified. Certify the following:

Nursery-propagated plants
Cacti, succulents, and native plants
Soil amendments and conditioners

Lawn seeds, stolons, and sod
Native seed mixes

430.2.2 Samples and Tests: The Engineer reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected materials shall be immediately removed from the site at the Contractor's expense. The Contractor shall pay cost of testing materials not meeting specifications.

430.2.3 Herbicide / Pesticide Applicators: All herbicide / pesticide applicators shall be appropriately licensed for application of non-restricted use chemicals with the Pesticide Management Division, Department A9. All landscape contractors are required to furnish a copy of their application from the Registrar of Contractors, which shall list the names of those employees approved as applicators by the Registrar of Contractors. Application of non-restricted-use pesticides shall not take place until the Engineer receives a copy of the application.

430.3 PLANT ESTABLISHMENT GUARANTEE AND MAINTENANCE

Unless otherwise authorized, the Contractor shall maintain all landscape areas on a continuous basis as they are completed during the course of work and until final Plant Establishment Guarantee and Maintenance Acceptance. The Contractor shall provide adequate personnel to accomplish maintenance. Maintenance shall include keeping the landscape areas free of debris on a weekly basis, chemical control of weeds and fertilization as needed, cultivating the planting areas, and mowing of turf where lawns are part of the project.

Plants shall be kept in a healthy, growing condition by watering, pruning, spraying, weeding and any other necessary operation of maintenance. Plant saucers and beds shall be kept free of weeds, grass and other undesirable vegetation. Plants shall be inspected at least once per week and appropriate maintenance performed. Pruning and re-staking is to include removal of any growth conflicting with vehicular or pedestrian movement.

Turf from seed or stolons shall be considered established when it is ready for use, and turf exceeds 95% coverage of an 18-inch-diameter ring when placed on the ground by the Engineer. The turf shall be vigorously growing, uniform in color and cut to a uniform height designated by the Engineer. Roots shall have penetrated the soil to a depth of not less than 4 inches.

The Contractor shall maintain the irrigation system and make any necessary repairs regardless of cause to assure a complete and operational system as originally designed and constructed. Repairs shall be made within 48 hours of detection.

The Contractor shall request an initial inspection by the Engineer when all planting and related landscape work is accomplished. After this initial inspection, and subject to approval of work by the Engineer, written field notification to the Contractor setting the effective date for beginning of the Plant Establishment Guarantee and Maintenance Period will be issued. This Period shall last for 90 days or as specified, unless extended by the Engineer. If the landscape areas are improperly maintained; if appreciable plant replacement is required (for whatever reason), if corrective work is required for the operation of the irrigation system, or if other corrective work is necessary, the Plant Establishment Guarantee and Maintenance Period shall be extended and the Contractor shall continue to maintain the entire site until accepted at no increased cost to the Owner.

At the end of the Plant Establishment, Guarantee and Maintenance Period, a final inspection will be performed. If, after inspection, the Engineer is of the opinion that all planting areas are weed free and plant materials are in satisfactory growing condition, the Engineer will give the Contractor written Notice of Acceptance of the landscape installation. Any plants that need to be replaced, regardless of the cause, shall be replaced prior to final acceptance.

430.4 JOB CONDITIONS

Site Examination: The prospective Contractors are encouraged to visit the jobsite prior to bidding on this project and to satisfy their concerns as to the magnitude of the work involved.

Water costs are the Contractors responsibility until Final Acceptance or end of Plant Establishment, Guarantee and Maintenance Period, whichever is longer, and the water meters are transferred to the city.

Before the beginning of landscape work, all planting areas shall be left free of construction debris and/or toxic material and subgraded to a level to permit landscape and irrigation construction. Trenches, foundation backfill or other filled excavations shall be compacted prior to the beginning of any landscape work. No soil preparation or planting shall begin before the site has been cleared and cleaned of debris. Commencement of work indicates acceptance of jobsite conditions.

Cooperate and coordinate with other Contractors and trades working in and adjacent to landscape areas.

430.4.1 Utilities: Determine location of underground utilities and perform work in a manner that will avoid possible damages. The Contractor, at no additional costs to the contracting agency, will repair any damages. Hand-excavate as required. Maintain stakes by others until removal is mutually agreed upon by parties concerned.

All plants and trees located within 10 feet from public water and sewer mains shall follow the requirements provided in the City of Phoenix Design Standards Manual for Water and Wastewater Systems.

430.4.2 Obstructions: If rock or other obstructions are encountered in excavation for planting, notify the Owner's representative. Proceed with work only as directed.

430.4.3 Existing Surface Soils (Borrow Excavation): Shall be used for plating non-pave (non-turf) areas and as part of the backfill mix for planting Nursery Stock.

430.4.4 Imported Clean Fill: Shall be used for turf areas and amended per Subsection 430.11 Preparation for Lawn. Unless otherwise specified, the minimum clean fill depth in lawn areas shall be 6 inches.

430.5 DELIVERY, STORAGE AND HANDLING

Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored on-site.

Sod: Time delivery so that sod will be placed within 24 hours after stripping at the sod farm. Protect against drying, cracking and breaking of soil on the rolled strips.

Trees and Shrubs: Do not prune prior to delivery unless otherwise approved by the Owner's representative. Do not bend or bind trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide adequate protection for root systems. Protect root balls from drying out in the wind and sun.

Deliver trees/shrubs just prior to planting. If planting is delayed more than 6 hours after delivery, set trees and shrubs in the shade, protected from weather and mechanical damage. Keep roots moist. Water as often as necessary.

Plant Inspection Prior to Delivery to the Project Site: Before delivery of any species to the project site, the Contractor shall make the necessary arrangements with the Engineer for an inspection of the plant material and tagging of representative plant stock. The Contractor will pay for travel to non-local nurseries out of the metropolitan Phoenix area when plants are not available locally.

The Contractor shall notify the Engineer at least 7 days in advance for inspection of the plant material. Prior to notification of the Engineer for inspection, the Contractor shall physically verify that the plant material meets the size specified.

After delivery, any plants found to be unsuitable in growth or condition or any plants that are not true to the specification or equal to the tagged plant stock shall be removed and replaced with acceptable plants at the Contractor's expense.

430.6 MATERIALS AND PRODUCTS

Materials and products shall conform to the requirements of Section 795.

430.7 SEQUENCING AND SCHEDULING

Proceed with and complete landscape work as rapidly as portions of the site become available, working with reasonable limitations for each kind of work required.

Plant or install lawns during normal planting seasons or as directed by the Engineer.

For Bermuda grass, seed from April 15 to the end of September, provided nighttime temperatures are averaging above 60ºF.

For perennial rye grass, plant when directed by the Engineer.

Coordination: Plant trees and shrubs after final grades are established and prior to planting lawns, unless otherwise accepted in the construction schedule by the Engineer. If tree and shrub planting occurs after lawn work, protect lawn areas and properly repair damage to lawns resulting from tree or shrub planting operations.

430.8 PREPARING THE SITE FOR LANDSCAPING

All non-paved areas, as directed by the Engineer, shall be treated with a chemical control, such as glyphosate or equal, to control and kill weeds. All applications of the chemical control agent shall contain a blue or green dye so that treated areas can be identified. These areas shall be cleared and grubbed no sooner than 2 weeks after the last application of chemical weed control, or when week kill has been established to the satisfaction of the Engineer. Any area to receive seed mix or which is to remain undisturbed shall be excluded from treatment.

Clear and grub landscape areas in accordance with Section 201.

Remove or relocate trees, shrubs, grass, improvements or obstructions that interfere with the installation of new work. Removal includes digging out stumps and roots to a depth of 12 inches below existing or proposed grade, whichever is lower.

Fill depressions caused by clearing and grubbing operations with satisfactory soil material. Place fill in 6-inch loose depths and compact to adjacent ground densities.

Soil Preparation in Non-Turf Areas Including Planters: After clearing and grubbing is complete, rough grade and remove all deleterious materials. Fine grade the areas. Rocks and debris, including miscellaneous concrete spillage clumps over 1 inch in any dimension, shall be removed and disposed of off-site.

The finish grade for landscape areas shall not vary more than 1 inch from specified grade and cross section and shall be a smooth, uniform surface free of abrupt grade changes or depressions. Surface drainage shall flow as designated on the plans.

Finished soil grades adjacent to paving, curbs or headers will consider the depth of applied toppings materials such as granite or river run. Unless otherwise specified, the soil grade for granite areas shall be 3 inches below adjacent pavements for application of 2 inches of granite. Apply a preemergent weed suppressant to the finish soil surface; include dye as specified with the application.

430.9 HEADER INSTALLATION

Headers shall be installed at the locations and elevations shown on the plans.

Concrete forms shall be approved by the Engineer prior to pouring concrete. Concrete shall be Class B.

430.10 EXECUTION OF PLANTING

Clearing and grading areas shall be free of construction debris and/or toxic materials and graded to permit landscape construction.

Landscape or planting areas shall not be cultivated when they are so wet as to cause excessive compaction or so dry as to cause excessive dust or the formation of large clods. Prior to excavating plant pits, layout individual trees and shrubs for the Owner's representative to approve the locations. Make minor adjustments as might be requested.

Protect existing vegetation from damage during planting operations. The Contractor is responsible to replace any damaged vegetation in kind as directed by the Engineer.

430.10.1 Deciduous and Evergreen Plantings

Excavation: Plant pits shall be dug to produce vertical sides and flat, non-compacted but firm bottoms. If pits are dug with an auger and sides of pits are glazed, scarify the glazed surface. The size of the pits shall be twice the diameter of plant root ball or container size, and only as deep as the root ball.

Drainage: Test drainage of plant pits by filling with water twice in succession. Plant pits retaining water for more than 24 hours shall be brought to the attention of the Owner's representative. Submit in writing a proposal for correction, for approval by the Engineer, before proceeding.

Setting and Backfill for Plants: Set plant material on non-compacted firm soil, plumb and in center of pit or trench. The crown (juncture of the root and shoot) shall be at grade when planting is complete. Remove pallets or containers before placing backfill. Do not handle container plants by foliage, branches or trunks. After removing the plant from its container, scarify side of the root ball. Do not plant stock if the root ball is cracked, broken or root bound. When set at the proper elevation and orientation, place additional backfill mix and brace the plant. Work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water the plant thoroughly before placing remainder of backfill. Repeat watering again after placing final layer of backfill mix until soil is completely saturated.

Plant Saucers: Prepare an example plant saucer for the Engineer's review and approval. Schedule this review with the Engineer before starting planting operations.

Stake All Trees Per Plans: Set stakes vertically and outside of root ball into undisturbed soil. Place tree ties for maximum support with top tie above scaffold branches and second tie midway to the ground level. Avoid "rigid" restraint of tree and allow for some trunk movement. Stakes are to be set into native soil.

430.10.2 Agave, Aloe, Cactus, Ocotillo and Yucca Plantings

Excavation and Drainage: Shall be completed per Section 430.10.1, except plant pit shall be 6 inches deeper than root ball.

Setting and Backfill: Do not set plant deeper than the plant would grow naturally. Prior to placement, lay the plant down just over the hole. Trim off old dead roots to no longer than 2 inches and clean out any rocks stuck in the plant. All new plant root growth will come from the center of the root ball, not from the old roots or from the side of the stem or trunk. Place plant in the hole and orient to match the previous heliotropic growing condition. Set plant elevation to the visible dirt line mark of the plant and backfill the plant using the specified backfill mix. Plant shall be planted to maintain positive drainage away from the root collar of the plant. Tamp the soil to stabilize the plant. Now drench and wash off the plant.

Monitor watering closely. Normal watering for agave, aloe, cactus, ocotillo and yucca is once per week. During the heat of the summer, briefly spray or mist these plants from a hose to cool the plants' surface temperature. During cooler temperatures, adjust the watering schedule for the time of day and frequency.

430.11 PREPARATION FOR LAWN

430.11.1 Soil Preparation and Fine Grading New Turf Areas: Excavate as necessary to accommodate depth of clean fill, topsoil and soil amendments. Prior to placing fills and amendments till to a depth of not less than 4 inches, make alternate passes at right angles. Remove rocks and debris greater than 1 inch in any dimension. Remove high areas and fill depressions. Apply soil amendments (refer to the Section 795) as follows:

Organic matter – 2 inches deep
Sulfur – 10 pounds/1000 square feet
Iron Chelate – 1 oz/1000 square feet

Roto-till soil and amendments to homogenous fine mixture, free of lumps clots, stones, roots and other extraneous matter. Till the mixture until it is uniform in color and appearance to the satisfaction of the Engineer.

Forty-eight (48) hours prior to seeding operations, fine grade lawn areas to a smooth, even surface with a loose, uniformly fine texture. Finish drag or rake lawn areas, removing all deleterious material ½ inch or larger from the surface and to a depth of 2 inches below the surface. Roll the lawn surface to obtain the desired compaction and remove ridges. Finish grade shall be as shown on the plans. Finish grade shall be set 1-1/2 inches below adjacent paving, curb and headers. The Engineer shall be able to push a hand probe to a depth of 4 inches at any location where turf is to be established.

Apply fertilizer (refer to Section 795), fertilizer percentages (N-P-K) and the rate of application per soil fertility test results. For bidding purposes, the fertilizer shall be (15-15-15) applied at 5 pounds/1000 square feet. Apply additional fertilizer at the end of the turf establishment or date agreed upon with the contracting agency. Establishing turf is the Contractor's responsibility.

430.11.2 Recondition Existing Lawn Areas: Areas damaged by Contractor's operations, including damage caused by movement of vehicles or from the storage of materials or equipment, shall be reconditioned prior to seeding or sodding.

Remove ridges, ruts and aerate compacted soils. Fill depressions with topsoil soil. Rake surfaces to remove clumps and debris and other deleterious material ½ inch or larger from the surface. Apply fertilizer (refer to Section 795) at the rate recommended by the manufacturer (stated on bag) before initial seeding operations.

430.12 LAWNS

The Contractor shall not begin planting until the irrigation system is completely installed, is adjusted for full coverage and is completely operational.

430.12.1 Sod: Allow for sod thickness in areas to be sodded. Apply commercial fertilizer at rates specified by the manufacturer and thoroughly mix into upper 2 inches of soil. Delay applications of fertilizer if planting will not follow within a few days.

Lay sod within 24 hours of initial cutting. Form a solid mass of sod with tightly fitted joints. Butt ends and sides of sod. Do not overlap joints. Stagger sod strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Sod edges and joints shall be leveled with approved soil mix.

430.12.2 Seeding Lawns: Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

Sow seed using a spreader or seeding machine at a rate of 3 1/2 pounds Bermuda grass per 1000 square feet. Do not seed when wind velocity exceeds 5 MPH. Distribute seed evenly over the entire area by sowing equal quantities in two directions at right angles to each other.

Bermuda seed shall be planted only at times when daytime atmospheric temperatures are consistently above 90ºF and the nighttime atmospheric temperatures are consistently above 60ºF. If turf establishment from seed cannot be

completed during the Contract period, then perennial rye grass seed will be planted when required by the Engineer, at no additional cost to the contracting agency. Apply rye grass at the rate of 15 pounds per 1000 square feet. Distribute rye seed evenly over the entire area by sowing equal quantities in two directions at right angles to each other.

Rake lightly into top 1/8 inch of soil, roll and water with a fine spray.

430.12.3 Hydroseeding Lawn Areas: The Contractor shall follow a two-step process of hydroseeding followed immediately by hydromulching. Equipment used shall be manufactured for the purpose of hydroseeding. It shall be equipped with a tank capable of continuous agitation, suspension and blending of the slurry components. It shall be equipped with a pumping system capable of maintaining a continuous spray. It shall be equipped with nozzles and hoses to obtain a uniform application on designated areas. The tank and accessories shall be cleaned and free of contaminants. The storage tanks shall have a means of estimating the volume used or remaining in the tank.

For hydroseeding and hydromulching materials, refer to Section 795. All materials shall be labeled or supplied with test information concerning analysis of the various components. All work shall be performed in a professional manner to the best industry standards. Care shall be taken to avoid drift and displacement of material or any damage to structures and landscape. Protective covering shall be used where material would be objectionable. Clean up shall be done daily. Seeded areas shall be protected from traffic and construction activities.

Water, fertilizer, mulch and seed shall be combined in proportion in the first application to cover the areas at the specified rates. The ingredients shall be allowed to mix thoroughly. Allow the ingredients to mix for a minimum of 5 minutes before application of the slurry, but do not allow seed to be in the tank longer than 60 minutes, inclusive of the time to agitate.

Hydroseed an even first application of the following components:

Bermuda grass seed	200 pounds/acre
Fertilizer	200 pounds/acre
Mulch (100% wood cellulose fiber)	400 pounds/acre

Hydromulch an even second application immediately after hydroseeding with the following components:

Mulch (100% wood cellulous fiber)	1400 pounds/acre
Tackifier	100 pounds/acre

Remove hydroseed or hydromulch deposited on adjacent trees and shrubs, roadways, structures or other area surfaces where they are not specified.

Water the hydroseed to germinate the seed and continue watering until established. Monitor watering every day. DO NOT overwater or underwater. It may be necessary to water several times a day. Newly germinated areas must be kept moist.

430.13 DECOMPOSED GRANITE AND RIVER RUN AREAS

The areas on which the granite mulch or river run rock is to be placed shall be graded according to the drawings prior to the placement of any granite or river run rock. The ground shall be reasonably smooth, and rocks larger than 1 inch in diameter within the top 1 inch of soil shall be removed and disposed of off-site.

The Contractor shall stake out all areas to receive granite mulch or river run rock. These areas shall be treated with a pre-emergent control such as Surflan or equal prior to and after placement of the cover material.

Decomposed granite shall be evenly distributed on the designated areas to a depth as indicated on the plans and details. If a depth is not indicated, the minimum depth shall be 2 inches.

After placing and grading the granite mulch, the Contractor shall water granite with a light spray to settle the granite and remove fine materials from the surface. Immediately after watering, the Contractor shall roll the granite mulch with an appropriate device to an extent satisfactory to the Owner's representative.

River run rock used shall be as specified on the plans. The rock shall be evenly distributed on the designated areas to a depth 1-1/2 to 2 times the maximum gradation size.

430.14 CLEANUP AND PROTECTION

During landscape work, keep pavements clean and work areas in an orderly condition. Sweep, scrub or hose affected areas as directed by the Owner's representative to maintain a clean and neat work area.

Protect landscape work and materials from damage due to landscape installation; operations by other contractors; and trades, trespassers and animals. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed by the Owner's representative. Remove all debris, trash and excess materials generated by the landscape installation.

430.15 MEASUREMENT AND PAYMENT

The lump sum or unit prices established on the schedule of values shall be full compensation for furnishing all labor, material, tools and equipment and for performing all work necessary to complete the landscaping operation to include planting of trees, shrubs and ground cover.

The quantities of lawn seeding will not be measured but shall be the quantities designated in the Contract documents, except that measurements will be made for revisions requested by the Engineer or for discrepancies of ±5% of the total quantity designated in the Contract. The quantity of lawn shall include soil preparation, fertilizer, seed and water established and accepted.

The quantity of sod to be measured will be the actual number of square feet, including soil preparation, water, fertilizer and sod established and accepted.

When line-item bids or schedule of values do not initially include a cost for the plant establishment and maintenance period, the cost shall be assumed in the schedule of values for landscape items (i.e., plant materials, irrigation and inert materials such as decomposed granite, river run and boulders). Ten percent of the sum total of landscape items in addition to retention will be held for distribution during the maintenance period. Equal monthly payments for maintenance will be authorized, based on inspection and subject to extensions, where the Contractor fails to comply with previously stated requirements in Subsection 430.3. Payment may or may not be supplemental to final project payment.

SECTION 431
PALM TREE TRANSPLANTING

Add SECTION 431 in its entirety:

SECTION 431
PALM TREE TRANSPLANTING

431.1 DESCRIPTION

This Section shall govern the relocation (transplanting) and planting of palm trees required by the plans or specifications. The Contractor shall furnish all labor, materials and equipment required to complete the excavation, lifting, transporting and transplanting of palm trees.

431.2 GENERAL

Unless otherwise provided by this Section, the work shall conform to the Section 430 and the following.

431.3 PALM ESTABLISHMENT GUARANTEE AND MAINTENANCE

Palm establishment, guarantee and maintenance shall be per Section 430 with the following modifications or additions:

The palm establishment, guarantee and maintenance period shall be for 90 days, unless otherwise extended.

Guarantee palms against the vascular disease *Penicillium (Gliocladium) vermoeseni*, the fungus *Fusarium oxysporum*, and the root disease *Phytophora* and similar vascular infections for a period of 5 years.

Replace all dead palms and all palms not in a vigorous condition without additional cost to the contracting agency . Replacement shall be when directed by the Engineer.

431.4 JOB CONDITIONS

Prospective contractors are encouraged to visit the jobsite prior to bidding on this project and to satisfy their concerns as to the magnitude of the work involved.

It may be necessary to supplement the irrigation system and provide additional water to establish newly planted palm trees. Water from the existing irrigation system will be paid for by the contracting agency. The Contractor is responsible for delivery and payment of water from other sources.

Remove all debris, trash and excess materials found on-site or generated by the Contractor’s operations.

Prior to digging and transplanting of palm trees, the Contractor shall notify the Engineer at least 2 working days before starting any work.

431.5 DELIVERY, STORAGE AND HANDLING

Palms shall be free of dead or dying fronds with all fronds of a normal size and color.

The landscape architect will be available to review and tag palms at place of growth and will again review palms upon delivery for conformity to the specifications. Travel to non-local nurseries out of the metropolitan Phoenix area, when requested by the Contractor, will be paid for by the Contractor. In lieu of non-local nursery review, the Contractor may elect to provide photographs with a person adjacent to each palm for preliminary review. Such review shall not impair the right of review and rejection during progress of the work should the palms not meet the specifications. The selected palms shall not exceed the specified height by more than 1 foot. It is unacceptable to plant the root ball deeper than 1 foot above the soil line of the palm.

The Contractor must certify that the palms are free of disease prior to shipment.

After tagging of the palms, remove all thatch from older leaves and cut back all resulting stems to within 2 inches of the base of the trunk. The crown of the palm shall be reduced per standard nursery practice prior to shipping. Use soft rope (organic twine) to tie remaining fronds to protect crown bud. Do not permit fronds to become damaged by means of restraint.

Exercise extreme caution while pruning palms to prevent spread of vascular diseases. Dip pruning tools in a sterilizing agent before beginning pruning and before moving from one palm to another. Do not use any chain type saws for pruning operations.

Lifting, Off-loading, and Transporting: A lattice-type crane, a telescoping-type crane or a specially designed tree crane is acceptable for lifting and off-loading palm trees. For transporting, the trailer used shall be long enough to avoid damage to the heart of the palm. Loading and unloading of palms must be accomplished with the aid of nylon or fabric sling/straps with a minimum width of 4 inches. Excessive scarring or trunk damage will not be permitted and will be cause for rejection of the palms at the project site.

If the palms are not planted the day they arrive at the project site, the crowns and root ball should be protected from the sun and from reflected heat from the ground. Avoid storing on an asphalt surface.

Covering material must allow air movement so that heat does not build up under the covering. Do not use plastic or rubberized tarpaulins. Trees may not be stored for more than 48 hours. Do not stack palms, but lay them in a single layer on a flat surface. Covered root balls must be watered lightly every couple of hours.

431.6 MATERIALS AND PRODUCTS

All palms shall have been grown in accordance with good horticultural practices under climatic conditions similar to those for the project for at least 2 years prior to shipment to the site.

All palms shall be well-grown, symmetrical, without curvature or leaning trunk from the perpendicular and so trained or favored in development and appearance as to be superior in form, compactness and symmetry of crown. All palms shall be within 1 foot above or below the height specified, measured from the bottom of the crown bud to finish grade after installation.

All palms shall be sound, healthy and vigorous; well foliated prior to pruning; and showing no signs of disease. They shall be free of disease, insect pests, eggs or larvae. They shall also have well-developed root systems. All palms shall be free from physical damage or adverse conditions that would prevent thriving growth.

Verify that all field-dug palms contain an adequate root ball to guarantee transplantation. Do not wrap the root ball in plastic. Do not install palms that have damaged root balls.

Accessories:

Clean-washed river sand

Frond Tie: Minimum 1/2-inch-diameter soft sisal rope capable of maintaining frond in tied condition for 1 year.

Fungicides: Soil Drench: "Subdue" by CIBA-GIEGY

431.7 SEQUENCING AND SCHEDULING

Coordinate delivery of palms with planting operations to avoid on-site storage longer than 48 hours. Planting delays may result in rejection of the palm.

431.8 PREPARING THE SITE FOR LANDSCAPING

Remove palms designated for replacement. Removal includes digging out stumps and roots to make room for replacement material. Remove all debris, trash and excess materials generated and dispose of this material off-site.

Protect existing plant material, walls, pavements and other site amenities from damage.

431.9 PALM TREE SALVAGING

Prior to excavation, the palm tree shall be thoroughly watered.

Excavation: A trenching machine, a backhoe with a narrow bucket or a properly sized tree spade, is acceptable as the excavation equipment. The exact equipment used must be approved by the Engineer.

Reduce the crown of palm trees per standard nursery practice. Use soft sisal rope to tie remaining fronds to protect the crown bud.

The size of the root ball taken shall be a minimum of 18 to 24 inches deep and have a 2- to 3-inch wider radius than the base of the palm, unless otherwise directed by the Engineer. Certify that all field-dug palms contain adequate root ball to guarantee successful transplanting.

Carefully lift and transport the palm tree to the new location so as not to cause damage to the tree or site.

431.10 EXECUTION OF PLANTING

Lay out palms at locations shown on the plans. Use 3-foot lath, color coded for each palm. The Engineer will check location of palms in the field to exact position before planting begins.

Where palms are to be preplanted to permit site improvements to be installed around them, be responsible for the accurate layout of those palms, measured to their centerlines. Be responsible for the protection of those palms while work is taking place. Provide regular irrigation as necessary until final acceptance.

The palm tree excavation shall be a minimum of 1.5 times larger than the root ball depth and 1 foot larger on all sides. It is acceptable for the final site grade around the palm to be 6 to 12 inches higher than the original soil line of the root ball. The depth of the pit shall be approved by the Engineer prior to planting the tree.

Water test each tree pit for drainage by filling the holes twice in succession with water. If, when filled with water the second time, the pit fails to drain within 24 hours, then additional excavation is necessary to break through the impermeable layer or provide a thick underlayer of sand below the root ball. The cost for over excavation and for the installation of a drainage chimney will be considered should the tree pit not drain.

Clean, moist, washed river sand should be added to the bottom of the hole and tamped or water jetted prior to insertion of the tree.

Install drainage and viewing pipe(s) in each tree pit to assure wetting of the whole root ball and to enable monitoring and viewing of the tree pit chamber. The vents shall be 4-inch-diameter perforated PVC with sufficient length to extend to the bottom of the tree pit. Do not backfill drainage or viewing pipes.

Backfill should be clean-washed river or concrete sand amended with 25% native soil. In areas where soils are heavy in caliche, 100% sand shall be used. After placement of the palm, moistened sand shall be thoroughly tamped as backfill is being added to assure stability of the tree.

A 6-inch-deep swale shall be made around each palm tree to provide water-holding capability.
Mulch: Apply a 2-inch layer of decomposed granite in all palm tree watering basins.

After planting, the crown buds of all the palms shall be within 1 foot of the designated palm height above finish grade.

After planting, drench the soil with the fungicide “Subdue” per manufacturer’s recommendations by flooding the planting basin. Reapply as often as label permits throughout the maintenance period.

Irrigation: It is essential that irrigation be deep enough to assure wetting of the whole root ball. The Contractor shall maintain the irrigation system to the existing trees and supplement additional water to newly planted trees as necessary for establishment. Use a tensiometer weekly during the maintenance period to verify correct watering at the surface and at the bottom of the root ball. Report moisture levels to the Engineer.

431.11 MEASURE AND PAYMENT

Measurement will be made on the number of trees that survive the planting operations. Unless otherwise specified by the Engineer, the Contractor shall be responsible for the cost of replacement and planting of any palm tree, in kind, that does not survive. Palms that do not survive become the property of the Contractor for disposal. Payment will be made at the unit bid price for each surviving tree, which will be full compensation for all labor, materials, tools and equipment required for excavating, transporting, transplanting and watering of the tree(s).

SECTION 440
SPRINKLER IRRIGATION SYSTEM INSTALLATION

Delete the title of this SECTION in its entirety and replace with the following:

LANDSCAPE IRRIGATION

Delete SECTION 440 in its entirety and replace with the following:

440.1 GENERAL

The Contractor shall furnish all labor, materials, tools, equipment, and services necessary for the execution and completion of the irrigation system work as indicated on the drawings and as described in these specifications and the General Conditions.

Due to the scale of the drawings, it is not possible to indicate all offsets, fittings and sleeves that may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of the work and plan the work accordingly, furnishing such offsets, fittings and sleeves as may be required to meet such conditions. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

The work of this Section generally includes provisions of an automatic underground irrigation system including the following:

Trenching, stockpiling excavation material, and refilling trenches.

Complete system including but not limited to piping, backflow preventer assemblies, valves, fittings, emitters, controllers and wiring, and final adjustments to insure complete coverage.

Replacement of unsatisfactory materials.

Cleanup, inspection, and approval.

Tests: The system shall efficiently and uniformly irrigate all areas and perform, as required, by the plans and specifications.

No irrigation work is to be performed until all areas are finished to proper grade and until soil preparation is completed and has been approved by the Engineer.

440.1.1 Work by the Water Services Department: The Contractor will coordinate with the Engineer at the Pre-construction Meeting to schedule water service dates well in advance of need. The Engineer will contact the Water Services Department to authorize work required to be performed by Water Services Department crews. At least 6 weeks prior to need, the Contractor will apply with the Water Services Department. At the time of application, the Contractor will contact the Water Services Department to schedule installation of a water tap and meter and to provide them with the billing address.

The Contractor shall pay for all water used until the project is accepted or until completion of the landscape maintenance period, whichever is later, and the water meter accounts are transferred back to the city. At the close of the project, the Contractor shall submit water meter account numbers to the Engineer and request transfer of the meter to the city. The Contractor will remain responsible for water used and payment thereof until transfer.

440.1.2 Work by the Power Company: The Contractor will be responsible for coordinating with the power company to locate power drops for the irrigation controller(s) when power is not serviced by a Service Entrance Section.

Unless otherwise specified or directed by the Engineer, the Contractor will obtain an account with the utility company and pay for all electrical power used until the project is accepted or until completion of the landscape maintenance period, whichever is later, and the utility accounts are transferred. At Final Acceptance, Contractor will submit electrical meter account numbers to the Engineer and request transfer of the meter to the city, or the Contractor will remain responsible for electrical use and payment thereof until transfer.

440.2 REFERENCES

Conform to the requirements of reference information listed below except where more stringent requirements are shown or specified in the Contract Documents.

American Society of Testing Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.

Underwriters Laboratories (UL) - UL Wires and Cables.

440.3 QUALITY ASSURANCES

Work involving plumbing for installation of copper piping, backflow preventer(s), and related work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.

440.3.1 Tolerances: Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, re-compaction and repair of finish grade treatment.

440.3.2 Coordinate Work with Other Trades: For a period of 1 year from Final Acceptance, guarantee/warranty irrigation materials, equipment and workmanship against defects. The Contractor shall replace any pavement damage resulting from the installation of the irrigation system and repair damage to grading, soil preparation, seeding, sodding or planting at no additional cost to the Owner. Make repairs within 3 days following notification by the Engineer.

440.3.3 Delivery Storage and Handling: Protect pipe from heat and sunlight during storage. Provide shade protective cover and allow air to circulate between pipes. Transport pipe so as not to subject pipes to bending or concentrated external loads. Pipe that is sun tanned, dented, or damaged will be rejected.

440.4 SUBMITTALS

440.4.1 Shop Drawings and Product Information: Prepare and make submittals in accordance with conditions of the Contract and as follows: A minimum of 10 days prior to beginning work on the irrigation system, the Contractor shall submit six (6) copies of manufacturer's literature. Highlight product specifics including name, model numbers of materials listed below and any other items requested by the Engineer. Do not order materials until the Engineer approves products.

Items to be submitted:

Sprinklers (turf heads, shrub bubblers, emitters)	Backflow preventers	Flowmeters
Pipe and fittings	Automatic valves	Flushcaps
Swing joint assemblies	Controllers	Micro-tubing and stakes
Quick-coupling valves	Solvents	Wire and connectors
Gate valves	Wye strainers	Valve boxes, pull boxes, etc.
Pressure-regulating valves		

All items shall be those specified and approved by the Engineer. Substitutions will not be allowed without approval.

440.4.2 Record Drawings: The Contractor shall maintain an accurate set of as-built plans on-site. At the end of each day, work accomplished shall be updated on the as-built plans. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following:

Connection to existing waterlines
Connection to existing electrical power
Gate valves
Routing of sprinkler pressure lines (dimension at a minimum of 100 feet along routing)
Emitter control valves
Routing of control wiring
Quick-coupling valves
Other related equipment as directed by the Engineer

The Contractor shall indicate any non-pressure pipe routing changes on the as-built drawings.

Before the final inspection, the Contractor shall deliver to the Engineer one copy of the as-built plans to review. Delivery of this set of plans does not relieve the Contractor of the responsibility of furnishing required information that may be requested by the Engineer. The Contractor shall make corrections noted and submit final as-built plans to the Engineer for approval and acceptance. The Engineer will not certify payment requests or make final payment if as-built plans are not current or complete.

440.4.3 Controller Charts: As-built drawings shall be approved by the Engineer before controller charts are prepared. The chart shall show the area controlled by the automatic controller and shall be 24- by 36-inch sheet size, unless a reduced size is approved by the Engineer. Identify the area of coverage of each remote-control valve using a distinctively different color, drawing over the entire area of coverage. Following review of the charts by the Engineer, they shall be hermetically sealed between two layers of 20-millimeter-thick plastic sheets. These charts shall be completed and approved prior to final inspection of the irrigation system. When approved by the Engineer, a separate card listing stations and areas covered may be substituted for the 24- by 36-inch hermetically sealed plan sheet(s).

440.4.4 Operation and Maintenance Manuals: Submit four (4) operation and maintenance manuals to the Engineer for review prior to final acceptance. The manuals should include the complete technical description of materials and products used, guarantee statement, and complete operating and maintenance instructions on all major equipment. The Contractor shall provide a demonstration to maintenance personnel, with the Owner's representative present, of how to adjust and maintain all sprinkler head types, controller functions, and recommended controller programs, as established by the Contractor. The Contractor is also to review recommended watering rates for new plant materials.

440.4.5 Equipment to be Furnished: All materials are to be new and bear the appropriate National Association seal of approval, e.g., NSF, UL, etc. Similar units shall be procured from the same manufacturer, and internal parts shall be common and interchangeable. Parts listing and source replacement will be furnished to the Engineer.

Equipment to be furnished:

a. Two sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied to the project.

b. Two quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.

c. One 5-foot valve key for operation of gate valves

The above-mentioned equipment and stock shall be turned over to the Owner at the conclusion of the project. Before final inspection, evidence that the Owner has received this material must be provided to the Engineer.

440.5 PERMITS

All permits for installation or construction of the work included under this Section, which are required by legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. The Contractor shall also arrange for and pay all costs in connection with any inspections and examinations required by these authorities.

440.6 EXECUTION

Examine areas and conditions under which work of this Section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

440.6.1 Staking: Mark the routing of the pressure supply line with powdered lime, and stake the locations of various components. Coordinate locations with other trades. Coordinate sleeves with other trades. Preliminary adjustments to conform to actual site conditions shall be accomplished during staking. Should changes be required, the Contractor shall obtain approval of the Engineer prior to actual work being performed. Utility connections, both water and electrical, shall be as shown on the plans or as designated by the utility concerned.

440.6.2 Trench Excavation: Trenches and other excavations shall be sized to accommodate the irrigation system components, conduit and other required facilities. Additional space shall be provided to assure proper installation and access for inspection. Unless otherwise specified, the minimum depth of cover over pipelines and conduits shall be as follows:

a. Electrical conduit – 18 inches of cover

b. Waterlines continuously pressurized – 18 inches of cover

c. Lateral sprinkler lines – 12 inches of cover

d. Plastic lines under pavement – 24 inches of cover

The bottom of the trenches shall be true to grade and free of protruding stones, roots or other matter, which would prevent proper bedding of pipe or other facilities. Where ledge rock, hard pan, or boulders are encountered, the trench bottom shall be undercut and filled with sand or fine-grained material approved by the Engineer.

Clearances:

a. Piping 3 inches and larger – minimum trench width of 12 inches.

b. Piping smaller than 3 inches – minimum trench width of 7 inches.

c. Provide not less than 4 inches of clearance between each line and not less than 12 inches of clearance between lines of other trades, to permit service or replacement without disturbing the other line.

Grading and stockpiling of trenched materials shall comply with Section 601.

440.6.3 Sleeving: Piping located under asphalt, concrete, or other pavements shall be sleeved, sized and scheduled as noted on the plan. If not noted, sleeves shall be Schedule 40, sized to easily accommodate piping. Use separate sleeve for wiring.

Boring will be permitted only where pipe must pass under obstructions that cannot be removed or when approved by the Engineer. When any cutting or removal of asphalt and or concrete work is necessary, it shall be saw cut in accordance with Section 601. Permission to cut asphalt or concrete shall be obtained from the Engineer. When piping on the drawings is shown in paved areas but running parallel and adjacent to planted areas, the intent of the drawings is to install the piping in the planted area.

440.6.4 Piping: Provide pipe, schedule and size as shown on the drawings and per these specifications.

PVC Pipe: Snake pipe in trench as much as possible to allow for expansion and contraction. Provide a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. Pipe shall be installed in accordance with ASAE Standard: ASAE 376. Pipe shall be clean prior to installation and shall be maintained in that condition during installation. When pipe laying is not in progress, the open ends of the pipe shall be closed by approved means.

If reclaimed water is used, all piping and associated appurtenances shall meet the applicable requirements of the Arizona Administrative Code R18-9-602(G). Signage will be placed to indicate the use of non-potable water.

Sand bedding or fine-grained material shall be provided where ledge rock, hard pan, or boulders are encountered. Compact bedding material is to provide a minimum depth of bed between pipe and rock of 4 inches.

Solvent-welded joints shall be made in accordance with ASTM D-2855, and the type of solvent and primer recommended by the pipe manufacturer shall be used. Primer and solvent shall be applied to the pipe ends in such a manner that no material is deposited on the interior surface or forced into the interior of the pipe during insertion. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly. The pipeline will not be exposed to water for at least 12 hours after the last solvent-welded joint has been made.

Schedule 80 pipe shall be used for threaded joints. Field threading shall be accomplished in the same manner as specified for steel pipe, except that a plug will be installed in the bore of the pipe prior to threading to prevent distortion. Solvent will not be used on threaded pipe. Threaded joints shall be hand tightened, with final tightening with a strap wrench as necessary to prevent leaks.

The pipe shall be protected from damage during assembly. All vises shall have padded jaws, and only strap wrenches will be used. Any plastic pipe that has been nicked, scarred, or otherwise damaged shall be removed and replaced. Care shall be exercised so that stress on a previously made joint is avoided.

When PVC to metal pipe connectors are required, these connections shall be accomplished first. A plastic adapter with external pipe threads should be used by screwing it into the metal internal pipe threads. Use a non-hardening pipe dope, such as Permatex #2 or equal, on all plastic to metal-threaded joints. The joint shall be hand tightened. Utilize a light wrench as necessary to prevent leaks.

When wrapped pipe is specified, joints and connectors shall not be wrapped until completion of the pressure test.

Use 45-degree fittings at all changes in depth of pipe. Couplings shall be Schedule 80 unless otherwise noted. Minimum length of PVC nipple shall be 3 inches.

440.6.5 Wiring: Service wiring shall be installed in rigid conduit from the service point to the controller at the minimum depth specified. A separate disconnect switch or combination meter socket, as required, shall be installed between the source of power and the controller. The minimum service wire shall be No. 12 AWG copper 600-volt type, TWH or larger, as required by the Contract documents or controller manufacturer. Wire splices for service wiring shall be located in pull boxes where required to facilitate installation of wiring. Pull boxes shall be plastic except where subject to vehicular traffic, in which case concrete rated boxes shall be required. Service wiring shall be per current local, state and national NEC requirements.

Low-voltage control wiring issuing from the controller shall be direct burial, type UF, No.12 AWG copper, unless otherwise required and installed in main or lateral waterline trenches wherever practical. Install common ground wire (type UF No. 12 AWG Copper) and one pilot or hot wire (type UF No. 14 AWG Copper) for each remote-control valve. (These are minimum wire sizes allowed when not noted otherwise on plans.) Multiple valves on a single control wire are not permitted.

Install two (2) control wires along the entire length of the mainline. Locate wire adjacent to main line piping. Never place wire on top of pipe. Bundle wires at 10-foot intervals with plastic electrical tape. Sufficient slack shall be left in the wiring to provide for expansion and contraction. Provide 12-foot loop (2 feet) at all changes in direction or at a minimum of 250 feet. When control wiring cannot be installed in the pipe trench, it shall be installed a minimum

of 18 inches below finish grade. Attach wire markers to the ends of the control wires and label valve stations at controller locations.

All pilot or "hot" wires are to be of a different color, and all common wires are to be of another (common) color. If multiple controllers are being utilized and wire paths of different controllers cross both common and control wires from each controller, each controller shall be of different colors.

Splices in control wire shall be made only in junction boxes and with approval from the Engineer. Splices shall be made with waterproof connector approved for underground use. Sufficient slack shall be left to allow splices brought to the surface without disconnecting the wire. No splices shall be permitted under pavements.

All wiring shall be tested for continuity, open circuits, and unintentional grounds prior to connecting the equipment. All controllers shall be grounded independent of any other controller as recommended by the controller manufacturer, and all valves shall be connected to the common ground wire of their respective controller. A single separate pilot or hot wire (different color) shall be extended from the valve to the specified controller. Low-voltage wire splices outside of the valve box are not permitted unless approved by the Engineer, in which case they must be made in a PVC pull box.

One spare #12 AGW wire “Pilot” (orange) and one #12 “Common” wire (for a total of two #12 wires) shall be installed from the controller along the entire length of pressure lines to last (farthest) electric control valve on each and every leg of the mainline. The color of the spare control wire is to be of an alternate color. Provide 3-foot length of all spare wires in each remote-control valve box along wire routing.

440.6.6 Valves, Valve Boxes and Special Equipment: Backflow Preventer Assembly: The backflow prevention assembly shall be installed per the details shown on the drawings and associated governing code requirements. Provide pipe supports and the accessories to properly secure the assembly. The irrigation system shall not be operated until the assembly has been tested and certified to meet the requirements of the Water Services Department.

After the backflow assemblies have been properly installed by the Contractor and approved by the Planning and Development Department, the Contractor shall pay for testing and be responsible for having the assembly(ies) tested by a certified backflow prevention assembly tester approved by the city. The tester shall prepare test report(s) showing the condition of the assemblies and confirming that the assemblies are properly functioning. It is the Contractor’s responsibility to submit the forms to the Engineer. Final acceptance will not be given until the reports are approved by the Engineer.

Valves, pressure regulators and related accessories shall be installed as shown on the plans, or as specified. They shall be installed in a normal upright position unless otherwise recommended by the manufacturer and shall be readily accessible for operation, maintenance and replacement. The equipment shall be set at a sufficient depth to provide clearance between the valve box cover and the valve handle, cap or key for operation of the system.

Gate valves and isolation valves shall be installed below ground and shall be housed in a concrete or plastic pipe with a bolt down locking cover that will permit access for servicing. The pipe shall be centered on the valve stem. Isolation valves shall not be located within range of the sprinklers they control without approval of the Engineer.

Drain valves shall be installed at all low points in pressure supply line as detailed. Provide drainage sump for each drain valve based on the table below.

TABLE 440-1

CUBIC FEET OF GRAVEL PER DRAIN VALVE
DISTANCE OF PIPING TO BE DRAINED

Pipe Size	0-250 LF	251-500 LF	501-750 LF	751-1000 LF
1 inch	0.75	1.50	2.25	3.00
1 1/4 inches	0.75	1.50	2.25	3.00
1 1/2 inches	1.50	3.00	4.50	6.00

TABLE 440-1				
CUBIC FEET OF GRAVEL PER DRAIN VALVE DISTANCE OF PIPING TO BE DRAINED				
Pipe Size	**0-250 LF**	**251-500 LF**	**501-750 LF**	**751-1000 LF**
2 inches	2.50	5.00	7.50	10.00
2 1/2 inches	4.00	8.00	12.00	16.00
3 inches	6.00	12.00	18.00	24.00
4 inches	11.00	22.00	33.00	44.00
6 inches	25.00	50.00	50.00	50.00

Quick couplers and hose bibcocks shall be installed as shown on the plans, or as specified. Their location shall be a minimum of 3 feet from curbs, pavements and walks, unless approved otherwise by the Engineer. Hose bibcocks shall be set 12 inches above finish grade and installed on a galvanized riser or as detailed.

Quick Coupler Assemblies shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly as manufactured by Lasco, Inc. or approved equal is specified. All quick couplers shall be set perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer.

Valve Boxes: Install one valve box for each valve installed as shown on the plans or specified unless directed otherwise by the Engineer. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted. Set valve boxes 1/2 inch above finish grade.

The valve boxes shall be branded and valves will be tagged with the controller letter and station number of the contained valve. The letter and number size shall be no smaller than 1 inch and no greater in size than 1-1/2 inches. Depth of branding shall not be more than 1/8 inch into the valve box lid. All labeling shall be neat and legible.

440.6.7 Sprinklers, Bubblers and Emitters: Install where indicated on the drawings, staked and approved. Set to finish grade as detailed; spacing of sprinklers shall not exceed maximum recommended by the manufacturer without approval of the Engineer. Assemblies shall be installed as detailed; provide at least 4 inches of clearance from vertical elements projecting above grade such as walls, planter boxes, curbs and fences.

Turf heads assemblies shall have double swing joint mobility to allow for full and optimal positioning. A pre-manufactured swing joint assembly such as that manufactured by Lasco, Inc. or approved equal is specified. All sprinkler heads shall be perpendicular to finish grade unless otherwise designated on the plans or instructed by the Engineer. Install for head-to-head coverage and uniform distribution throughout the turf area.

Plant bubbler assemblies shall consist of a horizontal connection to the lateral line with 1/2-inch S.D.R. 13.5 PVC lateral extension, Schedule 40 fittings, and 1/2-inch flex hose riser (Scheudle 40) with male adaptor (slip x thread) to receive the bubbler. Install bubbler assemblies as detailed on the plans. Locate the top of bubbler:

a. 1 inch above finish grade in shrub beds

b. In turf areas, provide 4-inch diameter (times 12-inch-long) PVC Class 200 vertical sleeve filled with pea gravel. Install bubbler 3 inches below top of sleeve. Set top of pipe flush with finish grade of turf.

Emitter assemblies provide a horizontal connection to the lateral line using schedule 40 PVC fittings and PVC to flex adapters (slip x slip), 1/2-inch Schedule 40 flex tubing (maximum length = 20 feet) and slip x threaded male adaptor to receive the emitter. Emitter outlets shall be installed to the high side of the plant. Provide a minimum of one outlet per shrub and three outlets per tree, equally spaced around the plant unless otherwise noted in the plans. Single port emitters shall be located 1 inch above grade as detailed. Multi-port emitters shall be located below finish grade, as detailed, and the distribution tubing staked in place then covered with 2 inches of mulch. The distribution tube outlet end shall be exposed above the soil/mulch surface to water the root ball of the plant.

440.6.8 Controller System: The controller and accessories shall be installed at the locations designated and per the details shown on the Contract documents. Submit shop drawings of components.

Controllers located outdoors shall be installed in cabinets specifically designed to house the controller, or as detailed on the plans. The concrete pad for controller enclosures shall be Class B, sized as shown, or if not shown, as recommended by the manufacturer. All copper pipes in contact with concrete shall be Type K copper and sleeved or wrapped with "Scotchwrap #50" or equal, minimum thickness 40 mils.

Controllers Located in Building: Prepare an elevation plan detailing placement of equipment, conduit, sleeves and wire gutter runs for the Engineer's approval. Stub out all conduit 2 feet beyond concrete foundations or walls and provide bushings for all conduit. All RGS conduit in contact with earth shall be wrapped with "Scotchwrap #50" or equal, minimum thickness 40 mils.

440.6.9 Pipe Bedding, Backfill and Compaction: Bedding: Pipe shall be bedded in at least 4 inches of finely graded native soil or sand to provide a firm uniform bearing. After laying, the pipe shall be surrounded with additional finely grained native soil, or sand, then covered with not less than 4 inches of the same material. Bedding sand shall be required when site conditions dictate and clean finely grained native soil is not available. Contractor shall verify site conditions and satisfy his concern prior to bidding; no separate payment shall be made for bedding sand.

Backfill trenches and excavations with clean material. Remove organic material as well as rocks larger than 1 inch in diameter. Place acceptable backfill material in lifts, the height of which shall not exceed that which can be effectively compacted, pending on the type of equipment and methods used. Trenches and excavations shall be backfilled to match engineered earthwork sections.

Partially backfill the irrigation trenches and pressure test the system prior to completing backfill operations. Center load the pipe with sufficient backfill to hold the line in place, keeping the joints exposed for observation until completion of testing.

Compaction shall be in accordance with Section 601. Water settling of the trenches is not permitted unless approved by the Engineer.

440.6.10 Cleaning: Maintain continuous cleaning operations throughout the duration of the work. Dispose of all trash or debris generated by installation of the irrigation system off-site at no additional cost to the Owner.

440.7 FLUSHING AND TESTING

After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove all foreign material. After flushing, the following tests shall be conducted in the sequence listed below. All equipment, materials and labor necessary to perform the tests shall be furnished by the Contractor, and all tests shall be conducted in the presence of the Engineer.

Pipeline Pressure Test: A water test shall be performed on all pressure mains. Pressure mains shall be tested with all control valves installed and in the closed position. The constant test pressure and duration of the test shall be for 6 hours at 125 psi. Any leaks that occur during the test period will be repaired immediately following the test. The pressure mains will then be retested until accepted by the Engineer.

Sprinkler Coverage Test: The coverage test shall be performed after the sprinkler heads have been installed and shall demonstrate that each section or zone in the irrigation system is balanced to provide uniform and adequate coverage of the areas served. The Contractor shall correct any deficiencies in the system.

Operational Test: The Contractor shall perform an operational test of the system to ensure proper and even distribution of water to all plants. Adjust or replace any type of irrigation equipment not operating correctly prior to the walk-through inspection.

440.8 PRELIMINARY, SUBSTANTIAL AND FINAL WALK-THROUGH INSPECTIONS

Arrange for a preliminary walk-through with the general contractor's superintendent when the entire system is operational. Operate each zone in its entirety. Additionally, open all valve boxes and expose items covered, if directed. Generate a list of items to be corrected and make adjustments, "fine-tuning" the entire system by regulating valves, adjusting patterns and break-up devices, and setting pressure regulators at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all outlet devices for optimum performance and to prevent run-off or spray on to walks, roadways and buildings.

Arrange for a Substantial Completion walk-through with the Engineer when all items generated from the preliminary walk-through have been corrected. Items deemed not acceptable by the Engineer shall be reworked to complete satisfaction. The landscape maintenance period will not begin unless the irrigation system is operating correctly and until authorization by the Engineer. All accessories, charts, record drawings and equipment, as required, will be provided before scheduling the final walk-through.

Following the landscape maintenance period, a final walk-through inspection will be scheduled to review the system and make adjustments to the watering schedules.

440.9 MEASUREMENT AND PAYMENTS

Measurement and payment shall be in accordance with the General Conditions. The lump sum established in the schedule of values shall be full compensation for furnishing all labor, materials, tools and equipment, and performing all work necessary for completion of the irrigation system described or specified in the Contract documents.

When unit bid items are included in the proposal sheets, the unit prices quoted shall include the following items of work and material:

(A) Water Service Tap and Meter: The work under this item will be performed by the City of Phoenix Water Services Department and consists of furnishing and installing a curb stop, concrete meter box with cover, tap to main and pipeline to the curb stop at the locations and in accordance with the details shown on the plans. The curb stop and water meter box will be paid for under this item. Payment will be made at the current price for this service as charged by the City of Phoenix. With some projects, an allowance may be shown in the bid proposal for this item (refer to Subsection 440.1.1).

(B) Backflow Prevention Unit: The unit price for this item shall include the backflow prevention unit, locking cage assembly, risers and concrete thrust blocks, complete and in place.

(C) Electrical Remote-Control Valve and Assembly: The unit price for this item shall include the valve, the valve box with stainless steel hex bolt secured cover, pea gravel and specified pipe to the meter or backflow prevention unit.

(D) Sprinkler Controller: The unit price for this item shall include:

Cost of sprinkler controller (automatic);

All wiring for a complete underground control system, including trenching, wire, conduit, boring or jacking;

Steel security cabinet with concrete base, grounding system, metal hasp and padlocks, and all wiring within the cabinet unless controller is placed on a building or within a walled enclosure; and

The junction box and any work and materials required from the stub out provided by the power company in order to complete the installation of the controller.

(E) Irrigation Pipe: The Contract price for this item shall include the pipe and fittings, trenching, backfilling and any necessary boring or jacking to install the pipe. Sleeves shall be Schedule 40.

(F) Pull Box: The Contract price for this item shall include the pull box (plastic irrigation valve box with stainless steel hex bolt secured cover).

(G) Sprinkler Head: The Contract price for this item shall include the head and all fittings, nipples and risers from lateral to the head.

This Page Reserve for Future Use

PART 500
STRUCTURES

SECTION 505
CONCRETE STRUCTURES

Subsection 505.1 DESCRIPTION: Delete the last paragraph in its entirety and replace with the following:

Permanent ladders, embedded ladder rungs and permanently embedded tie-off points are not permitted and shall not be installed.

SECTION 515
STEEL STRUCTURES

Subsection 515.1 DESCRIPTION: Add the following paragraph to the end of this Subsection:

This Section shall govern the construction of steel structures within the public right-of-way and public right-of-way easements.

Subsection 515.1.3 As Built Plans: Delete this Subsection in its entirety and replace with the following:

Before formal acceptance of the work, the Contractor shall submit detailed as-built plans of the structure to the Engineer. Scans of the as-built plans will be retained by the city as permanent records. As-built plans shall be submitted on bond paper and shall be of a quality satisfactory to the Engineer. Mylar or vellum plans may be submitted at the Contractor's option at no additional cost to the city (accepted in electronic format).

Subsection 515.2 STEEL BUILDING AND MISCELLANEOUS STEEL STRUCTURES: Delete the first paragraph in its entirety and replace with the following:

Details of design, fabrication and erection of such buildings and structures shall conform to the City of Phoenix Construction Code.

SECTION 520
STEEL AND ALUMINUM HANDRAILS

Subsection 520.2 FABRICATION: Add the following after the fourth paragraph:

Aluminum railings shall be approved for use by the city engineer or City of Phoenix Materials Lab supervisor prior to being installed in concrete. Aluminum items shall have an approved, continuous, protective coating on all surfaces that will be in contact with a Portland cement concrete product.

PART 600
WATER, SEWER, STORM DRAIN AND IRRIGATION

SECTION 601
TRENCH EXCAVATING, BACKFILLING AND COMPACTION

Delete SECTION 601 in its entirety and replace with the following:

The work covered by this specification consists of furnishing all labor, equipment, appliances, materials, and performing all operations in connection with the excavation, backfilling and compaction of trenches for pipe installations.

Excavation for appurtenance structures, such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc., shall be deemed to be in the category of trench excavation.

The Trench Cross-Section Detail shown on COP Detail P1200 illustrates the terminology used in this specification.

See Section 620 for cast-in-place concrete pipe.

Pipe materials that are considered to be rigid include reinforced concrete pipe, non-reinforced concrete pipe, reinforced concrete cylinder pipe, vitrified clay pipe, steel casings, cast iron, concrete pressure pipe, steel cylinder type and ductile iron pipe.

Pipe materials that are considered to be flexible include thermoplastic pipes (HDPE, SRPE, PVC, when allowed) and corrugated metal pipe.

601.2 EXCAVATION

601.2.1 General: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans, and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on any portion of the backfill. No extra monetary compensation or additional time will be authorized for claims that soil conditions differ from those anticipated or those indicated by soil logs and/or reports. It is the Contractor's responsibility to make his own determination as to actual existing conditions.

601.2.2 Trench Widths: Trenches for a single pipe shall conform to the dimensions in Table 601-1. Multiple pipe installations in a single trench shall be installed in accordance with details on the plans or in the special provisions.

TABLE 601-1

TRENCH WIDTHS

Size of Pipe (Nom. Dia.)	Maximum Width at Top of Pipe Greater Than O.D. of Bell	Minimum Width at Springline Each Side of Pipe Barrel
Rigid Pipes:		
Less than 18 inches	16 inches	6 inches
18 inches to 24 inches inclusive	19 inches	7.5 inches
27 inches to 39 inches inclusive	22 inches	9 inches
42 inches to 60 inches inclusive	30 inches	12 inches
66 inches to 78 inches inclusive	42 inches	15 inches
84 inches to 96 inches inclusive	50 inches	19 inches
102 inches to 120 inches inclusive	60 inches	24 inches
Flexible Pipes:		
Less than 18 inches	20 inches	8 inches
18 inches to 24 inches inclusive	23 inches	9.5 inches
27 inches to 39 inches inclusive	28 inches	12 inches

TABLE 601-1		
TRENCH WIDTHS		
Size of Pipe (Nom. Dia.)	**Maximum Width at Top of Pipe Greater Than O.D. of Bell**	**Minimum Width at Springline Each Side of Pipe Barrel**
42 inches to 60 inches inclusive	34 inches	14 inches
66 inches to 78 inches inclusive	44 inches	16 inches
84 inches to 96 inches inclusive	48 inches	18 inches
102 inches to 120 inches inclusive	54 inches	21 inches

The width of the trench shall not be greater than the maximum indicated in Table 601-1, at and below the level of the top of the pipe. The width of the trench above that level may be made as wide as necessary for shoring, bracing and proper installation of the work. The Contractor may elect to slope the trench walls in lieu of shoring, sheeting or other wall support measures. In all cases the Contractor shall be responsible for any and all problems encountered and costs incurred as a result of increased trench width. No increases in contract time will be allowed as a result of sloping trench walls. Table 601-1 shall be used for computing trench pay width.

If the maximum trench width as specified in Table 601-1 is exceeded at the top of the pipe, additional load-bearing capacity to compensate for the increased pipe loading may be required by the Engineer. The Contractor shall provide, at no additional cost to the Contracting Agency, the additional load-bearing capacity. This may require changing the material requirements of initial backfill, a higher strength pipe, a concrete cradle, cap or encasement, or other means approved in writing by the Engineer.

Where safety or undermining situations occur, a controlled low-strength material (CLSM) backfill as specified in Sections 604 and 728 may be used as needed.

601.2.3 Trench Grade: Alignment and elevation stakes shall be furnished by the Contractor at set intervals and agreed upon offsets. On water main projects, elevation stakes will be furnished only when deemed necessary by the Engineer. In all cases where elevation stakes are furnished, the Contractor will also furnish the Engineer with cut sheets.

For all pipe 8 inches or greater in diameter, the Contractor shall excavate for and provide a bedding at least 4 inches thick or 1/12 the O.D. of the pipe barrel, whichever is greater. This bedding material shall be placed at a uniform density with minimum compaction and fine graded as specified herein.

601.2.4 Fine Grading: The bedding or the bottom of the trench when bedding is not required shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells or other joint types and for proper sealing of the pipe joints.

601.2.5 Over-excavation: Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the depth needed to accommodate the required bedding depth.

Unauthorized excavation below the specified trench grade line shall be refilled at the Contractor's expense with aggregate base (ABC) material compacted to a uniform density of not less than 955 of the maximum density and within +/- 2% of optimum moisture content as determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ 227c will be used for rock correction.

Whenever rock is encountered in the trench bottom, it shall be over-excavated to a minimum depth of 6 inches below the bottom of the pipe barrel or bedding. The over-excavation shall be backfilled with ABC material compacted to a uniform density of not less than 955 and within +/- 2% of optimum moisture content.

Whenever unsuitable soil incapable of supporting the pipe is encountered, the Contractor will notify the Engineer and a field determination will be made as to the depth of over-excavation and the granular fill required. If the

Engineer determines that over-excavation and backfilling below the bedding material is required as a result of unsuitable material, it will be considered extra work. Payment and construction time extension will be negotiated with the Contractor. As a condition of the Contractor receiving payment for the extra work, agreement on method of payment and construction time extensions shall be reached prior to start of work.

601.2.6 Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories: The Contractor may place concrete directly against excavated surfaces for cast-in-place items, provided that the faces of the excavation are firm, unyielding, and at all points outside the structure lines shown on the plans. If the native material is such that it will not stand without sloughing or if precast structures are used, the Contractor shall excavate as needed to place bracing, shoring and forms or to place the precast structure.

When the structure is within the maximum trench limit, backfilling shall be in accordance with the requirements specified for the adjoining pipe. If the item is being constructed outside of the maximum trench limits, the over-excavation shall be backfilled with ABC compacted to 100%.

Any unnecessary excavation below the elevation indicated for the foundation of any structure shall be replaced with ABC per Section 702 and compacted to at least 95% within 2% of optimum moisture content, or with 1-1/2 sack controlled low-strength material as specified in Section 728. When using 1-1/2 sack CLSM, placement of the material shall be per Section 604, which requires a time lag between placement of the CLSM and the structural concrete. The placement of the additional material shall be at no cost to the Agency.

601.2.7 Pavement and Concrete Cutting and Removal: Where trenchless methods are not used and trenches or other excavations lie within the Portland cement concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be completely removed between the closest adjacent joints. Removal methods shall produce neat, straight lines in such a manner that the remaining adjoining concrete will not be damaged.

Sidewalk, curb, gutter and other concrete flatwork shall have complete joint-to-joint replacement of all damaged sections. The construction replacing damaged concrete sections and joints shall be compliant with Section 340.

The existing joint system in Portland cement concrete pavement (PCCP) shall be maintained. Reconstruction of PCCP panels and joints shall be in accordance with Section 324.

Initial asphalt pavement removal shall be clean-cut to be the minimum width required for conduit installation and proper trench compaction. No ripping or rooting will be permitted outside the pavement cut limits. Surfacing materials removed shall be hauled from the jobsite immediately and will not be permitted in the backfill.

Final pavement removal for pavement matching and surface replacement shall occur after the final backfill and the aggregate base material are in place and compacted. Pavement matching and final surface replacement shall be in accordance with the requirements of Section 336.

601.2.8 Grading and Stockpiling: All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods. There shall be no additional payment for this work.

During excavation, material suitable for backfilling shall be placed in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the jobsite and disposed of by the Contractor. Excavated material, with excessive or inadequate moisture content, shall be considered unsuitable for proper compaction. The Contractor shall, at his own expense, remove or add moisture to the excavated material to bring it within the range of +2% to -2% of the optimum moisture content in order that proper compaction, as per Table 601-2, can be obtained.

In lieu of the above, the Contractor may, at no cost to the Contracting Agency, haul off and dispose of excessively wet or dry material and replace it with material conforming to the backfill specifications. Disposal shall be in accordance with the project specifications. The Contractor shall, prior to commencement of the work, submit a letter to the Contracting Agency stating the location of each disposal site for all excess or unsuitable material and certify that he has obtained the property owner's permission for the disposal of all such materials.

In either event, the proper compaction and stability shall be obtained. There will be no additional payment or time extension for this work.

Where the plans and/or special provisions provide for segregation of topsoil from underlying material for purposes of backfill, the material shall not be mixed.

When a trench excavation crosses an ACP waterline 12 inches in diameter or smaller, the requirements in Subsection 601.2.10 shall be followed.

601.2.9 Shoring and Sheathing: The Contractor shall do such trench bracing, sheathing or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. The bracing, sheathing or shoring shall not be removed in one operation but shall be done in successive stages to prevent overloading of the pipe during backfill operations. The cost of the bracing, sheathing or shoring, and the removal of same, shall be included in the unit price for the pipe or other item that necessitated the work.

All shoring and sheathing deemed necessary to protect the excavation, employees, vehicular and pedestrian traffic, the Engineer's representatives during inspection and testing procedures, and any other permitted public uses, shall be installed and maintained. See Section 107.

601.2.10 Open Trench: Except where otherwise noted in the special provisions or approved in writing by the Engineer, the maximum length of open trench, where the construction is in any stage of completion (excavation, pipe laying or backfilling), shall not exceed 1320 feet in the aggregate at any one location.

Any excavated area shall be considered open trench until all ABC for pavement replacement has been placed and compacted. With the approval of the Engineer, pipe laying may be carried on at more than one location, the restrictions on open trench applying to each location. Trenches across streets shall be completely backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular work hours. Steel plates shall be installed in accordance with COP Detail P1170. Safe and convenient passage for pedestrians shall be provided. The Engineer may designate a passage to be provided at any point he deems necessary. Access to hospitals, fire stations and fire hydrants shall be maintained at all times. Steel plates with adequate trench bracing shall be used to bridge across trenches as needed to provide driveway access to adjacent properties where trench backfill and temporary patches have not been completed during regular work hours.

Where a trenching operation crosses under existing 12-inch or smaller ACP waterlines (excluding service lines) and 4 feet or more of the existing ACP pipe is exposed, the Water Services Department’s Water Distribution Division will isolate the exposed waterline by either cutting in any necessary valves or by the use of existing valves. After the exposed waterline has been isolated, the Contractor shall remove that part of the exposed waterline to the limits shown in MAG Standard Detail 403-3. The waterline shall then be replaced by the Contractor (during the trench backfilling operation) with the same size, Class 350, ductile iron pipe as shown in MAG Standard Detail 403-3. The removal and replacement section shall extend at least 5 feet beyond the trenching operation’s trench wall and into undisturbed ground. The Contractor shall contact the inspector to make the necessary arrangements and coordinate with city forces. City forces will perform the shutdown prior to any work required to complete the replacement. There will be no charges to the Contractor for this work. On permit work, the Contractor shall pay for any and all work required.

The Contractor will be paid for the ductile iron pipe at the unit price bid per each crossing under the bid schedule item WATERLINE REPLACEMENT. If there is an unanticipated conflict at the crossing that can be resolved with “offset pipe joints,” the Water Services Department will supply the offset joints to the Contractor at no cost. Offset pipe joints will be picked up by the Contractor at the City's Water Stores Warehouse at 2640 South 22nd Avenue. Requests to pick up such material must be conveyed to the Water Services Department at least 24 hours in advance by the city inspector. The Contractor shall install the offset joints at no additional cost. The WATERLINE REPLACEMENT item shall include costs for trench excavation, backfill, compaction and surface restoration.

601.3 PROTECTION OF EXISTING UTILITIES:

601.3.1 Utilities: Unless otherwise shown on the plans or stated in the specifications, all utilities, either underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements and agreements with the owner and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall be reconstructed in its original or new location as soon as possible and to a condition at least as good as the previous. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by both the Engineer and the owner of the utility.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are shown on the plans (Sections 107 and 105 apply). This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not shown on the plans is discovered, the Contracting Agency will either negotiate with the owner for relocation, relocate the utility, change the alignment and grade of the trench or, as a last resort, declare the conflict as "extra work" to be accomplished by the Contractor in accordance with Section 104.

Backfill around utilities that are exposed during trench excavation shall be placed in accordance with the utility's haunching and initial backfill requirements.

601.3.2 Irrigation Ditches, Pipes and Structures: The Contractor shall contact the owners of all irrigation facilities and make arrangements for necessary construction clearances and/or dry-up periods.

All irrigation ditches, dikes, headgates, pipe, valves, checks, etc., damaged or removed by the Contractor shall be restored to their original condition or better by the Contractor at no additional cost to the Contracting Agency.

601.3.3 Building Foundations and Structures: Where trenches are located adjacent to building foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction.

Except where authorized in the special provisions or in writing by the Engineer, water settling of backfill material in trenches adjacent to structures will not be permitted.

601.3.4 Permanent Pipe Supports: Permanent pipe supports for the various types and sizes of sewer, water and utility lines shall conform to the Standard Details or the details shown on the plans. Such pipe supports shall be erected at the locations shown on the plans and/or at any other location as necessary as determined by the Engineer.

601.4 BEDDING, HAUNCHING, BACKFILLING AND COMPACTION:

601.4.1 Bedding: Bedding is ABC material per Section 702 (unless otherwise specified in Subsection 601.4.11 or 601.4.12) placed below the bottom of the pipe at a uniform density with minimum compaction to provide uniform bearing and support along the bottom of the pipe except where necessary to excavate for bells and other pipe joint couplings. Lime-treated bedding material shall be prohibited.

Bell and joint coupling holes shall be dug after the trench grade has been fine graded. Such holes shall be of sufficient width to provide room for caulking, banding or bolting. Holes shall be excavated only as necessary to permit accurate work in making of the joints and to ensure that the pipe will rest upon the prepared foundation material and not be supported by any portion of the joint. Depression of joints, other than bell and spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

601.4.2 Haunching and Initial Backfill: Haunching is the material placed between the bedding and springline. Material shall be deposited and compacted to the specified density uniformly on each side of the pipe to prevent lateral displacement of the pipe. When CLSM is not required as haunching under the pipe, the material shall be hand shoveled or shovel sliced into place to allow for proper subsequent compaction without soft spots.

Initial backfill is the material placed between the springline to 12 inches above top of pipe (1 inch above the top of pipe for SRPE pipe). Initial backfill shall be placed in lifts that can be effectively compacted depending on the type of material, type of equipment and methods used.

The haunching and the initial backfill material shall be ABC or CLSM, unless otherwise specified in Subsection 601.4.11 or 601.4.12. Lime-treated haunching and initial backfill material shall be prohibited. Open graded rock will not be used without the written approval of the Engineer.

Where water consolidation is used, haunching and initial backfill for pipes 24 inches or less in I.D. may be placed in one lift. For larger pipes, the first lift shall not exceed the springline of the pipe. Where mechanical compaction is used, the moisture content shall be within a range of +2% to -2% of the optimum moisture content prior to placing the material in the trench. The first lift shall be 8 inches or 2/3 of the distance to the springline, whichever is greater. Succeeding lifts shall not exceed 1 foot loose and extreme care will be taken to prevent damage to or movement of the conduit by the compaction equipment.

The Contractor shall employ the necessary means and methods to maintain roundness of CMP, HDPE and SRPE type pipe during haunching, initial backfilling and final backfilling. The Contractor shall adequately anchor the pipe against buoyant forces to maintain grade and alignment during the placement of the CLSM haunching and initial backfill.

601.4.3 Haunching and Initial Backfill for Storm Drains Maintained by the City of Phoenix: Haunching and initial backfill for public storm drain pipe lines maintained by the City of Phoenix shall conform to this subsection.

601.4.3.1 Haunching and Initial Backfill for Storm Drain Mainline Pipe: CLSM haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types, except cast-in-place pipe that is cast against the trench walls.

ABC initial backfill shall be utilized from the springline to 1 foot above reinforced concrete pipe (RGRCP) and cast-in-place concrete pipe storm drains.

The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

High density polyethylene (HDPE) pipe shall have CLSM for haunching from the bottom of the pipe to springline, and for initial backfill from the springline to 1 foot over the outside top of the pipe.

Steel reinforced polyethylene pipe (SRPE) shall have CLSM for haunching from the bottom of the pipe to springline, and initial backfill from the springline to 1 inch over the outside top of pipe. No additional initial backfill will be required over the CLSM initial backfill.

601.4.3.2 Haunching and Initial Backfill for Storm Drain Catch Basin Connector Pipe: ABC haunching or CLSM haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain pipe types. ABC initial backfill shall be utilized from the springline to 1 foot above the pipe for all approved storm drain pipe types.

The Contractor, at his option, may substitute CLSM for other haunching and initial backfill materials specified at no additional cost.

601.4.3.3 Haunching and Initial Backfill for Storm Drain Culverts: CLSM haunching shall be placed from the outside bottom of the pipe to the springline of the pipe for all approved storm drain culvert types, except cast-in-place pipe that is cast against the trench walls. ABC initial backfill shall be utilized from the springline to one (1) foot above the top of culvert. The Contractor, at his option, may substitute CLSM for other initial backfill materials specified at no additional cost.

Corrugated metal pipe (CMP) culvert shall have CLSM for haunching from the bottom of the pipe to springline, and for initial backfill from the outside bottom of pipe to one (1) foot over the outside top of pipe.

601.4.4 Initial Backfill: See Subsection 601.4.3.

601.4.5 Final Backfill: Material shall be placed above the initial backfill to the top of the trench or to the bottom of the road base material. Final backfill shall be sound material free from broken concrete, broken pavement, wood or other deleterious material. Final backfill shall be placed in horizontal layers not more than 12 inches in depth before compaction.

When mechanical compaction is to be used, the Contractor will provide a test section demonstrating his proposed method and equipment to be used. Upon agreement with the Engineer as to the acceptability of the Contractor's proposed method and equipment, they shall not be changed without the prior approval. Mechanical compacted lifts in excess of 1 foot will not be allowed without the written consent of the Engineer. With Agency approval, an increase in the loose non-compacted lift depth may be obtained for a project based on specific equipment, methods and soil conditions. For approval of an increase of the non-compacted lift depth, the Contractor shall demonstrate to the satisfaction of the Agency that the required density will be obtained using the Contractor-identified equipment and methods. The non-compacted lift height shall not be more than can be compacted to the required density with the equipment and methods being used.

Final backfill shall be CLSM per Section 604, ABC per Section 702, and/or granular material or native backfill material per Section 601.4.8. The type of final backfill required shall conform to Subsection 336.3

Backfill under street pavement shall be constructed per COP Detail P1200 with the type of trench and surface replacement as noted on the plans or in the special provisions. Unless otherwise noted, backfill under single curb, curb and gutter, attached sidewalk, driveways, valley gutters, etc. shall be the same as the adjacent street pavement.

601.4.6 Compaction Densities: Trench backfill shall be thoroughly compacted to not less than the densities shown in Table 601-2 when tested and determined by AASHTO T-99 and T-191 or ASTM D6938. When AASHTO T-99, method A or B, and T-191 are used for density determination, ARIZ-227c shall be used for rock correction.

Bedding, haunching and initial backfill material shall be processed prior or while being placed and then compacted to obtain the required optimum moisture content within +/- 2 percentage points when tested in place.

The moisture content shall be uniform throughout the final backfill material. If clayey material is encountered within the trench excavation, the optimum moisture deviation range shall be determined by the Engineer. Clayey material will not be utilized as trench backfill without the approval of the Engineer. It shall be the Contractor's responsibility to blend excavated material, removing or adding moisture as may be necessary to meet the requirements of the specifications, all at no increase in cost to the Contracting Agency. Material not meeting these requirements may be required to be removed from the trench and moisture added or removed to correct the deficiencies prior to replacement, all at no increase in cost to the Contracting Agency.

The moisture content requirements contained herein are waived when granular final backfill material is used and water consolidated.

At the discretion of the Engineer, mechanically excavating test pits to expose previously compacted lifts where documentation is not available may be allowed. Test pit locations and depths for the compaction testing shall be selected by the Engineer or designated geotechnical representative. No hydro-excavating of test pits shall be allowed. Excavation of test pits shall be done during full-time observations by the Engineer or designated geotechnical representative. Once compaction tests have been taken, the Contractor shall backfill and re-compact the test pits in accordance with Table 601-2. Excavating, backfilling and compacting test pits shall be at Contractor’s expense.

TABLE 601-2				
MINIMUM TRENCH COMPACTION DENSITIES				
Backfill Type	**Location**	**From Surface To 2 feet Below Surface**	**From 2 feet Below Surface To 1 foot Above Top of Pipe**	**From 1 foot Above Top of Pipe to Bottom of Pipe**
I	Under any existing or proposed pavement, curb, gutter, attached sidewalk, roadway shoulders, and other areas within right-of-way subject to vehicular traffic, or when any part of the trench excavation is within 2 feet of the existing pavement, curb or gutter.	100% for granular and non-granular	95%	95%
II	On any utility easement or right-of-way outside limits of Type I backfill.	95%	95%	95%
III	Around any structures (manholes, etc.) or exposed utilities outside limits of Type I backfill.	95% in all cases		

Note: The compaction type required will generally be shown on the plans and the plans will govern. Where no compaction type is shown on the plans, the compaction type shall comply with the above.

When backfill material is CLSM and it is placed in accordance with Section 604, no compaction testing is required, the compaction density shall be deemed acceptable.

A consideration in determining the compaction types as shown on the plans is based on the trench widths as shown in the Contract Documents. If these trench widths are increased beyond those widths referred to above and fall within the 2-foot limit of paved surfaces and other improvements due to construction means and method or site conditions, the compaction designation for that portion within the 2-foot limit of such improvements shall be Type I even though Type II may be shown on the plans.

The Engineer may require all or any part of the trench to be load tested for stability with Contractor's equipment prior to placement of asphalt or PCCV. Unstable pumping areas as determined by the Engineer shall be corrected by the Contractor at no increase in cost to the Contracting Agency.

601.4.7 Water Consolidation: Jetting is the only acceptable water consolidation method and its use is restricted. Jetting may only be used in Type I Backfill for the haunching and initial backfill zones and in Type II Backfill locations as defined in Table 601-2.

Water consolidation by jetting shall use a 1 1/2-inch pipe of sufficient length to reach the bottom of the lift being settled and shall have a water pressure of not less than 30 pounds per square inch. All jetting shall be accomplished transversely across the trench at intervals of not more than 6 feet with the jetting locations on one side of the trench offset to the jetting locations on the other side of the trench. The entire lift shall be leveled and completely saturated working from the top to the bottom.

Jetting shall be used as the consolidation method for all conduit haunching and initial bedding. The Contractor shall be responsible for establishing each lift depth so as to avoid floating the pipe being placed and shall make any needed repair or replacement at no cost to the Contracting Agency. For pipes larger than 24 inches I.D., the first lift shall not exceed the springline of the pipe and subsequent lifts shall not exceed 3 feet.

Flooding is not acceptable as a water consolidation method unless authorized by the Engineer.

Where jetting is used and the surrounding material does not permit proper drainage, the Contractor shall provide, at his expense, a sump and a pump at the downstream end to remove the accumulated water.

The use of water consolidation does not relieve the Contractor from the responsibility to make his own determination that such methods will not result in damage to existing improvements. The Contractor shall be responsible for any damage incurred.

Where water consolidation is not permitted or does not result in adequate compaction, the haunching, initial backfill and final backfill material shall be compacted with hand and/or mechanical work methods using equipment such as rollers, pneumatic tamps, hydro-hammers or other approved devices which secure uniform and required density without injury to the pipe or related structures.

Water consolidation will not be permitted for non-granular material.

601.4.7.1 New Residential Development Area: In a new development area, prior to paving and prior to opening the area to public traffic, the following deviation to water consolidation, haunching, initial backfill and compaction shall only apply to new local streets:

(A) Water consolidation by jetting of non-granular material will be permitted only at the Engineer's discretion and approval. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.

(B) Water consolidation by flooding shall be allowed ONLY where backfill material meets the specification for granular backfill material (Subsection 601.4.7) OR the bottom of the lift is less than 4 feet from top of subgrade. Increased quantity of compaction testing (100% increase per lift) will be required in accordance with the Streets Lab minimum testing requirements.

(C) The minimum density required for haunching and initial backfill shall be 95%. Manholes shall be compacted to 95% within 24 inches of the structure. Outside these limits, 95% shall be required. Native material is acceptable.

(D) The minimum density required for backfill from 2 feet below the surface to the top of initial backfill shall be 95%. The minimum density from the surface to 2 feet below the surface shall be as prescribed in Table 601-2.

(E) Sewer services shall require compaction tests on 30% of the total sewer services in new subdivision.

601.4.8 Granular Material and Native Backfill Material: For purposes of this specification, granular material is material for which the sum of the plasticity index and the percent of the material passing a No. 200 sieve does not exceed 23. The plasticity index shall be tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90. The percent of the material passing a No. 200 sieve shall be tested in accordance with ASTM C136 and ASTM C117. Granular Backfill Material shall not be used in the pipe embedment zone.

Native material used for backfill shall be sound earthen material free from broken concrete, broken pavement, wood or other deleterious material with no piece larger than 4 inches.

601.4.9 Rights-Of-Way Belonging to Others: Backfill and compaction for irrigation lines of the Salt River Valley Water Users' Association and Roosevelt Irrigation Districts and for trenches in State of Arizona or another entity's right-of-way outside the limits of the Contracting Agency shall be accomplished in accordance with their permit and/or specifications.

601.4.10 Test Holes: Boring logs shown on the plans do not constitute a part of the contract and are included for the Contractor's convenience only. It is not intended to imply that the character of the material is the same as that shown on the logs at any point other than that where the boring was made. The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, clay and water to be encountered in the work to be performed.

601.4.11 Bedding and Backfilling for Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: The bedding and backfill for these underground facilities shall be native material or sand, which conforms to the grading requirement of ASTM C33 for fine aggregate. Lime-treated bedding, haunching and initial backfill shall be prohibited. When backfill material consists of aggregate base course, crushed stone, or other material containing stones, only sand will be used within the bedding, haunching, and initial backfill zones. The bedding depth shall be 6 inches. and initial backfill depth shall be 1 foot above the top of the facility. Compaction shall be in accordance with Table 601-2.

601.4.12 Bedding, Haunching and Initial Backfill for Gravity Sewer Vitrified Clay Pipe (VCP): The Contractor shall excavate and provide a granular bedding at least 4 inches thick or 1/6 of the O.D. of the pipe, whichever is greater. ABC or CLSM shall be used for the haunching and initial backfill as shown in the City of Phoenix Supplemental Standard Details Nos. P1120 through P1127 VCP Trench Loading details.

601.4.13 Minimum Testing Frequencies: The procedures and methods used to sample and test materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with the City of Phoenix Exhibit A—Acceptance Sampling/Testing Requirements, located on the City of Phoenix Materials Lab website at: https://www.phoenix.gov/streetssite/Pages/COP-MaterialsLab.aspx and the standard test methods of Arizona, AASHTO or ASTM, which were in effect and published at the time of advertising for bids..

601.5 CONTRACTOR CERTIFICATION OF INSTALLATION PROCEDURES:

When requested in the Special Provisions or by the Engineer prior to installation, the Contractor shall furnish to the Contracting Agency an affidavit (certification) from the pipe manufacturer (or his designee) stating that the Contractor is familiar with the manufacturer's suggested installation methods and procedures and the manufacturer's suggested installation methods and procedures are consistent with MAG requirements.

When required by the Special Provisions, the pipe manufacturer or his designee will review the Contractor's methods and procedures for pipe installation in the field. The Contractor will make any adjustments in the installation as recommended by the manufacturer or his representative. If necessary, the Contractor may be required to reinstall or provide corrections to pipe installed prior to the field review at no cost to the Agency. Once the manufacturer or his representative has reviewed the Contractor's installation methods and the Contractor has adjusted his installation methods as recommended by the same, the manufacturer or his representative shall furnish to the Contracting Agency an affidavit (certification) that the Contractor's installation methods and procedures, at the time of the review, complied with the manufacturer's installation practices. The affidavit must provide the name of the manufacturer's representative witnessing the pipe installation.

601.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION:

601.6.1 Grading: The Contractor shall do such grading in the area adjacent to backfilled trenches and structures as may be necessary to leave the area in a neat and satisfactory condition approved by the Engineer.

601.6.2 Restoring Surface: All streets, alleys, driveways, sidewalks, curbs, or other surfaces in which the surface is broken into or damaged by the installation of the new work shall be resurfaced in kind or as specified to the satisfaction of the Engineer in accordance with Section 336.

601.6.3 Cleanup: The jobsite shall be left in a neat and acceptable condition. Excess soil, concrete, etc., shall be removed from the premises.

601.6.4 Temporary Pavement: The Contractor shall install temporary asphalt pavement or the first course of permanent pavement replacement in accordance with Section 336 immediately following backfilling and compaction of trenches that have been cut through existing pavement. Except as otherwise provided in Section 336, this preliminary pavement shall be maintained in a safe and reasonably smooth condition until required backfill compaction is obtained and final pavement replacement is ordered by the Engineer. Temporary paving removed shall be hauled from the job site and disposed of by the Contractor at no additional cost to the Contracting Agency.

601.7 PAYMENT:

The cost for work covered in this Section, which may include the removal of asphalt pavement, removal of obstructions, trench excavation, overexcavation, bedding, haunching and initial backfilling (including CLSM), final backfilling, compaction, testing and placement of temporary pavement shall be considered incidental to the respective structure, pipe and conduit work and shall be included in the unit price bid in the proposal for the structure, pipe and conduit work.

End of Section -

SECTION 604
PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

Subsection 604.4 PERFORMANCE TESTING: Add the following before the first paragraph:

When CSLM is used for haunching and up to one foot above the top of VCP pipe, it shall not be covered until one of the following performance criteria have been met:

(A) When in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM D4832, or

(B) When a ball drop indentation of 3-inches in diameter or less is obtained, when tested in accordance with ASTM D6024.

End of Section -

SECTION 610
WATERLINE CONSTRUCTION

Subsection 610.3 MATERIALS: Delete the second, third, and fourth paragraphs in their entirety and replace with the following:

6-inch to 24-inch diameter pipe shall be ductile iron per Section 750 unless a specific material is specified. Minimum pipe class shall be per Section 750.2 or as designated in the plan or special provisions.

Pipe over 24 inches to 42 inches in diameter shall be ductile iron pipe (DIP), concrete pressure pipe (CCP) or steel cylinder pipe, per Section 750, 758 and 759.

Pipe over 42 inches in diameter shall be DIP or steel cylinder pipe, per Section 750 or 759.

Subsection 610.4 CONSTRUCTION METHODS: Add replace Subparagraph (B) and add the following to Subsection 610.4.1 Trenching/Cover:

(B) 48 inches for main 12 inches, and 16-inch mains identified for distribution

(C) 78 inches for mains 16 inches, except those in Subparagraph (B) and larger

Subsection 610.4 CONSTRUCTION METHODS: Delete the last sentence in Subsection 610.4.2 Laying Pipe.

Subsection 610.4 CONSTRUCTION METHODS: Delete the first paragraph and replace with the following in Subsection 610.4.3 Blocking and Restrain:

All pipe lines, valves and fittings 16 inches and smaller in diameter shall be restrained with an approved system in accordance with standard details. Thrust block is not allowed to be used in-lieu of approved restrained joint systems. Thrust block can, however, be used in addition to the approved restrained joint systems or where a specific city supplement or adopted MAG Standard Detail requires the use of a thrust block. The areas stipulated in the standard details are minimums and shall not be decreased.

Subsection 610.4 CONSTRUCTION METHODS: Add the following Subsections:

610.4.6 Construction Work by City Forces

(A) City forces shall perform all valve cut-ins, waterline shutdowns and wet taps necessary for construction.

The Contractor shall contact the inspector to make the necessary arrangements to have the city forces perform the required work. With the exception of permit work, there will be no charge for valve cut-ins, waterline shutdowns and wet taps that are necessary for construction.

For any valve cut-ins, waterline shutdowns, or wet taps requested by the Contractor that are not necessary and are for the convenience of construction, the Contractor shall make application and pay the required charges to the city.

On permit work, the Contractor shall pay all costs incurred.

(B) When an existing waterline other than as noted on the plans conflicts with any proposed new work in the Contract and no provision has been made in the proposal for relocating such lines, the city has the option to make any necessary adjustments or relocations, alter the proposed new work or negotiate with the Contractor for relocating the obstructing line.

610.4.7 Construction Work by Other Utility Owners: Except as otherwise provided in the plans or project specification, all private utilities in conflict with the new work will be relocated by the Owner thereof. Utility

companies will adjust their manholes. In the event of an unanticipated conflict between the new work and a utility and the Owner thereof disclaims responsibility for relocation, the contracting agency will negotiate with the owning utility and the conflict shall be resolved without extra cost to the Contractor. It will be necessary for the Contractor to coordinate his work with the utility companies in the relocation of their facilities during construction.

610.4.8 Construction Work by the Contractor

(A) The Contractor shall adjust valve and meter boxes to final grade as described in Section 345.

(B) Where the centerline of the new waterline parallels the existing curb and gutter and is approximately 2 feet from the lip of the gutter, the Contractor shall remove and replace the pavement to the lip of the gutter. The Contractor will be paid for the extra pavement replacement in addition to the normal pavement re-placement over the pipe trench in accordance with Section 336.

(C) The Contractor shall accomplish the cutting and plugging of city water mains, where required on the plans, in accordance with COP Standard Detail P1343.

The cuts and plugs will remain exposed until line pressure is restored and they can be inspected for leakage. The Contractor shall schedule the restoration of line pressure through the Engineer.

Payment shall be at the unit bid price or lump sum bid price for "CUTTING AND PLUGGING EXISTING WATERLINES." This payment shall be full compensation for material, labor, tools and equipment necessary to complete the work.

(D) Unless other adequate provisions are made for fire protection, a fire hydrant will not be out of service for a period exceeding 24 hours. When relocating water meters that utilize either galvanized or polyethylene service pipe (or any other non-standard service pipe), the entire service piping shall be replaced using the approved service pipe material for that particular meter size. The existing corporation stop can be used provided and approved copper pipe adapter is used. Approved adapters are provided on the Water Services Department Approved Products List (https://www.phoenix.gov/waterservices/publications) or equal.

(E) The Contractor shall submit record drawings and make a record of the locations of all work completed as part of the project. The as-builts shall show the locations of the beginning(s) and end(s) of the construction, all valves, fire hydrants, blow-off hydrants, pipe fittings, service connections, and meters and where pipes change alignment. The as-builts shall also show the locations and elevations where pipe changes elevation abruptly. Locations shall be shown by stationing and dimensioning from appropriate monument lines or, in their absence, appropriate lot lines, property lines or easement line references.

610.4.9 Approved Water Service Components: The approved components are provided on the Water Services Department Approved Products List (https://www.phoenix.gov/waterservices/publications). Approvals shown are not necessarily exclusive. If approval of a similar device believed to be comparable and equal is desired, a request should be submitted supported by appropriate information and data.

If general approval is desired, a request should be submitted directly to the Water Services Department.

610.4.10 Concrete Pressure Pipe – Steel Cylinder Type: Where concrete, steel cylinder, pressure pipe is installed the following shall apply:

(A) The Contractor shall mortar the inside and outside of all pipe joints. The mortar shall be applied in the field on the inside joints such that the mortared surface is flush with the adjacent pipe mortar lining. The outside of the joints shall be mortar coated by the diaper method. The mortar shall be a Type "M" mortar per Section 776 using Type II, low alkali cement.

(B) All non-mortar coated steel, including flanges, shall be covered with a minimum of 2 inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Mortar shall be the same as applied to the joints. Field-applied coal tar coatings will not be accepted in lieu of mortar. Coat tar enamel in accordance with AWWA C-203 shall be applied to the non-mortar coated steel and flanges on the 24-inch side outlets in access manholes.

(C) Joint restraints shall be provided by means of welded joints. The extent of welded joints shall be as shown on the pipeline and layout drawings and shall in no case be less than that shown on the plan drawings. Where welded joints are required, the weld shall be continuous about the entire circumference of the pipe joint. Welds shall be made intermittently in short sections of about 6 inches to avoid overheating the gaskets on points where a gasket is used. Welds shall conform to that shown on the approved shop drawings and calculations.

610.4.11 For Mains Eighteen (18) Inches and Larger, the following shall apply:

(A) Backfill and compaction for the full distance encompassed by welded/restrained joints shall be completed prior to testing.

(B) All mainline valves shall be covered with a minimum of 2 inches of hand-packed mortar. Wire mesh shall be used to hold the mortar in place. Field-applied coal tar coatings will not be accepted in lieu of mortar. Portions of valves within manholes shall not be mortar coated. The mortar shall be a Type "M" mortar per Section 776 using Type II, low alkali cement.

(C) Where plans call for welding joints and ductile iron pipe is furnished, the Contractor shall restrain the joints by an approved joint restraint method.

610.4.12 Restrained Joints on Mains Less Than Eighteen (18) Inches in Diameter: Where restrained joints are specified on mains less than 18 inches in diameter, ductile iron pipe shall be used with an approved joint restraint method.

610.4.13 Joints in Fire Hydrant "Run-Out" Piping: Joints in fire hydrant "run-out" piping shall conform to the Subsection 750.3. All joints in the fire hydrant "run-out" from the main through the shut-off valve shall be restrained by an approved joint restraint method, which may include the use of thrust blocks as approved the City of Phoenix engineer.

610.4.14 Payment for Water Used During Construction: The Contractor shall pay for all water used during the course of construction. This cost shall be included in the unit bid price for pipe. The final fill of the pipeline with replacement water shall not be included in the cost. Water rates shall be obtained from the Water Services Department, Accounting Division (602-262-6687).

Measurement will be through a fire hydrant meter or, if this is not possible, calculated by one of the procedures listed below:

(A) Unmetered water used for testing, flushing and chlorination shall be calculated on a cubic foot basis using the volume per foot pipe multiplied by the number of times the pipe is filled and by the total length of pipe installed for each hydrostatic test, flushing and chlorination procedure. If any additional testing, flushing or chlorination is required, because of failure to meet any of the above conditions, the volume of water used for each procedure shall be calculated as on the above basis for first procedure.

TABLE 610-4

FOR 1-FOOT LENGTH OF PIPE

Diameter (Inches)	Cubic Feet	Gallons	Gallons Per Mile
3	.0491	.3673	1939
4	.0873	.6528	3447

TABLE 610-4			
FOR 1-FOOT LENGTH OF PIPE			
Diameter (Inches)	**Cubic Feet**	**Gallons**	**Gallons Per Mile**
6	.1963	1.469	7756
8	.3490	2.611	13,786
10	.5455	4.081	21,547
12	.7854	5.876	31,025
14	1.069	7.977	42,224
16	1.396	10.44	55,123
18	1.767	13.22	69,802
20	2.182	16.32	86,170
24	3.142	23.50	124,080
30	4.909	36.72	193,882
36	7.069	52.88	279,203
42	9.620	71.96	379,950
45	11.044	82.62	436,233
48	12.566	94.02	496,326
54	15.90	118.97	628,162
60	19.63	146.88	775,526
66	23.76	177.72	938,362
72	28.27	211.44	1,116,403

(B) Unmetered water used for settling trench backfill for small waterlines 12 inches and less in diameter shall be estimated at a volume of 2.66 cubic feet of water per linear foot of trench settled.

(C) Water used for settling trench backfill on waterlines 14 inches and larger shall be metered by a fire hydrant meter or other means approved by the Engineer.

Subsection 610.6.1 GENERAL: Delete the title of this Subsection and replace with the following:

General

Subsection 610.6.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

Pipe, valves and fittings shall be protected from corrosion by encasement in a polyethylene protective wrapping referred to hereafter as polywrap. Although not intended to be a completely airtight and watertight enclosure, the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

Subsection 610.6.2 Materials: Add the following sentence to the beginning of the first paragraph:

Materials shall meet requirements of ANSI/AWWA C105/A21.5-10, most current version.

Subsection 610.6.2 Materials: Delete "Table 610-1" in the last paragraph and replace with the following:

Table 610-5

Subsection 610.6.2 Materials: Delete the title for TABLE 610-1 and replace with the following:

TABLE 610-5 (from AWWA C105-05) POLYWRAP FLAT TUBE WIDTHS

Subsection 610.9 FIRE HYDRANTS: Add the following to the end of this Subsection:

Except where otherwise required on the plans, the City of Phoenix will furnish the Contractor fire hydrants without cost for City of Phoenix projects. To secure the hydrants, the Contractor shall obtain a permit at the Water

Distribution Special Operations office at 3045 South 22nd Avenue and then pick up the hydrants at the City of Phoenix Water Stores, 2500 South 22nd Avenue.

If a new fire hydrant furnished by the City of Phoenix is found to be defective, the Contractor shall remove the defective hydrant, return it to the water stores, pick up a new one and install as indicated on the plans. The second installation will be treated as a new fire hydrant installation, and the Contractor will be paid for both installations, each at the unit bid price in the proposal for fire hydrant installations.

All connections from the main to the fire hydrant shall be cast iron or ductile iron pipe as shown on the detail drawings. Fire hydrants shall be the dry-barrel type. If plugs are present in the weep holes, they shall be removed before installation.

Extenders for hydrants or valves are not permitted on new fire hydrant installations unless approved by the Water Services Department.

Subsection 610.11 CONNECTION TO EXISTING MAINS: Add the following to the end of this Subsection:

For any tie-ins/connections or required shutdowns to existing transmission mains (16 inches and larger) and systems, the Contractor shall submit a shutdown/tie-in plan to the city inspector and/or Engineer that shall be approved at least 2 weeks prior to the start of the event. The plan shall include dates, durations, procedures, staffing and any other information pertinent to shutting down the system and connecting to a new system.

Subsection 610.13 METER SERVICE CONNECTIONS: Delete the second paragraph in its entirety and replace with the following:

All water service connections shall be made using Type K copper tubing that conforms to Subsection 754.1 and fittings that conform to Subsection 754.2. Joints in the copper tubing shall be made by the use of approved compressing fittings such as flared joints or pack joints. Soldered joints are not acceptable.

Subsection 610.13 METER SERVICE CONNECTIONS: Delete Subparagraph (A) in its entirety and replace with the following:

(A) When a meter is specified to be relocated, the Contractor shall replace and/or extend water service lines in accordance with COP Standard Detail P1342. The Engineer will determine when the existing service lines are unsatisfactory and must be replaced. Existing copper services in good condition, with sufficient cover, may be extended. Where the existing service pipe material is other than copper, the entire service shall be replaced from main to meter.

Subsection 610.13 METER SERVICE CONNECTIONS: Add the following Subparagraph:

(E) The use of direct taps on water mains for meter service connections will not be allowed. New service taps shall be installed using an all bronze double-strap tapping saddle or a tapped coupling.

SECTION 611
WATER, SEWER AND STORM DRAIN TESTING

Subsection 611.2.2 HYDROSTATIC TESTING: Delete this Subsection in its entirety and replace with the following:

The Contractor shall test waterlines for watertightness, including all fittings and connections. Each pipe shall be tested for leakage and pressure in accordance with applicable provisions of AWWA standards and/or manuals, except as modified below.

The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking and pump, including measuring device and all other equipment necessary for making the tests.

The pipe shall be tested between the closed ends of the pipe. There shall be no testing against a valve unless otherwise approved. Pipe test section shall be limited to 2500 linear feet or less unless otherwise approved in writing by the Engineer. The new pipeline must be separated from any potable system in such a way as to prevent any potential for cross-contamination between the existing potable water system and the new pipeline.

The test shall be made after the backfilling is completed or compacted, regardless of the compaction method.

All connections, blowoffs, hydrants and valves shall be tested with the main, where practical.

The test section shall be slowly filled with potable water and all air shall be vented from the line. The rate of filling shall be as approved by the superintendent of water distribution, with at least 24-hour notice required before filling is scheduled.

(A) Pressure Tests: Waterlines, including all fitting and connections, shall be tested for watertightness by subjecting each test section to pressure test. The test pressure shall be measured at the lowest end of the test section. The test pressure shall be 188 psi unless otherwise specified. The duration of each pressure test shall be at least 2 hours.

The pressure test shall begin after the pipe has been filled with water for at least 24 hours to allow for absorption.

(B) Leakage Tests: Leakage tests shall be made after pressure test has been completed, pressure test results are satisfactory, and all backfilling and compaction are completed.

The duration of each leakage test shall be at least 2 hours. Leakage test pressure shall be at least 150 psi, and the test pressure shall be maintained within 5 psi of the specified leakage test pressure during the test. Water may be continually fed or added when the pressure drops 5 psi.

The maximum allowable leakage from the pipeline shall be determined by the formula:

$$\frac{L = ND\sqrt{P}}{7400}$$

in which:

L = Allowable leakage in gallons per hour

N = Number of joints in the pipe being tested, with no allowance for joints at branches, blowoff, fittings, and similar appurtenances. “N” is calculated using the standard length of pipe installed divided into the length being tested.

D = Nominal inside diameter of pipe in inches

P = Average test pressure, in psi gage, as measured at the lowest point in the test section

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and correct until the leakage is within the specified allowance for a 2-hour duration. All repairs and retests shall be at the Contractor's expense.

Leakage is defined as the quantity of make-up water necessary for the test section to maintain the specified leakage test pressure after the pipeline has been filled with water and all air expelled.

All water must be dechlorinated to negligible levels prior to discharge to any location. Connections to existing pipelines or existing valves shall be made after new construction has satisfactorily passed both the pressure and leakage tests and potable water piping has been flushed and disinfected in accordance with Section 611.

Subsection 611.3.3 Final Flushing, Sampling and Testing: Delete this Subsection in its entirety and replace with the following:

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its extremities until the replacement water throughout its length shall, upon testing, be proved comparable in quality to the water served to the public from the existing water system. Prior to sample collection for laboratory testing, the residual chlorine shall be verified using a color comparator or chlorine meter at each sample point to ensure the chlorine residual is not less than 0.2 ppm or greater than 4.0 ppm. Swimming pool test kits or chlorine test strips are not sensitive enough to provide results within this range and shall not be used. Once the required residual chlorine level in the pipeline is achieved, samples shall be taken as outlined below. The quality of water in the new main shall be as determined by laboratory examination and analysis of the samples over a period of up to 3 full days (72 hours).

Water Services Department laboratory technicians will perform sampling for tests of new water mains upon receipt, from the inspector, of a written request by the Contractor. The written request should be made to the Water Services Department no less than 24 hours prior to the time when samples are to be taken so that the Department can properly schedule laboratory work. Waterlines less than 150 feet in length require one sampling riser installed as near the end as possible; lines 150 feet to 300 feet in length, two sampling risers, one near each end of the line; lines 300 feet to 3,000 feet in length, a minimum of three sampling risers. In addition, dead ends on main lines should be represented with a sampling riser.

Samples shall be taken from a tap and riser located and installed in such a way as to prevent outside contamination. Samples shall never be taken from an unsterilized hose or fire hydrant because such samples will seldom meet bacteriological standards. One sample shall be taken at each sampling riser.

Results of all tests shall be sent by the laboratory to the Water Services Department. Results of laboratory analysis will be interpreted by the Water Services Department and reported to the Engineer. Under no circumstances shall the Contractor contact the laboratory. If there is need for test results before written reports are submitted, such information shall be obtained only from the Water Services Department.

Subsection 611.4 SEWER LINE TESTING: Delete Subparagraphs (C) and (D) in their entirety and replace with the following

(C) Closed-Circuit TV Inspection:

The contracting agency reserves the right to visually inspect the interior of the sewer line using a television camera. Sanitary sewer lines 8 inches and larger in diameter shall be subject to closed-circuit TV inspection.

The Contractor shall notify the Engineer at least 48 hours prior to completion of the backfilling so that the inspection can be scheduled. Closed-circuit TV inspections will be conducted by the City of Phoenix Water Services Department after backfilling has been completed.

Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the contracting agency.

Subsection 611.5 SANITARY SEWER MANHOLE TESTING: Delete the first sentence and replace with the following:

All new sanitary sewer manholes installed shall be tested for exfiltration either by a watertightness test or by a negative air pressure (vacuum) test modified for the time frames listed below.

Subsection 611.5 SANITARY SEWER MANHOLE TESTING: Delete the Table 611-2 and replace with the following:

TABLE 611-2		
Manhole Depth	**Minimum Test Duration (Secs) 48-Inch Diameter Manhole**	**Minimum Test Duration (Secs) 60-Inch Diameter Manhole**
12 feet or less	60	75
Greater than 12 feet to 15 feet	Not Applicable*	90
Greater than 15 feet	Not Applicable*	105

*Manholes greater than 12 feet in depth shall be 60 inches in diameter

Subsection 611.6 POST-INSPECTION OF NEW MAINLINE STORM DRAINS: Delete the first sentence in Subparagraph (A) and replace with the following:

The Contractor shall provide the Engineer with an annotated video inspection record and accompanying report (in an acceptable electronic format) of the new mainline storm drain pipeline and laterals.

Subsection 611.6 POST-INSPECTION OF NEW MAINLINE STORM DRAINS: Delete the first paragraph of Subparagaph (B) in its entirety and replace with the following:

The Contractor shall perform a deflection test on the system by use of a mandrel or other approved method as directed by the Engineer. Any part of the installation which shows deflection in excess of 5% of the nominal inside diameter per Section 738 and 739 shall be evaluated and appropriate remedy, if any, shall be performed, as required by the Contracting Agency.

Subsection 611.6 POST-INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS: Add the following to the end on this Subsection:

(C) Leakage Test for Mainline HDPE, or SRPE Storm Sewer Pipe:

In addition to full CLSM haunching and initial backfill of HDPE and SRPE mainline storm sewer pipe, the Engineer may require the Contractor to also perform random leakage tests on the mainline. Field leakage tests, if required, will be conducted in accordance with the following criteria:

1. After placement of CLSM haunching and initial backfill to 1 foot above HDPE pipe and 1 inch above SRPE pipe, the Engineer will select a minimum of three (3) joints of mainline pipe to be tested in accordance with the following procedure:

    a. Testing shall be accomplished by plugging the pipe test section and all branch lines and filling the pipe with water. Equipment for the test shall be furnished by the Contractor and shall include a standpipe, a suitable meter or other acceptable method of measuring the quantity of water used. A period of at least one (1) hour shall be allowed for absorption before making the test.

    b. The allowable water loss shall not exceed 1 gallon per hour per 100 linear feet of pipe per inch of pipe diameter under a minimum test head of 4 feet above the top of the pipe at the

upper end of the test section. A minimum test time of one (1) hour shall be required after the initial one (1) hour for absorption.

c. The leakage test shall be made by the Contractor in the presence of the Engineer.

2. If the first test exceeds the specified leakage limit, the Contractor shall repair or replace all sections that fail the leakage test at no additional cost to the City of Phoenix. All repaired or replaced pipe sections shall be retested for compliance. The Engineer reserves the right to require additional leakage tests as deemed necessary during the course of construction to ensure that the remainder of the pipeline is leak resistant.

Subsection 611.7 PAYMENT: Add the following as the third paragraph of this Subsection:

There will be no measurement and payment for sewer line testing. The Contractor shall include all associated costs in the unit bid price for sewer pipe installation.

Subsection 611.7 PAYMENT: Add the following as the last paragraph of this Subsection:

There will be no separate pay item for the HDPE or SRPE Storm Drain Pipe Leakage Tests. If requested by the Engineer, initial leakage tests shall be paid by the City of Phoenix. Retests shall be paid by the Contractor at no cost to the City of Phoenix.

SECTION 615
SANITARY SEWER LINE CONSTRUCTION

Subsection 615.2 MATERIALS: Delete the fourth and sixth bulleted items listed in this Subsection.

Subsection 615.3 TRENCHING: Delete the first paragraph in its entirety and replace with the following:

Excavation of trenches shall be accomplished in accordance with Section 601.

Subsection 615.4 SEPARATION: Delete the section in its entirety and replace with the following:

To protect waterlines from contamination by sewer lines, separation and extra protection shall be in accordance with Section 610 and MAG Standard Detail No. 404-1, 404-2, and 404-3.

Sewer lines that are constructed of ductile iron pipe for extra protection shall be CIPP lined per COP Supplement Section 751.

Subsection 615.8 SANITARY SEWER SERVICE TAPS: Delete this Subsection in its entirety and replace with the following:

When the construction of sanitary sewer service taps is called for in the special provisions or drawings, they shall be constructed in accordance with standard details for sewer taps.

The locations of the service tap for each property shall be in the downstream third of the lot, or as requested by the property owner. Sewer service taps shall not be covered until they have been plugged and marked in accordance with standard details and their location has been recorded by the Engineer. Electronic markers shall be placed at no greater depth than electronic locating devices can locate them (typically 2 to 4 feet).

When sewer taps are found to be in conflict with the new work and no provision has been made in the proposal for relocating such taps, they shall be relocated by the contracting agency or the contracting agency will negotiate with the Contractor for their relocation. When a sewer tap or other sewer line is in conflict with the new work and it is impractical or impossible to raise or lower the tap or sewer to clear the new work, the contracting agency will negotiate with the Contractor to relocate the sewer on a different alignment or grade to avoid the conflict.

Subsection 615.11 BACKFILLING: Delete the first paragraph in its entirety and replace with the following:

Backfilling and compaction shall be done in accordance with Section 601.

Subsection 615.16 MEASUREMENT AND PAYMENT: Add the following Subsection:

(D) Concrete Encasement:

Measurement and payment for concrete sewer encasement shall be by the linear foot of sewer concrete encased, the price of which shall include trenching, backfill, compaction, materials and any pavement and surface replacement in excess of the applicable pay widths assigned to the adjacent water pipe.

SECTION 618
STORM DRAIN CONSTRUCTION WITH CONCRETE PIPE

Delete the title of this SECTION in its entirety and replace with the following:

STORM DRAIN CONSTRUCTION WITH PRECAST CONCRETE PIPE, HIGH-DENSITY POLYETHYLENE PIPE OR STEEL-REINFORCED POLYETHYLENE PIPE

Subsection 618.1 DESCRIPTION: Delete this Subsection in its entirety and replace with the following:

This Section covers rubber-gasketed reinforced concrete pipe (RGRCP) line, high-density polyethylene (HDPE) pipeline and steel-reinforced polyethylene (SRPE) pipeline construction used for the conveyance of storm drainage in public storm drains, including public drainage easements that are built to public standards.

This Section does not include irrigation pipelines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipelines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in state highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

Subsection 618.2 MATERIALS: Delete this Subsection in its entirety and replace with the following:

In general, the pipe class or strength specified will be based upon the maximum anticipated design loads and trench conditions to which the pipe will be subjected upon completion of the project.

The structural design of the pipe for any depth of cover shall be in conformance with Section 6 of the City of Phoenix Storm Water Policies and Standards Manual (Latest Edition), applicable ASTMs, applicable AASHTO Standards, and established manufacturer recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section 336 unless otherwise noted in the plans and specifications.

Should the Contractor, as a result of his construction means and methods, or for any other reason, subject the pipe to loading or trench conditions that do not conform to the plans and specifications, it shall be the Contractor's responsibility to take whatever steps are necessary to remediate, strengthen or otherwise protect the pipe from damage at the Contractor's expense.

Pipe that is stronger than that specified may be furnished at the Contractor's option and expense.

The RGRCP, HDPE and SRPE pipe, specials, joints, gaskets and testing shall be according to Sections 735, 738 and 739, except as specified below.

(A) Specials: Pipe specials such as closure pieces, wyes, tees, bends and manhole shafts shall be provided as indicated on the plans, and such specials shall be made equal in strength, diameter and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing, or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication.

(B) Gasket Joints: The joint shall be sealed with a continuous ring gasket made in such size and cross section as to fill the annular space provided for it. The gasket shall be the sole element depended upon to make the joint watertight and shall have smooth surfaces, free from pits, blisters, porosity and other imperfections.

(C) Water Stops: Water stops will be required when connecting HDPE and SRPE pipe to concrete structures, manholes, etc. The water stop shall comply with Section 738 or Section 739 and will be installed per manufacturer recommendations.

(D) Storm Drain Pipe Size Option: The Contractor may substitute the next larger multiple of 6-inch storm drain pipe for the intermediate 3-inch pipes shown on project plans at his discretion. The cost of the increase in size shall be borne by the Contractor. The intermediate 3-inch pipe will remain in the bid proposal as the required size. If the Contractor elects to use the next larger multiple of 6-inch pipe, he shall be responsible for any utility or any other conflict caused by the increase in the size of the pipe. There shall be no extension of time granted for any delay caused by these conflicts.

Subsection 618.3 CONSTRUCTION METHODS: Delete this Subsection in its entirety and replace with the following:

Excavation, bedding, haunching, backfilling, compaction or consolidation, and testing shall be accomplished in accordance with Section 601 except as specified below.

The laying of the pipe shall be in finished trenches free from water or debris and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot, and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipeline unless otherwise approved by the Engineer. Curves, bends and closures shall be made in accordance with Section 735, 738 and 739. Pipe shall be of the type, class and size shown on the plans or in the special provisions.

The minimum and maximum cover for HDPE and SRPE pipe shall be in conformance with Subsection 6.4 of the City of Phoenix Stormwater Policies and Standards Manual (Latest Edition), applicable ASTMs, applicable AASHTO Standards, established manufacturer recommended design procedures and special provisions.

All pipes installed in railroad rights-of-way shall be reinforced concrete pipe per ASTM C76, Class V, and the minimum cover over all pipes shall be as specified in the railroad permit and/or special provisions. Bedding and backfill shall be in accordance with the railroad's standards and details and/or special provisions.

HDPE and SRPE pipe is prohibited as an alternate pipe material for culverts. HDPE and SRPE pipe is also prohibited as an alternate pipe material within a minimum distance of 24 feet from an open end condition requiring a headwall, trash rack or access barrier. The pipe transition shall utilize an external, gasketed coupling band with cinching straps or bolts to provide a waterproof connection. The transition shall be fully bedded with CLSM or a concrete pipe collar. No separate payment will be made for the transition, and the cost shall be considered incidental to the cost of the pipe.

The Contractor shall employ the necessary means and methods to maintain roundness of the HDPE and SRPE pipe during haunching, initial backfilling and backfilling. The Contractor shall employ all necessary means and methods to adequately anchor the pipe against buoyant forces to maintain grade during the placement of the CLSM haunching and initial backfill. The Contractor shall schedule a meeting with the HDPE and/or SRPE pipe supplier, the installing contractor and the Engineer to discuss the installation procedures prior to trench excavation.

618.3.1 Pipe Joints for RGRCP: Either O-ring gasket joints or offset spigot-profile gasket joints will be used. Hydrostatic water tests may be required at the discretion of the Engineer. Certification for hydrostatic tests will be required for all pipe joints. Gasket joints will not require mortaring and grouting.

618.3.2 Procedure for Connecting Pipes to New Storm Drain and Temporary Pipe Closure: All inlet connecting pipes and lateral pipes shall remain temporarily plugged until all lines and facilities downstream have been completed to the satisfaction of the Engineer.

Existing storm drains shall be connected to the new storm drain where indicated on the plans. However, existing storm drain systems shall remain intact or a bypass maintained until mainline downstream has been completed to the satisfaction of the Engineer.

All pipes shall have a temporary closure placed at the open end at the end of each work day.

618.3.3 Connecting Extensions to Mainline Storm Drains: Prior to extending any existing mainline storm drain, the Contractor shall verify the depth, size, pipe type and horizontal location of the existing storm drain in the field. If the new pipe extension is the same type and size as the existing, or if the pipe manufacturer makes a standard watertight adapter fitting made specifically to join with the existing pipe type, a standard manufacturer-recommended connection may be used. Otherwise, a concrete field collar in accordance with COP Standard Detail P1505 shall be used. The cost of connections shall be considered incidental to the cost of the project. No separate measurement or payment will be made for field connecting extensions to existing mainline storm drain pipes except that the removal of an existing pipe plug shall be paid under a separate item.

618.3.4 Structures: Inlets, manholes and similar reinforced concrete structures generally built underground as part of the storm drain are shown on the plans and shall conform to Section 505. Castings shall conform to Section 787. Miscellaneous steel shall conform to Sections 727 and/or 770.

Through manhole, lateral manhole or transition manhole, when specified on the plans, shall denote the construction and installation of a complete manhole, including the base, shaft, reinforced concrete rings, frames and covers, concrete caps, frame adjustment to grade, etc., as shown on the plans and standard details. Note: Manhole steps shall not be installed. If installed, they shall be removed and the holes filled with approved epoxy or approved commercial-source non-shrink, non-metallic, patching grout with an approved bonding agent.

As an option, MAG Standard Detail 522 is hereby modified to allow precast unreinforced manhole shaft pipe and cones, which shall have a thickness of 6 inches and be manufactured of an approved Portland cement concrete mix per Section 725. All other features of MAG Standard Detail 522 shall remain unchanged.

Water stops will be required when connecting HDPE, SRPE, or CMP to concrete structures, manholes, etc. The water stop gasket shall conform to the requirements of ASTM C923.

618.3.5 Cleaning Pipe: All pipe shall be swabbed, flushed with water, or subjected to a combination of these or other methods in order to leave the pipeline clean and free from debris, garbage, rubbish, stones, deposits and like foreign materials.

618.3.6 Material and Layout Submittals: At least 6 weeks prior to the manufacture and delivery of the storm drain pipe, the Contractor shall submit material and layout drawings to the Engineer for review and approval.

Submittals shall show pipe material type, layout, stationing, laying length, pipe class or gauge thickness (as appropriate), detailed fabrication drawings for mainline, curvilinear sections, prefabricated bends, special sections, etc. and any other pertinent data including certification that pipe joints have been independently tested and conform to watertight joints per ASTM D3212.

In addition, a list of catch basin connector pipes shall be submitted. The list shall contain the following information:

1. Inside diameter and type of material to be used (RGRCP, HDPE, SRPE).

2. If RGRCP is used for connector pipe, the pipe class shall be shown.

3. Station at which connector pipes join mainline

4. Number of sections of pipe and laying length of sections

Subsection 618.6 MEASUREMENT: Delete the title of Subpragraph (B) and replace with the following:

Catch Basin Connector Pipe

Subsection 618.6 MEASUREMENT: Add the following Subsections to the end of this Subsection:

(C) Prefabricated Tees and Wyes: When separate bid items are provided in the proposal, they shall be measured by the number of such tees and wyes constructed.

(D) Concrete Pipe Collars: There shall be no measurement for construction of pipe collars for pipe less than 24 inches in diameter. For pipe collars on pipe 24 inches or larger, measurement shall be the number of such pipe collars constructed.

Subsection 618.7 PAYMENT: Delete this Subsection in its entirety and replace with the following:

(A) Main Line Pipe: Will be paid at the unit price bid per linear foot, to the nearest foot, for each size of pipe and shall be compensation in full for furnishing and installing the pipe as specified and as shown on the plans, including removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, testing, temporary pavement, joint materials, joining and field closures.

(B) Catch Basin Connector Pipe: Will be paid at the unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing complete in place as shown on the plans and as specified, the connecting pipe and specials including spur connections, removal of asphalt pavement, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, temporary pavement, joint materials, joining, collars, field closures, and testing.

(C) Prefabricated Tees and Wyes: The cost of prefabricated tees and wyes shall be included in the unit price bid for main and connector pipes unless separate bid items are included in the proposal.

(D) Concrete Pipe Collars: There shall be no payment for construction of pipe collars for pipe less than 24 inches in diameter. Payment for pipe collars, on pipe 24-inches or larger, shall be made at the unit price bid for each and will be compensation in full for all labor, material, equipment and incidentals required for construction.

SECTION 620
CAST-IN-PLACE CONCRETE PIPE

Delete the title of this SECTION in its entirety and replace with the following:

STORM DRAIN CONSTRUCTION WITH CAST-IN-PLACE CONCRETE PIPE

Subsection 620.1 GENERAL: Delete the first sentence of the first paragraph and replace with the following:

This specification covers cast-in-place non-reinforced concrete pipe intended for use in storm drain systems.

Subsection 620.1 GENERAL: Delete Subparagraph (D) in its entirety and replace with the following:

In systems that will not exceed a 15-foot operating head at any time during the life of the system.

Subsection 620.1 GENERAL: Add the following Subparagraph:

(E) When designated as an allowable alternate pipe material on the Alternate Pipe Chart Sheet of the Plans. Designation of CIPP as an allowable alternate pipe material shall not be construed to indicate that the site conditions will be suitable for its use. The Contractor shall be responsible for all costs incurred to properly evaluate, prepare and utilize CIPP as part of a complete storm drain pipeline.

Subsection 620.1 GENERAL: Add the following Subparagraph:

(F) When approved by the Engineer as a result of a formal Value Engineering Process that considered all location, geologic, hydrologic and maintenance conditions. The Contractor shall be responsible for all costs incurred for developing and presenting the engineering and documentation of the Value Engineering proposal for a thorough evaluation.

Subsection 620.1 GENERAL: Add the following to the end of this Subsection:

CIPP is prohibited from being placed:

(A) Within the curb lines of arterial and major collector streets.

(B) Within the curbs of signalized and potentially signalized intersections to the limits of the curb returns.

(C) Within railroad rights-of-way.

(D) In fill, unless it can be demonstrated to the satisfaction of the Engineer that the fill will adequately support the pipe.

(E) Where expansive or collapsible soils are encountered below the top of pipe.

Subsection 620.2.2: Delete the first sentence and replace with the following:

Sand aggregate used for concrete and mortar shall conform to Section 701.

Subsection 620.2.4: **Delete this Subsection in its entirety and replace with the following:**

Concrete shall be a minimum Class A per Section 725. Concrete shall be of a type and have a design strength and slump necessary for the site conditions and the Contractor’s construction methods. The slump shall not exceed 3 inches (75 millimeters).

Subsection 620.3.1 Excavation: Delete the last sentence in the second paragraph.

Subsection 620.3.1 Excavation: Add the following paragraph after the second paragraph of this Subsection:

The excavated trench shall be checked for compliance with requirements for grade and alignment prior to placement of concrete. The Contractor shall submit his proposed method of grade and alignment control and checking of same for conformance with specifications to the Engineer for his approval prior to start of work. The Contractor shall supply manpower, equipment and materials, as are required, to provide and confirm compliance with grade and alignment requirements. This is a non-pay item and all costs incurred shall be included in the bid item(s) for the pipe installation.

Subsection 620.3.2 Placement: Add the following paragraphs after the third paragraph of this Subsection:

Under no circumstances will the Contractor be allowed to continue the pipe installation if the vibrators of the cast-in-place machine are inoperable. Portable vibrators or "stingers" shall only be used to supplement internal vibrators on the machine and not as a sole source to consolidate and distribute the concrete mix.

The Contractor shall make provisions for removing sloughed material, debris and any foreign objects from trench before and during placement of concrete such that build-up of material does not occur ahead of the machine. In addition, small transverse trenches shall be dug across the trench bottom, at distances not to exceed 25 linear feet, to receive soil any build-up that is pushed ahead of the slipform.

Subsection 620.3.2 Placement: Delete the first paragraph of Subparagraph (A) in its entirety and replace with the following:

When pipe placement stops in excess of ninety (90) minutes, a construction joint shall be formed. The ends of the pipe that are to be butt contact shall be left in rough condition with a slope between 20 and 45 degrees. Number 4 reinforcing bars shall be embedded 12 inches in the previous pour and 12 inches into the next pour and shall be placed 12 inches on center for pipe 42 inches in diameter or less and 18 inches on center for pipe diameters in larger than 42 inches. For pipe diameters 60 inches or less, an excavation shall be made along the sides and bottom of the joint before resuming to permit casting of a concrete collar around the outside of the joint. This collar shall have a minimum thickness of 1-1/4 times the wall thickness of the pipe and shall lap the entire joint by at least two (2) times the wall thickness. Immediately before resuming concrete placement, the surface to be bonded shall be cleaned of all laitance, coatings, foreign materials and loose or defective concrete thoroughly wetted and coated with a layer of bonding mortar (Subsection 620.2.5) approximately 1/4 inch (6 millimeters) thick. In lieu of the bonding mortar, neat cement paste may be thoroughly scrubbed onto the wet surface of the previously placed concrete.

Subsection 620.3.2 Placement: Delete Item (2) of Subparagraph (B) in its entirety and replace with the following:

The minimum wall thickness shall be 1/12th of the inside diameter plus 1 inch.

Subsection 620.3.3 Curing and Backfilling: Delete this Subsection in its entirety and replace with the following:

The Contractor shall be responsible for proper curing of the concrete and backfilling the trench to an even grade. Final backfill and compaction shall not be started sooner than 7 days after concrete placement and only after the concrete has attained a compressive strength of at least 3000 psi. The pipe shall be checked for grade, alignment and thickness prior to backfilling. Curing shall be performed in such a manner as to prevent the premature drying of the concrete.

Polyethylene film complying with ASTM C-171, nominal thickness 0.0015 inch (0.038 millimeter), shall be placed on the exposed top surface of the pipe immediately after the pipe is cast. The film shall be anchored in place with loose soil to assure continuous, adequate curing.

A humid atmosphere within the pipe, as evidenced by condensation on the interior surface, shall be maintained for at least seven (7) days following concrete placement. To prevent air drafts, which may dry the pipe, and to maintain a humid atmosphere inside the pipe, all openings, ends, manholes and connector pipes shall be kept closed or securely covered, except when actual work is in progress on the inside of the pipe. The pipeline shall be partially filled with water during the curing period when work is not being performed on the inside of the pipe. If necessary, a maximum 24-hour period will be permitted within the 7 days following placement for removal of forms and repairs.

Subsection 620.3.4 Repair: Delete this Subsection in its entirety and replace with the following:

Immediately after removal of the forms, the inside of the pipe shall be inspected for required repairs and conformance with all dimensional requirements including alignment and grade.

The Engineer shall be the sole judge as to the repairability of deficiencies. He shall require removal and replacement of those sections of pipeline that he judges to be non-repairable or are not within required dimensional tolerances including alignment and grade.

When concrete placement is done by a method requiring the use of metal inner forms, the Contractor shall schedule his work force by extended, staggered or multiple shifts, as required, to provide for removal of forms within 4 to 6 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

When concrete placement is done by methods using pneumatically inflated inner liner, the Contractor shall schedule his work force by extended, staggered or multiple shifts, as required, to provide for removal of the pneumatic inner liner within 12 hours of placement of concrete and start of repairing, patching and finishing of pipeline to conform with specification requirements.

All rock pockets, non-longitudinal cracks or indentations shall be cleaned out, moistened and filled with 1:2 cement grout or approved epoxy material. Except where, in the opinion of the Engineer, the width and/or length of the crack may indicate a structural deficiency, repairs shall be made as required for longitudinal cracks.

At the discretion of the Engineer, longitudinal cracks exceeding 0.01 inch in width and 12 inches in length may be cause for rejection and removal and replacement of that portion of the pipe. Subject to the approval of the Engineer, cracks may be repaired using a pressure-applied epoxy compound capable of providing structural correction to the area in addition to sealing the void. A longitudinal crack shall be defined as one which has the general direction of a 30-degree angle or less with the alignment of the pipe.

Irrespective of concrete placement method, all repairs, patches and finishing shall be completed within 24 hours of concrete placement.

The Contractor shall submit a written schedule of his proposed work activities and work time schedules for the Engineer’s review and approval prior to the start of concrete placement on the project. No time schedule requiring overtime by the Engineer’s staff is authorized without specific written approval of the Engineer.

Subsection 620.3.5 Finish: Delete this Subsection in its entirety and replace with the following:

Except for the form offsets, the interior surface of the pipe shall be equivalent to or better than a wood float finish. Form offsets shall be trimmed so as to provide a reasonably tapered slope from surface to surface. The bottom of the pipe below the metal forms shall be finished in a workmanlike manner and shall conform to the general circular circumference of the pipe without sags, dips and humps. All extraneous concrete shall be removed from the interior surface.

Subsection 620.4 METHOD OF TESTS: Delete the title of this Subsection in its entirety and replace with the following:

TESTS

Subsection 620.4 METHOD OF TESTS: Delete this Subsection in its entirety and replace with the following:

Random tests of the wall thickness at the top, bottom and sides shall be made on a daily basis by probes, approximately every 100 feet, through fresh concrete or small holes drilled through the concrete. Holes shall be properly and permanently closed and sealed, flush with the inside surface of the pipe, after measurements are made, in accordance with the requirements of the fourth paragraph of Subsection 620.3.4.

Test cylinders shall be prepared and tested per Section 725. If the 28-day strength test does not comply to the specified compressive strength requirements, cores shall be taken from the same section of concrete represented by the non-compliant test under the supervision of the Engineer. The diameter of the core specimens for the determination of compressive strength should be at least three (3) times the maximum nominal size of the coarse aggregate used and at least twice the maximum nominal size of coarse aggregate.

The length of the specimen, when capped, should be twice the core diameter. A core having a maximum height of less than 95% of its diameter before capping or a height less than its diameter after capping shall not be tested.

If cores are taken, the Contractor shall patch all core holes in a manner that will be permanent, will be watertight to a minimum of 15 feet of internal pressure head, and will have a smooth interior finish flush with the interior surface of the pipe.

Obtaining the core specimens, preparing the specimens, testing the specimens, restoring the pipe and the Engineer's supervision shall be at the Contractor's expense.

The Engineer will evaluate the test results and his decision as to required corrective action will be final.

Subsection 620.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment will be made at the Contract unit price bid per linear foot to the nearest foot for each size of pipe and shall be compensation in full for furnishing and installing the cast-in-place concrete pipe complete as specified, including removal of paving and obstructions; excavating, backfilling and compacting; testing; and repair and all necessary incidental costs not specifically covered in other items in the proposal.

SECTION 621
CORRUGATED METAL PIPE AND ARCHES

Delete the title of this SECTION in its entirety and replace with the following:

STORM DRAIN CULVERT AND CATCH BASIN CONNECTOR PIPE CONSTRUCTION WITH CORRUGATED METAL PIPE AND ARCHES

Subsection 621.1 DESCRIPTION: Delete this Subsection in its entirety and replace with the following:

This Section covers corrugated metal pipe and arches used as culverts and catch basin connector pipes for the conveyance of storm drainage in public storm drains.

This Section does not include irrigation pipelines for private irrigation systems, the Salt River Valley Water Users' Association system or other irrigation districts' systems. Irrigation pipelines shall conform to the specifications and permit requirements of the respective irrigation district and project special provisions.

Installation of pipe in state highways shall conform to the specifications and permit requirements of the Arizona Department of Transportation.

Subsection 621.2 MATERIALS: Delete the second paragraph in its entirety and replace with the following:

The structural design of pipe and arches shall be in conformance with Section 6 of the City of Phoenix Stormwater Policies and Standards Manual (Latest Edition), applicable ASTMs, applicable AASHTO Standards, and established manufacturer-recommended design procedures. The pay width for pavement replacement shall remain in accordance with Section 336.

All helical corrugated metal pipe shall have a marking system that shall provide a quick external visual check of diameter variations during and after the manufacturing process.

All prefabricated fittings for connector and culvert pipes larger than 24 inches shall be welded fittings.

Subsection 621.3 INSTALLATION: Delete the first paragraph in its entirety and replace with the following:

Excavation, bedding, haunching, initial and final backfill and compaction shall be in accordance with Section 601.

Subsection 621.3 INSTALLATION: Delete the last sentence of the second paragraph and replace with the following:

All pipes and arches shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

Subsection 621.3 INSTALLATION: Delete the third paragraph in its entirety.

Subsection 621.3 INSTALLATION: Delete the fourth paragraph in its entirety and replace with the following:

Corrugated metal pipe and pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. CMP shall be handled carefully at all times to prevent damage to the coating. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to verify that no damage that will be concealed when the pipe is placed has been done to the coating. Damaged coating shall be repaired in accordance with AASHTO M-36. As determined by the Engineer, pipe and arch that is damaged to such

an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the contracting agency.

Subsection 621.3 INSTALLATION: Add the following to the end of this Subsection:

Where a curved alignment is indicated, curves shall be formed by straight pipe and fabricated specials. Pipe shall be of such length that no deflection angle of the pipeline exceeds 10 degrees. All deflection angles shall occur between the point of curvature and point of tangent of the curve as shown on the plans.

Transition manhole bases, for pipe larger than 48 inches, may be constructed with a prefabricated transition and a 48-inch stubbed manhole shaft cast as one structure. Dimensions of this structure shall be equivalent to those shown in the Standard Detail. A shop drawing of this option shall be submitted to the Engineer for review. Corrugated steel manhole shafts will not be permitted unless a detail of construction is included and reviewed with the shop drawing.

Pipe layout shall be such that for manholes not located at a joint, the outside edge of the manhole shaft shall be a minimum of 1.5 pipe diameters away from the nearest joint on both sides of the manhole.

If the manhole cannot be so located, then the concrete encasement shall be extended to include the joint or joints, not outside to minimum distance of 1.5 pipe diameters from the outside of the manhole shaft.

Subsection 621.3.1 Joints: Delete this Subsection in its entirety and replace with the following:

Joint materials shall be in accordance with Section 760.

Pipe sections shall be joined together with annular corrugated-type bands or hugger-type bands locking in at least one annular corrugation and shall be designed to form a leak-resistant joint. The hugger-type band shall use an O-ring gasket. The annular corrugated-type band shall use a 1/4-inch-thick rubber sleeve gasket the same width as the connecting band.

One-piece bands may be used on pipe with diameters up to and including 48 inches. O-ring gaskets or one-piece bands shall be a minimum of 3/4 inch in diameter. Two- or more piece bands shall be used on all pipe diameters exceeding 48 inches. For pipe with diameters exceeding 48 inches, O-ring gaskets shall be a minimum of 7/8 inches in diameter. The minimum connecting band width shall be 7 inches for pipe diameters of 12 inches through 30 inches, 10-1/2 inches for pipe diameters of 33 inches through 60 inches, and 13-1/2 inches for pipe diameters greater than 60 inches through 120 inches. The connecting bands may be two numerical gage thicknesses lighter than the gage specified for the pipe material, but not less than 0.064 inch (16 gage) nor more than 0.109 inch (12 gage).

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed hugger-type band and gaskets or other type band incorporating a locking channel and gaskets.

The band shall be tightened evenly, keeping equal tension on the bolts. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint, the nuts shall be testing for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained.

Subsection 621.3.2 Pipe Elongation: Delete the title of this Subsection in its entirety and replace with the following:

Vertically Elongating Catch Basin Connector Pipe

Subsection 621.3.2 Pipe Elongation: Delete this Subsection in its entirety and replace with the following:

When connector pipe is not fully bedded with CLSM, pipe may be vertically elongated. Pipe may be elongated 5 ± ½% of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical dimension of the pipe at any point along the pipe

section, after backfill and compaction is completed, be less than the nominal diameter of the pipe or more than 5% greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the contracting agency. Strutting of pipe shall be approved by the Engineer.

Subsection 621.3 INSTALLATION Delete Subsection 621.3.3 Cutting in its entirety.

Subsection 621.2 INSTALLATION: Delete Subsection 621.3.4 Repair of Damage to Coatings in its entirety.

Subsection 621.4 TEST SPECIMENS: Delete the first paragraph in its entirety.

Subsection 621.5 MEASUREMENT: Delete this Subsection in its entirety and replace with the following:

Measurement of corrugated metal pipe will be the number of linear feet of pipe, measured horizontally, from end to end of the pipe through manholes and specials. No separate measurement will be made for specials and other necessary fabrications. At changes in pipe diameter within a structure, the measurement will be to center of manhole or drainage structure.

Subsection 621.6 PAYMENT: Delete this Subsection in its entirety and replace with the following:

Payment will be made at the unit price bid per linear foot, to the nearest foot, for each size of pipe and shall be compensation in full for furnishing and installing the corrugated metal pipe, specials and necessary fabrications, including removal of asphalt paving, removal of obstructions, excavation, foundation, bedding, backfilling, compacting, temporary pavement, joints, joint materials, transitions with other pipe types, testing and all incidental costs not specifically covered in other items in the proposal.

SECTION 625
MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

Subsection 625.2 MATERIALS: Delete the second paragraph in its entirety and replace with the following:

Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames per Section 345. Bricks for manholes shall be per Section 775.

Subsection 625.2 MATERIALS: Add the following:

Precast polymer concrete manholes shall be per Section 744.

Subsection 625.2 MATERIALS: Add the following:

Precast polymer concrete manholes shall be per Section 744.

Subsection 625.3.1 Manholes: Delete the first paragraph in its entirety and replace with the following:

Manholes shall be constructed of precast concrete or polymer risers, cones, flat tops or of cast-in-place concrete, with cast iron frames and covers**.** Precast manholes or brick repairs and adjustments shall be constructed in accordance with the standard details. All manhole bases shall be constructed by either cast-in-place concrete or with precast polymer concrete. Precast concrete manhole bases shall not be used. Cast-in-place manholes shall be constructed from details sealed by a Structural Engineer licensed in the State of Arizona. Manhole steps are prohibited. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve, having a radius as large as the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

Subsection 625.3.1 Manholes: Delete the first sentence of the fifth paragraph and replace with the following:

Brickwork, precast concrete structures, or cast-in-place concrete shall not be laid upon a concrete manhole base less than 24 hours after such manhole base has been poured. No brickwork, precast concrete structures, or cast-in-place concrete shall be laid in water, nor, except as prescribed for curing, shall water be allowed to stand or run on any brickwork until the mortar has thoroughly set.

Subsection 625.3.1 Manholes: Delete the seventh paragraph in its entirety and replace with the following:

All machined surfaces on the frame and cover shall be such that the cover will lie flat in any position in the frame and have a uniform bearing through its entire circumference. Manhole covers in pavement shall be standard open pickslot unless otherwise designated by Engineer. When specified, provide concealed pickslot, watertight or boltdown covers and frames in lieu of open pickslot. Refer to COP Standard Detail P1424. Any frame and cover which creates any noise when passed over by automobiles shall be replaced. Frames shall be set firmly in a bed of mortar true to line and grade. The frame and cover shall be continuously and solidly supported per MAG Standard Detail 422 prior to placing the collar concrete. A concrete collar per MAG Standard Detail 422 with steel reinforcement shall be constructed around the frame and cover after the frame and cover is adjusted to grade and solidly supported.

SECTION 625.3 CONSTRUCTION METHODS: Add the following Subsection:

625.3.3 Sanitary Sewer Manhole Testing: All new sanitary sewer manholes installed shall be tested per Section 611.

SECTION 626
CORROSION PROTECTIVE COATING OF SANITARY SEWER MANHOLES AND STRUCTURES

Delete SECTION 626 in its entirety and replace with the following:

SECTION 626
CORROSION PROTECTION COATING OF SANITARY SEWER MANHOLES AND ACCESS STRUCTURES

626.1 GENERAL

6.26.1.1 Description

(A) Scope: Unless otherwise approved by the Owner, Engineer or as called for on the plans, all new concrete manholes and access structures constructed on 15-inch and larger diameter sanitary sewers, plus those extending to and including one upstream manhole regardless of lateral size, shall have an internal corrosion protective coating applied as specified herein. Drop manholes and force main manholes on 8-inch or larger diameter lines shall also be coated. When specified, existing sanitary sewer manholes shall be repaired as necessary and similarly coated. For this document, the terms manhole and access structure will be used interchangeably.

(B) Requirements

(1) The Contractor shall furnish all labor, materials and equipment required to clean, repair (if necessary) and coat the manholes.

(2) The Contractor shall comply with the local authority(ies) and all Occupational Safety and Health Administration (OSHA) requirements for confined space entry.

(3) All materials specified by name brand or manufacturer shall be delivered unopened to the jobsite in original containers.

(4) All safety precautions recommended by the manufacturer in printed instructions or special bulletins shall be obtained and followed. Safety data sheets (SDS) shall be kept on-site.

(5) For existing manholes, application of coating shall be carried out after all required cleaning, surface preparation and repairs to cone, walls, pipe penetrations, bench and invert are completed and meet all required Quality Assurance/Quality Control (QA/QC) inspections and tests.

(6) The Contractor shall ensure that any underlayment products, including repair materials, fillers and primers, are compatible with the specified coating product.

(7) The Contractor's coating applicator shall be certified by the coating and underlayment material manufacturers and properly trained for applying the manufacturer's coating and underlayment products. This certification and training requirement applies to both the applicator firm and individually to the firm's field personnel who will be directly involved with the application of the underlayment and/or coating products.

(8) Approved Water Service Vendors and Products: The approved vendors and products are provided on the Water Services Department Approved Products List. (https://www.phoenix.gov/waterservices/publications). Approvals shown are not necessarily exclusive. If approval of a similar product believed to be comparable and

equal is desired, a request should be submitted supported by appropriate information and data.

626.1.2 Warranty

(A) Standardization: Materials and supplies provided shall be the standard products of manufacturers as approved by the Owner and specified by the Engineer. The standard products of manufacturers other than those specified shall be reviewed by the Engineer and approved by the Owner.

(B) Warranty:

(1) The Contractor shall provide a non-prorated 5-year warranty for all materials and the installation of protective coatings or systems applied to sanitary sewer manholes and/or access structures. If the protective coating fails within 5 years from the date of substantial completion and Letter of Acceptance by the Owner, the Contractor will repair or replace the defective coating at no cost to the Owner, including all materials and labor. The repair or replacement shall be completed within 30 days of notice from the Owner.

(2) A coating failure is defined as blistering, cracking, embrittlement, softening, peeling, pitting or adhesion failure to the substrate. The warranty shall cover the products, installation and workmanship of the entire coating system, including all repair materials, defect fillers and primers and all intermediate and finish coats. The warranty shall include but is not limited to all labor, equipment, permitting, traffic control, bypass pumping, third-party quality control inspection and installer General Conditions required to repair or replace defective or failed coatings. Any testing performed during construction, including but not limited to spark testing and adhesion testing, shall not in any way modify the warranty or relieve the Contractor from its responsibility to repair or replace failed coatings. Mechanical damage due to maintenance operations or ancillary work on the coated manhole or structure by others is excluded from this warranty. The Contractor will have a list of warranted structures and the Owner's GIS Manhole number for each listed structure.

(3) The Contractor shall be the single point of contact for the Owner for all warranty issues and claims and is solely responsible to the city for the supply, administration and execution of all repairs and replacements covered by this warranty.

(4) The Contractor shall submit a certification letter to the Engineer documenting the effective warranty date, typically after all manholes have passed testing and after any manhole adjustments are complete for the specific project. The effective warranty date may also be a mutually agreed upon date or some other established acceptance date if otherwise directed by the Engineer or the Owner.

626.1.3 Warranty Period Inspection

The Engineer may conduct inspections before 5 years following substantial completion and Letter of Acceptance of new coating work and/or repaired coating work. The Contractor shall be notified of any apparent coating failures. The Contractor shall be responsible for any coordination with the coating manufacturer on the resolution and remediation of the coating failures. Defective work or coating failures shall be repaired per specifications and to the satisfaction of the Engineer. If warranty inspections are not held, the Contractor is not relieved of responsibilities under the contract documents.

626.1.4 Submittal Information Requirements

(A) The Contractor shall submit the following for review and approval by the Engineer at least 4 weeks before commencement of fieldwork unless stated otherwise:

- Copy of the State of Arizona contractor license for the applicator/installer.

- Certificate/documentation from the coating system manufacturer that the applicator/installer firm is a certified/approved installer of the coating system.
- Description of coating system manufacturer training/certification program as completed by applicator/installer as a firm.
- Description of coating system manufacturer training/certification program as completed by individual employees of the applicator/installer participating in the field installation of the coating system.
- List of individual employees of the applicator/installer assigned to the project, their roles/ responsibilities, and proof of completion of coating system manufacturer certification/training/ recertification for each employee within 2 years of commencement of the project. Proof of certification/training/recertification is required for all individuals directly involved in the surface preparation and/or application of the coating product(s). This shall include the certified applicator, the superintendent, the foreman and workmen who perform surface cleaning, patching, and underlayment and workmen who mix, apply and test the protective coating.
- Applicator/installer QA/QC plan to include at minimum the level of involvement of the coating system manufacturer's representatives; documentation of compliance to the manufacturer's product storage, mixing, surface preparation and application requirements; and quality control testing requirements and methodology.
- Project reference/installation list for the installer/applicator for the coating system for the past 5 years with Owner contact information.
- Coating system technical product with, at minimum, manufacturer information, product data sheets, mechanical/structural properties per ASTM testing, acid and chemical resistance testing results, and SDSs. The Technical Product Submittal shall include repair materials, underlayments/primers and finish coat materials.
- Coating system manufacturer-approved product application plan and requirements shall include but not be limited to product storage requirements, maximum storage life, mixing and proportioning requirements (as applicable), substrate repair and surface preparation requirements, manhole environmental condition requirements for application, the application film thickness of underlayment and finish coat(s) and the required curing time.
- Manufacturer representative verification of compliance to coating system application plan.
- 5-year Warranty Letter/Statement covering both product and installation, including a list of asset IDs and Owner location IDs covered by the warranty (at substantial completion).
- Sample of finished product, representative of finished color and texture.
- Detailed project schedule.
- Flow bypass plan(s) (as applicable).
- Copies of federal, state, and local permits and agreements (as applicable).
- Contractor Health and Safety Plan (for information only).
- Pre-construction photos/videos of existing site conditions.
- Post-construction photos/videos of existing site conditions (at substantial completion).

626.2 PRODUCTS

626.2.1 Coating Material

(A) Approved Materials: The coating material shall be an Owner-approved product or system.

(B) Dry film thickness of epoxy/polymer coatings shall be a minimum of 1/8 inch (125 mils) thick, or per the manufacturer's recommendation, whichever is greater.

(C) Cured underlayment thickness shall equal or exceed the minimum thickness recommended by the manufacturer but shall provide a uniform finished surface for the surface coating application.

(D) An underlayment process and material recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared per the manufacturer's recommendations and requirements of this document before applying any underlayment and coating. The Engineer may require a separate adhesion pull test to verify the integrity of any underlayment repairs.

626.3 EXECUTION

626.3.1 Manhole Cleaning:

(A) Cleaning shall remove all sediment, rocks, debris, roots, grease accumulations and obstructions from the manholes. Cleaning the manhole walls, bench and channel shall remove all grease, scale encrustation and loose mortar so that no foreign intrusion shall cause imperfections in the coating. Cleaning methods shall include high-pressure water jetting, dry or wet abrasive blasting, mechanical abrading, or other methods approved by the Engineer.

(B) The Contractor shall prepare concrete surfaces per NACE No. 6/SSPC-SP13 Joint Preparation Surface Standards and ICRI Technical Guidelines. The Contractor shall use abrasive blasting, high-pressure water jetting or mechanical abrading to remove all laitance, curing compounds, hardeners, sealers and other contaminants from the concrete surface. A minimum ICRI-CSP 5 surface profile shall be provided before applying the coating. The Contractor shall also be responsible for any additional surface preparation as the coating system manufacturer requires. Where additional preparation is required, the Contractor shall provide all labor materials and equipment as necessary at no additional cost to the Owner.

(C) The surface must be clean before the coating system's installation. Excess water shall be blown from the surface using compressed air equipment with oil-trapping filters. Suitable heaters shall be used as needed to produce a dry surface condition. The surface shall be vacuumed to ensure that loose particles are not present.

(D) No sediment or debris from the cleaning operations is allowed in the sewer. Any sedimentation deposited into the sewer system, as determined by the Engineer, shall be removed at no cost to the agency.

626.3.2 Coating Installation and Repair

(A) With the Engineer's approval, new manholes may have corrosion coating applied at the manhole manufacturer's facility. Still, all final acceptance testing shall be performed in the field following the installation of the manhole. If a new manhole is coated at the manufacturer's facility, all joints will require sealing and coating in the field after manhole assembly. After the joint is assembled in the field, the Contractor shall prepare the coated surface above and below the joint to receive the protective coating per the manufacturer's recommendations. Typically, a light abrasion blast to 2 inches above and below the joint will clean the surface and give the coating a suitable surface to adhere to.

(B) If the new manhole is coated at the manufacturer's facility, coating of joints, concrete adjustment rings and bench and invert and any necessary repairs to barrel or cone shall be performed in the field after successful leakage testing per Section 611.

(C) New manholes that do not have corrosion coating applied at the manhole manufacturer's facility shall be fully coated in the field, including barrels, cones, joints, concrete adjustment rings, and bench and invert after successful leakage testing per Section 611.

(D) Where specified for corrosion coating, existing manholes shall be prepared per these specifications and the manufacturer's recommendations. Weak and deleterious material shall be removed down to the sound substrate. Repairs shall be made with the coating manufacturer's recommended underlayment. The Contractor shall verify that the atmospheric conditions, including the ambient and substrate temperatures, are within the coating manufacturer's requirements for application. If the atmospheric conditions are unsuitable, the Contractor shall, with the approval of the Engineer, either delay the coating application or take appropriate steps to bring the conditions to within requirements. The coating shall be applied to barrels, cones, joints, concrete adjustment rings, and bench and invert. If flows cannot be bypassed or diverted with a flow-through plug, the Engineer may waive coating of invert.

(E) If the frame and cover of an existing coated manhole are adjusted in the field, the existing or added concrete adjustment rings shall be coated or have coating repaired as necessary per the manufacturer's recommendations.

626.3.3 Inspection Milestones

The Contractor shall inform the Owner of its progress in rehabilitating each manhole. At each manhole, the Owner may inspect the work after each milestone listed below before the Contractor shall commence work on the next milestone:

(1) Completion of required cleaning and surface preparation activities.

(2) Completion of all void-filling activities and underlayment application before surface-coating application, with the associated adhesion testing of the underlayment layer.

(3) Testing the pH of the surface following cleaning and void-filling underlayment activities before surface-coating application.

(4) Completion of the surface-coating installation before testing.

(5) Adhesion/bond testing of the finished coating system.

(6) Holiday spark testing of the final surface coating.

Following final cleanup and inspection, the Contractor shall digitally prepare and submit a table documenting the testing results that include, at a minimum, the GIS manhole number, pull test locations with corresponding test results and spark test pass/fail results.

626.3.4 Inspection and Testing Requirements

(A) The Contractor shall give the Engineer at least 2 business days' advance notice before any surface preparation work, underlayment application work, coating application work or testing.

(B) All work and testing shall be performed in the presence of the Engineer or a designated representative of the Engineer unless the Engineer has granted prior approval to perform portions of the work in their absence.

(C) An independent testing agency or laboratory approved by the Engineer may witness the acceptance for holiday and adhesion testing. Documentation shall be per the Engineer's requirements. The cost of this inspection and testing shall be the Contractor's responsibility.

(D) Additional illumination, scaffolding and confined space entry equipment and support shall be provided by the Contractor as necessary to facilitate inspection by the Engineer or the Engineer's representative and/or testing agency when requested at no additional cost to the agency.

(E) The Contractor shall furnish appropriate equipment and supplies for pH testing, holiday testing, dry and wet film thickness testing and coating adhesion testing. The Contractor shall provide trained personnel for performing required acceptance testing, including the operation of holiday detection devices.

(F) Holiday testing equipment and procedures shall be performed per NACE SP0-188 Discontinuity (Holiday) Testing of New Protective Coatings on Substrates. Areas containing holidays shall be marked, repaired, re-coated and retested per the coating manufacturer's printed instructions. High-voltage pulse-type holiday detectors shall be adjusted to operate at the voltage required to cause spark jumps across air gaps equal to twice the specified coating thickness. The minimum applied voltage for 125 mils coating shall be 12,500 volts or at a setting as the coating manufacturer requires. The inspection equipment shall be in good working order and annually certified by the equipment manufacturer. Certificates of calibration shall be provided to the Engineer upon request.

(G) The Contractor shall report the wet film thickness measurement to the Engineer. The information shall be presented after underlayment top coating operations are completed and shall state the number of manufacturer's product units used and the total square footage of surface area covered. The Engineer shall have the option of requiring the Contractor to document the number of units (coating materials) on hand before and after coating operations to verify the actual minimum dry film thickness applied. All film thicknesses not meeting the required minimums will be re-coated per the manufacturer's recommendations to the required minimum 125 mils thickness.

(H) The Contractor shall perform adhesion tests on 30% of the manholes coated on any project (at least one manhole if 30% is less than 1.0). Adhesion tests shall conform to ASTM D7234, and the minimum pull-off strength shall be 200 psi on concrete and 100 psi on brick. Some portion of the substrate shall be adhered to the coating and dolly. A minimum pull-off strength of 150 Psi on concrete will be acceptable if the substrate is attached to the coating and dolly on more than Yi the area of the dolly. Fifty-millimeter dollies shall be used for adhesion testing.

(I) Adhesion tests shall be required at a minimum of three underlayment adhesion tests and three finished coating system adhesion tests per manhole tested.

(J) For each manhole tested, one adhesion test will be performed on the cone, wall and bench. The Owner or Owner's representative shall select specific test locations within each manhole. The Owner or Owner's representative shall be present to observe all adhesion testing.

(K) The Contractor shall measure the coating thickness on the three adhesion test dollies and report the average measurement to verify the applied coating thickness.

(L) In the event of a failure, the Engineer and Contractor shall determine the limits of failure through additional investigation, sounding and pull tests. Failed areas shall be removed and repaired per these specifications and the manufacturer's recommendations. The Repaired area(s) shall be retested per these requirements. The Engineer shall be allowed to increase the testing frequency depending on the number or percentage of failed test results.

(M) The pH of the surface of the manhole wall shall be tested per ASTM D4262 and reported.

626.4 MEASUREMENT

Measurements shall be per the square foot of manhole wall coated or per each treated manhole as required by the Contract documents.

626.5 PAYMENT

If required, payment shall be made at the agreed-upon unit price. It shall consider total compensation for cleaning, surface preparation materials, application, testing and any incidentals in conformance with the plans and specifications.

-End of Section-

SECTION 627
PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE

Add SECTION 627 in its entirety:

SECTION 627
PAINTING SANITARY SEWER MANHOLES WITH INSECTICIDE

627.1 GENERAL

This specification pertains to manholes on sewer, 15 inches in diameter and under.

All new manholes shall be painted with insecticide.

After the new pipe has been tested, inspected and accepted for service and the manhole has been adjusted to final grade, the top 8 feet or from the manhole bench to the finish grade, whichever is less, shall be painted. The entire interior circumference shall be covered, including adjusting rings.

The interior of the manhole shall be free from all loose material to provide a clean bonding surface. Refer to manufacturer's specifications for preparation instructions.

Existing manholes to which corrosion coatings are applied shall be painted with insecticide.

627.2 INSECTICIDE PAINT

Product shall meet requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application.

627.3 APPLICATION

Product shall be applied in accordance with requirements of the current City of Phoenix IFB Requirements Contract for Manhole Insecticide Application. Paint must be applied to top 8 feet of manhole cone and barrel. Paint must be applied by a State of Arizona Licensed Pest Control Applicator.

Existing manholes to which a tap or main connection is made do not require insecticide paint.

627.4 MEASUREMENT

Measurement shall be per manhole.

627.5 PAYMENT

Payment shall be made at unit price bid per manhole, and be full compensation for cleaning, surface preparation, materials, application and any incidentals, thereto, in conformance with plans and specifications.

-End of Section-

SECTION 630
TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATERLINES

Subsection 630.3 GATE VALVES: Delete the paragraph "630.3.2 Supplements Specifically Relating to Valve Size:" in its entirety and replace with the following Subsection:

630.3.2 Supplements Specifically Relating to Valve Sizes: Iron body resilient-seated gate valves are allowed up to 30 inches..

Subsection 630.4.2 Tapping Sleeves: Add the following as the first paragraph of this Subsection:

All tapping sleeves where the tap size is the same size as the size of the main to be tapped shall conform to Subsection 630.4.2 (A)

Subsection 630.5 BUTTERFLY VALVE: Add the following Subparagraphs to Subparagraph (A):

(14) The rubber valve seats shall be located in the valve body for valves 16 inches in diameter and larger. Valve seat configurations that rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable. The seating surfaces mating with rubber seats shall be AISI Type 304 or 316 stainless steel, monel or plasma-applied nickel-chrome overlay for all valves.

(15) Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts with a hexagonal cross section is not acceptable. The connection between the shaft and the disc shall be mechanically secured by means of a solid, smooth sided, stainless steel or monel taper pin or dowel pin. Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of bolts, setscrews, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins or other devices instead of the solid, smooth sided, stainless steel or monel taper pins or dowel pins shall not be acceptable.

(16) Prior to installation of the butterfly valve, the Contractor shall provide to the inspector certification statements from the valve manufacturer indicating the leakage tests in both directions, proof of design tests were performed and successfully met per AWWA C504-06 Section 5.1.2. If certifications are not provided, the Contractor can elect to perform tests per AWWA C504-06 Section 5.1.2 witnessed by the inspector. If the tests are not successful, the Contractor is required to contact the manufacturer to have the seats adjusted until such a time the tests are successful in both directions.

This Page Reserve for Future Use

PART 700
MATERIALS

SECTION 701
AGGREGATE

Subsection 701.4 RECLAIMED CONCRETE MATERIAL (RCM): Delete the first two sentences of the second paragraph and replace with the following:

The use of RCM in any manner shall require prior approval from the Engineer. In accordance with Section 7 of AASHTO M319, RCM shall not contain more than 5% by mass of brick or concrete block and shall be free of wood, metal, plaster and gypsum board. RCM shall be free of all materials that fall under the category of solid waste or hazardous materials as defined by the state or local jurisdiction.

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Delete the title of this Subsection in its entirety and replace with the following:

RECLAIMED ASPHALT PAVEMENT (RAP) AND RECLAIMED ASPHALT SHINGLES (RAS)

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Delete the last two sentences in the first paragraph and replace with the following:

RAP shall not be used in Portland cement concrete or CLSM. RAP shall not be used in structure backfill. The use of RAP in other fill shall require prior approval from the Engineer.

Subsection 701.5 RECLAIMED ASPHALT PAVEMENT (RAP): Add the following paragraph to the end of this Subsection:

RAS is defined as all recovered, salvaged or recycled asphalt roof shingles that have been processed to make the material reusable. RAS shall not be used in asphalt concrete, Portland cement concrete or CLSM. RAS shall not be used in structure backfill. The use of RAS in other fill shall require prior approval from the Engineer.

SECTION 702
BASE MATERIALS

Delete this SECTION in its entirety and replace with the following:

702.1 GENERAL

Base material (Select Material Type A, Select Material Type B, Aggregate Base ABC) shall be crushed aggregate, with gradation per Table 702-1.

The Contractor shall submit documentation to the Engineer from a city-approved testing laboratory showing compliance with Table 702-1 ten (10) days prior to placement of base material except where base materials are being obtained from an approved source that is on a list maintained by the City of Phoenix, Street Transportation Department, Design and Construction Management Division, Materials Lab Section.

RCM and RAP meeting the requirements of Section 702 may be utilized as base material with prior approval from the City of Phoenix Materials Lab.

Cement or lime treated base meeting the requirements of Section 702 may be utilized as base material, except within the pipe embedment zone around Reinforced Concrete Pipe (RCP) and metal pipe.

702.1.1 Aggregate Base Course is primarily used in roadway applications or where otherwise specified by project plans or special provisions.

702.1.2 Select Material is primarily used, as a subbase in roadways, fill and embankment applications or where otherwise specified by project special provisions.

702.2 PHYSICAL PROPERTIES

Crushed aggregate shall consist of crushed rock or crushed gravel or a combination thereof as defined in Section 701.

TABLE 702-1

SIEVE ANALYSIS
TEST METHODS AASHTO T-27, T-11

Sieve Size	Accumulative Percentage Passing Sieve, by Weight		
	Select Material		Aggregate Base Course
	Type A	Type B	
3 in.	100	--	- -
1-1/2 in.	--	100	100
1 in.	--	--	90–100
No. 4	30–75	30–70	38–65
No. 8	20–60	20–60	25–60
No. 30	10–40	10–40	10–40
No. 200	0–12	0–12	3–12
Plasticity Index **Test Methods AASHTO T-89 Method A, T-90, T146 Method A**			
Maximum allowable value	5	5	5

TABLE 702-1			
SIEVE ANALYSIS TEST METHODS AASHTO T-27, T-11			
Fractured Face, One Face Test Method ARIZ 212, Percent by Weight of the Material Retained on a #4 Sieve			
Minimum required value	50	50	50
Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine Test Method AASHTO T-96, Percent Loss by Weight			
Maximum allowable value at 100 revolutions	10	10	10
Maximum allowable value at 500 revolutions	40	40	40
CBR Test Method AASHTO T-193			
Minimum at 0.2000 inch penetration at 65 blows, 100% compaction	50	50	50
Friable or Deleterious Substances Test Method ASTM C-142, Percent by Weight			
Maximum allowable in fine aggregate	3	3	3
Maximum allowable in coarse aggregate	3	3	3
Soundness Test Method ASTM C-88, Percent Loss by Weight			
Maximum allowable in fine aggregate	10	10	10
Maximum allowable in coarse aggregate	12	12	12
Apparent Specific Gravity Test Method ASTM C-127			
Minimum (considering other factors)	2.65	2.65	2.65
pH and Resistivity Test Method ARIZ 236			
pH	6–10	6–10	6–10
Minimum Resistivity	2000 ohm-cm	2000 ohm-cm	2000 ohm-cm

702.2.2 Acceptance:

When tested for acceptance, Base material that does not meet Table 702-1 properties for gradation or PI may be approved for specific project at the Engineer's discretion if the R-Value is at least 70, when determined by test method AASHTO T-190 (see Table 310-1).

-End of Section-

SECTION 710
ASPHALT CONCRETE

Subsection 710.1 GENERAL: Remove the second paragraph of the subsection and replace with the following:

Asphalt concrete is designated as Type C ¾-inch Base, Surface or Single Course; Type D ½-inch Single or Surface Course. Each mix shall be designed using Marshall or gyratory compaction methods, as specified for each project.

TABLE 710-1 RECOMMENDED LIFT THICKNESS FOR ASPHALT CONCRETE MIXES: Delete Table 710-1 and replace with the following Table 710-1:

TABLE 710-1

RECOMMENDED LIFT THICKNESS FOR ASPHALT CONCRETE MIXES

Asphalt Concrete Mix Designation (inches)	Minimum Lift Thickness Marshall Mixes	Maximum Lift Thickness Marshall Mixes	Minimum Lift Thickness Gyratory Mixes	Maximum Lift Thickness Gyratory Mixes
D 1/2 inch	1.5 inches	3.0 inches	2.0 inches	3.0 inches
C 3/4 inch	2.5 inches	4.0 inches	3.0 inches	4.0 inches

Subsection 710.2.3 Reclaimed Asphalt Pavement: Remove the subsection in its entirety and replace with the following:

710.2.3 Reclaimed Asphalt Pavement (RAP): When approved for use by the City of Phoenix Materials Lab on a city project, Reclaimed Asphalt Pavement (RAP), as defined in Section 701.5, may be used in asphalt concrete provided all requirements of Section 710 are met. References to use of RAP in Section 710 apply only if RAP is used as part of the mixture.

When RAP is used in asphalt concrete, it shall be of a consistent gradation, asphalt content and properties. When RAP is fed into the plant, the maximum RAP particle size shall not exceed 1 1/2 inches. The percentage of asphalt in the RAP shall be established in the mix design. The percentage of RAP binder shall be established in the mix design.

When RAP is used, the amount of RAP aggregate and resulting RAP binder replacement should not exceed 10% contribution.

In addition to the requirements of Section 710.3.1, the job mix formula shall indicate the percent of asphalt RAP and the percent and performance grade of virgin (added) asphalt binder.

When up to 10% RAP binder is used by weight of total binder in the mix, the added virgin binder shall meet the requirements for PG 70-10, as shown in Section 711, unless testing indicates that the blend of the recovered RAP binder and virgin binder meets the requirements for PG 70-10 as shown in Section 711.

Subsection 710.3.1 General: Add the following after the first paragraph of this subsection:

Should the Contractor choose to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab 15 working days prior to the start of the asphalt placement. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification

and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through biennial asphalt concrete supplier calibrations.

Subsection 710.3.1 General: Delete the last paragraph in this subsection and replace with the following:

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor use additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the asphalt binder, including modifiers in the asphalt binder, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

TABLE 710-3 MARSHALL MIX DESIGN CRITERIA: Delete Table 710-3 and replace with the following Table 710-3:

TABLE 710-3

MARSHALL MIX DESIGN CRITERIA

Criteria	Requirements		
	1/2-inch Mix	3/4-inch Mix	Designated Test Method
1. Voids in Mineral Aggregate: %, min	14.0	13.0	AI MS-2
2. Effective Voids: %, Range	4.0 ±0.2	4.0 ±0.2	AI MS-2
3. Absorbed asphalt: %, Range*	0-1.0	0-1.0	AI MS-2
4. Dust to Eff. Asphalt Ratio, Range**	0.6-1.4	0.6-1.4	AI MS-2
5. Tensile Strength Ratio: % Min.	65	65	ASTM D4867
6. Dry Tensile Strength: psi, Min.	100	100	ASTM D4867
7. Stability: pounds, Minimum	2,500	2,500	AASHTO T-245
8. Flow: 0.01-inch, Range	8-16	8-16	AASHTO T-245
9. Mineral Aggregate Grading Limits			AASHTO T-27
	Percent Passing with Admix		
Sieve Size		1/2-inch Mix	3/4-inch Mix
1-1/4 inch		--	--
1 inch		--	100
3/4 inch		100	90-98
1/2 inch		85–100	--
3/8 inch		62–85	62–77
No. 8		40–50	35–47
No. 40		10–20	10–20
No. 200		2.0–10.0	2.0–8.0

*Unless otherwise approved by the Engineer.
**The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

TABLE 710-4 GYRATORY MIX DESIGN CRITERIA: Delete Table 710-4 and replace with the following Table 710-4:

TABLE 710-5			
GYRATORY MIX DESIGN CRITERIA			
Criteria	**Requirements**		**Designated Test**
	1/2-Inch Mix	**3/4-Inch Mix**	**Method**
1. Voids in Mineral Aggregate: %, Min.	14.0	13.0	AI MS-2
2. Effective Voids: %, Range	4.0 ± 0.2	4.0 ± 0.2	AI MS-2
3. Absorbed Asphalt: %, Range *	0–1.0	0–1.0	AI MS-2
4. Dust to Eff. Asphalt Ratio, Range **	0.6–1.4	0.6–1.4	AI MS-2
5. Tensile Strength Ratio: %, Min.	75	75	ASTM D4867
6. Dry Tensile Strength: psi, Min.	75	75	ASTM D4867
7. Mineral Aggregate Grading Limits			AASHTO T-27
	Percent Passing with Admix		
Sieve Size	**1/2-inch Mix**	**3/4-inch Mix**	
1 inch	--	100	
3/4 inch	100	90–97	
1/2 inch	90–100	43–89	
3/8 inch	53–89	--	
No. 8	29–40	24–36	
No. 40	3–20	3–18	
No. 200	2.0–7.5	2.0–6.5	

*Unless otherwise approved by the Engineer.
**The ratio of the mix design composite gradation target for the No. 200 sieve, including admixture, to the effective asphalt content shall be within the indicated range.

-End of Section-

SECTION 719
POLYMER MODIFIED ASPHALT CONCRETE

Subsection 719.3.1 General: Add the following after the first paragraph:

Should the Contractor choose to utilize a City of Phoenix mix design from a non-approved source, the mix design(s) shall be submitted to the City of Phoenix Materials Lab fifteen (15) working days prior to the start of the asphalt placement. Included with the mix design, the Contractor shall also submit the appropriate asphalt concrete for mix verification and laboratory calibrations as specified by the City of Phoenix Materials Lab. These samples will not include standard City of Phoenix mix designs approved through biennial asphalt concrete supplier calibrations.

Subsection 719.3.1 General: Delete the last paragraph in this subsection and replace with the following:

The mix design shall be submitted to the Agency or Engineer by the Contractor/Supplier for which it was developed as part of his project submittals. Once the mix design has been approved by the agency or Engineer, the Contractor and/or his supplier shall not change plants nor use additional mixing plants without prior approval of the Engineer. Any changes in the plant operation, the producer's pit, the asphalt binder, including modifiers in the asphalt binder, or any other item that will cause an adjustment in the mix, shall be justification for a new mix design to be submitted.

SECTION 725
PORTLAND CEMENT CONCRETE

Subsection 725.8.1 Field Sampling and Tests: Delete the eighth paragraph in its entirety and replace with the following:

Sampling and testing for the 7-day cylinder, the two 28-day concrete acceptance test cylinders and the three HOLD cylinders will be at the expense of the contracting agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

Subsection 725.8.2 Concrete Cylinder Test: Add the following sentence after the fourth sentence:

A single 7-day cylinder shall be made and tested to provide progress information only and neither shall be considered an acceptance test. Two HOLD cylinders shall also be made and shall be acceptance tested at 56 days when the 28-day test fails to comply.

Subsection 725.9 ACCEPTANCE: Delete the first sentence of Subparagraph (2) and replace with the following:

Limit the maximum allowable temperature of the concrete mixture immediately before placement to 90ºF unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer.

SECTION 728
CONTROLLED LOW-STRENGTH MATERIAL

Subsection 728.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

Unless approved by the Engineer, the Controlled Low-Strength Material (CLSM) shall be from an approved commercial source and is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. Approved CLSM shall be identified by a product code that includes "PHCLSM." CLSM is a self-compacting, flowable, cementitious material primarily used as a backfill, structural fill or a replacement for compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section 604.

Subsection 728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES: Delete Note (2) for Table 728-1 and replace with the following:

(2) Ready-mixed concrete, including timed-out, rejected and truck wash-out material, shall not be used in lieu of CLSM without prior approval from the Engineer and shall be subject to rejection.

SECTION 735
REINFORCED CONCRETE PIPE

Subsection 735.1 GENERAL: Add the following after the second paragraph of this Subsection:

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

When specified in the special provisions, four sets of pipeline layout drawings shall be furnished to the Engineer prior to the manufacture of the concrete pipe. The pipe layouts will be used by the contracting agency for reference only, but their use shall in no way relieve the Contractor of the responsibility for the correctness of the layout. Catch basin connector pipe need not be included in the pipeline layout; however, pipe stubs shall be included. In lieu of including catch basin connector pipe in the pipe layout, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall contain the following information:

(A) Size and class of pipe

(B) Station at which pipe joins main line

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

All pipe installed in tunnels shall be ASTM C76, Class III. Pipe stronger than that specified may be furnished at the Contractor's option and at no additional cost to the contracting agency, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

Subsection 735.2 JOINTS: Delete the last paragraph in its entirety.

Subsection 735.4 MATERIALS: Add the following as the last sentence of Subparagraph (C):

The area of steel used shall be the same as that shown on the shop drawing for that pipe.

SECTION 736
NON-REINFORCED CONCRETE PIPE

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 738
HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN AND SANITARY SEWER

Delete the title of this SECTION in its entirety and replace with the following:

HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN AND LIFT STATION FORCE MAINS

Delete this SECTION in its entirety and replace with the following:

738.1 GENERAL

738.1.1 Lift Station Force Mains: For all requirements related to HDPE pipe used on force mains serving wastewater lift stations, refer to the latest version of the Water Services Department Wastewater Lift Station Design Guidance Manual. The rest of this section refers to requirements applicable to storm drain systems.

738.1.2 Storm Drain Pipe and Fittings: This specification, including all subsections below, covers the requirements of profile-reinforced and corrugated (Type S) high-density polyethylene (HDPE) pipe manufactured per ASTM F894 or AASHTO M-294 for gravity flow and low-pressure storm drain systems. When noted on the plans or in the special provisions, gravity flow and low-pressure storm drains may be constructed using HDPE pipe. HDPE pipe will be 15 inches in diameter through 48 inches in diameter only. For the purpose of this specification, low pressure is defined as the test pressures of 3.5 psi of air or 4 feet of water as specified in Section 615.11.

All pipe joints shall conform to the controlled pressure test of 10.8 psi of air or 25 feet of water as stipulated in ASTM D3212.

The size and class of the HDPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than RSC-63 for ASTM F894 open profile pipe or the Pipe Stiffness (PS) for corrugated Type S pipe per the requirements of AASHTO M-294.

738.2 MATERIALS

738.2.1 Base Material Composition: Open profile pipe base material and fittings shall, in accordance with ASTM F894, be made from a PE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248 and with an established hydrostatic design basis (HDB) of not less than 1250 psi for water at 73.4ºF as determined in accordance with Method ASTM D2837. Materials meeting the requirements of cell classification PE 334433 C or higher cell classification, in accordance with ASTM D3350, are also suitable. Corrugated Type S pipe base material shall comply with the requirements of AASHTO M-294 (Type S) and have a minimum cell classification of PE 335420C.

738.2.2 Other Pipe Materials: Materials other than those specified under Base Materials Composition shall comply with ASTM F894 or AASHTO M-294.

738.2.3 Gaskets: Gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

738.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band or a take-up device used for mechanically compressing the water stop against the pipe.

738.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

738.2.6 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

738.3 JOINING SYSTEMS

738.3.1 Gasket Type: Joints for the piping system and fittings shall consist of an integrally formed bell and spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket located on the spigot is compressed radially on the pipe or fitting bell to form a watertight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made. The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections that would adversely affect sealability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

738.3.2 Pipe to Concrete Structure Connections: An approved flexible connection, mechanical seal or water stop shall be provided at manhole entry or concrete structure connections to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

Storm drain manholes in public rights-of-way, right-of-way easements and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

738.3.2 Thermal Weld Type: The pipe ends shall consist of an integrally formed bell and spigot, with or without the elastomeric centering gasket, which join together to form an interface between bell and spigot, such that it is suitable to seal by thermal weld using the extrusion welding process, in accordance with the manufacturer's recommended procedure.

Thermal welded joints may be affected by welding from inside or outside the pipe, or both.

The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

Thermal welded joints shall be used only when specified on plans or in specifications.

738.4 FITTINGS

Fittings for HDPE open profile or corrugated Type S pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket-type or thermal weld-type joints in accordance with Subsection 738.3.

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of-way easements and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

738.5 CERTIFICATION

A manufacturer's certification that the material was manufactured, sampled, tested and inspected in accordance with ASTM F894 and been found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

Pipe and resin producers that manufacture according to AASHTO M-294 shall be certified according to the Plastic Pipe Institute protocol for their Third-Party Certification Program.

A manufacturer's certification that the material was manufactured, tested and supplied in accordance with AASHTO M-294 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

738.6 DIMENSIONS AND TOLERANCES

Open profile HDPE pipe dimensions shall comply with dimensions given in Table 1 of ASTM F894. The "average or nominal inside diameter" of profile wall HDPE pipe shall not deviate from its normal pipe size by more than as specified in Table 1 of ASTM F894. Corrugated Type S HDPE pipe dimensions shall be "nominal inside diameter" dimensions and shall not deviate from its nominal pipe size by more than the minimum and maximum tolerances as described in AASHTO M-294, Section 7.2.3.

Pipe shall have a Ring Stiffness Constant (RSC) or Pipe Stiffness (PS) as shown on the plans. The minimum RSC for open profile HDPE pipe shall be RSC-63. The minimum PS for corrugated Type S pipe shall be as shown in AASHTO M-294 (Section 7.4) and tested per ASTM D2412. In no case shall the minimum PS be less than the equivalent PS value for RSC-63.

738.7 CLASSIFICATIONS

HDPE open profile pipe products shall be made in four standard RSC classifications: 40, 63, 100 and 160. These are referred to as RSC-40, RSC-63, RSC-100 and RSC-160. The RSC test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with ASTM F894. HDPE corrugated (Type S) pipe shall meet the minimum PS requirements of AASHTO M-294. The PS test shall be conducted in accordance with ASTM D2412 with the exceptions listed in accordance with AASHTO M-294.

738.8 MARKINGS

Markings on pipe shall be per ASTM F894 or AASHTO M-294. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but are not limited to the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol. In addition, manufacturers of corrugated HDPE Type S, AASHTO M-294, shall print on or affix the appropriate Plastic Pipe Institute Program Mark on each length of pipe produced that meets the requirements of the program.

738.9 CARE OF PIPE AND MATERIALS

Care of pipe materials shall comply with Subsection 736.5.

HDPE profile reinforced RSC type pipe in shipping or storage shall not be stacked higher than three rows for pipes 21 inches in diameter or less, nor higher than two rows for pipes 24 to 36 inches in diameter inclusive. Pipe shall not be stacked, shipped, or stored with weight on the bells of the pipe.

Corrugated HDPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than 5 rows for pipe 24 inches or less in diameter, or 3 rows for pipe greater than 24 inches in diameter.

Pipe that is gouged marred or scratched forming a clear depression shall not be installed and shall be removed if damaged in the installation.

-End of Section-

SECTION 739
STEEL-REINFORCED POLYETHYLENE PIPE AND FITTINGS
FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

Delete the title of this SECTION in its entirety and replace with the following:

STEEL-REINFORCED HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN

Delete this SECTION in its entirety and replace with the following:

739.1 GENERAL

This specification covers the requirements of ribbed-pipe profile steel-reinforced polyethylene pipe (SRPE) pipe manufactured per ASTM F2562 for storm drains. When noted on the plans or in the special provisions, storm drains may be constructed using SRPE pipe. SRPE pipe shall be designed in accordance with AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Section 12. Trench excavation, backfilling and compaction for this flexible pipe shall be in accordance with Section 601. Construction and installation shall be in accordance with Section 618 for storm drain. The SRPE pipe will be 24 inches in diameter through 48 inches in diameter only.

The size and class of the SRPE pipe to be furnished shall be designed by the Engineer and shown on the plans or in the project specifications. At no time will the class designed be less than Class 1 per the requirements of ASTM F2562.

739.2 MATERIALS

739.2.1 Base Steel Materials: Continuous high-strength galvanized ribs shall be cold rolled steel meeting the requirements of either ASTM A1008 or ASTM A1011 with a minimum yield strength of 80,000 psi. Steel ribs shall be completely encased within the HDPE profile.

739.2.2 HDPE Material Composition: SRPE pipe high-density polyethylene material and fittings shall, in accordance with ASTM 2562, be made from a high-density polyethylene plastic compound meeting the minimum requirements of cell classification 335464C or higher cell classification, in accordance with ASTM D3350.

739.2.3 Gaskets: Rubber gaskets shall be manufactured from a natural rubber, synthetic elastomer or a blend of both and shall comply in all respects with the physical requirements in ASTM F477.

739.2.4 Water Stops: Water stops shall be manufactured from a natural or synthetic rubber and shall conform to the requirements of ASTM C923. The water stop shall have expansion rings, a tension band or a take-up device used for mechanically compressing the water stop against the pipe.

739.2.5 Thermal Welding Material: The material used for thermally welding the pipe material shall be compatible with the base material.

739.2.6 Lubricant: The lubricant used for assembly shall comply with manufacturer's recommendations and have no detrimental effect on the gasket or pipe.

739.2.6 Other Materials: Materials other than those specified above shall comply with ASTM F2562.

739.3 JOINING SYSTEM

739.3.1 Gasketed Type: Steel-reinforced bell and spigot joints for the piping system and fittings shall consist of an integrally formed steel-reinforced bell and steel-reinforced spigot gasketed joint. The joint shall be designed so that when assembled, the elastomeric gasket is compressed radially on the pipe or fitting bell to form a watertight seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service. The elastomeric gasket shall meet the provision of ASTM F477.

All pipes shall have a home mark on the spigot end to indicate proper penetration when the joint is made. The bell and spigot configurations for the fittings shall be compatible to those used for the pipe.

Joints shall provide a seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections that would adversely affect seal ability. The assembly of the gasketed joints shall be in accordance with the pipe manufacturer's recommendations.

739.3.2 Thermal Weld Type: Electro fusion (EF) joints shall utilize plain ended pipe welded together by internal pressure-testable couplers. The internal couplers shall have a minimum wall thickness equal to or greater than the pipe wall thickness as defined in pipe specification ASTM F2562. The assembly of the welded joints shall be in accordance with the manufacturer's recommendations.

739.3.3 Pipe to Concrete Structure Connections: An approved flexible connector, mechanical seal or water stop shall be provided at manhole entry or concrete structure connection to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

Storm drain manholes in public rights-of-way, right-of way easements and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

739.4 FITTINGS

Fittings for SRPE pipe may include tees, elbows, manhole adapter rings, plugs, caps, adapters and increasers. Fittings shall be joined by gasket-type or thermal weld-type joints in accordance with Subsection 739.3.

A clamp gasket or approved method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket. A non-shrink grout shall be used for grouting.

Storm drain manholes in public rights-of-way, right-of way easements and dedicated public drainage easements shall conform to COP Standard Detail P1520, MAG Standard Detail 522 excluding steps, and Section 625.

739.5 CERTIFICATION

A manufacturer's certification that the product was manufactured and tested in accordance ASTM F2562 and found to meet the requirements shall be submitted. A report of the test results shall be included in the submittal.

739.6 DIMENSIONS AND TOLERANCES

Profile wall SRPE pipe dimensions shall comply with dimensions given in Table 2 of ASTM F2562. The "inside diameter" of profile wall SRPE pipe shall not deviate from its published inside diameter by more than as specified in Section 6.2.3 of ASTM F2562.

739.7 MARKINGS

Markings on pipe shall be per ASTM F2562. These markings shall be clearly shown on the pipe at intervals of approximately 12 feet and include but are not limited to the manufacturer's name or trademark, nominal size, the specification designation, plant designation code, date of manufacture or an appropriate code. All fittings shall be marked with the designation number of the specification and with the manufacturer's identification symbol.

739.8 CARE OF PIPE MATERIALS

All pipe and materials shall be manufactured, handled, loaded, shipped, unloaded and installed in such manner as to be undamaged and in sound condition in the completed work. Particular effort shall be exercised to protect the ends of pipe. Repairs on damaged pipe shall be made to the satisfaction of the Engineer or removed from the site. Pipe

that has gouging, marring and scratching that forms a clear depression shall not be installed, and it shall be removed if damaged during the installation. Rubber elastomeric gaskets shall be covered in a factory-applied protective wrap.

SRPE pipe in shipping and storage shall be stacked per manufacturer's recommendation, but in no case higher than four rows. Pipe shall not be stacked, shipped or stored with weight on the bells of the pipe.

-End of Section-

SECTION 740
POLYETHYLENE PIPE AND FITTINGS FOR STORM DRAIN, IRRIGATION AND SANITARY SEWER

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 741
LINING FOR REINFORCED CONCRETE SANITARY SEWER PIPE

Delete this SECTION in its entirety and replace with the following:

741.1 GENERAL

The interior area of the reinforced concrete pipe as indicated on the plans shall be protected with lining, as specified below.

The installation and application of the pipe lining shall be accomplished by the supplier of the reinforced concrete pipe.

All work for and in connection with the installation of lining in concrete pipe and the field welding of joints shall be done in strict conformance with all applicable published specifications, instructions and recommendations of the approved lining manufacturer.

741.2 MATERIALS

741.2.1 Material Composition: The material shall be a liner plate that is a combination of inert, synthetic resins, pigments and plasticizers, compounded to make a permanently flexible sheet.

The liner plate shall be resistant to oxidizing agents; sulfuric, phosphoric, nitric, chromic, oleic and stearic acids; sodium and calcium hydroxides; ammonia, sodium, calcium, magnesium and ferric chlorides; ferric sulfate; petroleum oils and greases; and vegetable and animal oils, fats, greases and soaps that normally occur in sanitary sewers.

Liner plate shall be impermeable to sewage gasses and liquids and shall be nonconductive to bacterial or fungus growth. All liner plates shall be factory checked electrically to ensure freedom from any porosity with a high-voltage holiday detector set at a minimum of 20,000 volts.

Joint strips and welding strips shall have the same general composition and corrosion resistance as liner plate but shall not have locking extensions.

The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to a 0.25-inch settling crack, which may take place in the pipe or in the joint after installation without damage to the lining.

Once cast into the pipe, the lining shall be permanently and physically attached to the concrete by locking extensions and shall not rely on an adhesive bond.

741.2.2 Material Details and Dimensions: The liner plate shall not be less than 0.065 inch in thickness. The locking extension shall be of the same material as the liner and shall be integrally extruded with the sheets. If steel bands are used to transversely secure the liner plate to the forms, strap channels shall be formed by removing the locking extensions as required.

The liner plate shall be supplied either as pipe size sheets or tubes and fabricated by shop welding together using the di-electric welding process. Tensile strength measured across the shop welded joint shall be in accordance with ASTM D412 using Die B and shall be at least 2000 psi.

Joint strips shall be 4 inches ± 0.25 inch in width and shall have each edge beveled prior to application.

Welding strips shall be 1 inch ± 0.125 inch in width and shall have the edges beveled at time of manufacture.

The Contractor shall submit a shop drawing showing liner plate details for approval by the Engineer prior to fabrication of the pipe.

741.3 INSTALLER QUALIFICATIONS

The application of joint strips, weld strips and plastic liner to forms and other surfaces is considered to be specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation and shall demonstrate their ability to the Engineer prior to commencing work.

Each welder shall pass an approved qualification welding test before doing any welding. Certification shall be renewed on a yearly basis and the list of qualified personnel shall be maintained by the pipe manufacturer. All test welds shall be made in the presence of the agency's representative and shall consist of the following:

(A) Two pieces of liner at least 15 inches long and 9 inches wide shall be lapped 1 ½ inches and held in a vertical position.

(B) A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner. Each end of the welding strip shall extend at least 2 inches beyond the liner to provide tabs.

The weld sample shall be tested by the Engineer as follows:

(A) Each welding strip tab, tested separately, shall be subjected to a 10-pound pull normal to the face of the liner with the liner secured firmly in place. There shall be no separation between the welding strip and liner.

(B) Three test specimens shall be cut from the welded sample and the weld shall be tested for tensile strength in accordance with ASTM D412 using Die B. Tensile strength measured across the welded joint shall be at least 2000 psi.

(1) If none of these specimens fail when tested as indicated above, the weld will be considered as satisfactory.

(2) If one specimen 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.

(3) If two of three specimens fail, the welder will be considered to be an unqualified welder and shall be disqualified.

A disqualified welder may submit a new welding sample when he has had sufficient off-the-job training or experience to warrant re-examination.

741.4 INSTALLATION OF LINER PLATE

The installation of liner plate, including the welding of all joints, shall be done in accordance with the manufacturer's recommendations. The liner plate shall be installed with locking extensions parallel with the longitudinal axis of the sewer, unless otherwise shown on the plans. All joints between individual sheets or sections of liner plates shall be continuously heat-welded by the use of welding strips of the same general composition and equivalent thickness of material as the liner plates (with the exception of the integral extension ribs).

Liner plate shall be held snugly in place against inner forms by means of light gage steel wire, light steel banding straps or other suitable means. If steel banding straps are used, they shall be applied in strap channels provided for this purpose or onto flaps created at pipe ends.

Locking extensions (T-shaped) shall be integrally extruded to all lower, terminal or longitudinal edges of liner plate as applied to concrete pipe. If banding straps are used, a steel rod ¼ inch in diameter may be inserted in each locking extension along the longitudinal edges of each sheet of liner plate for concrete pipe or some other approved method for holding the lower edge of the liner plate snugly against the form shall be provided. Concrete poured against liner

plate shall be compacted in a careful manner so as to protect the liner plate and to produce a dense, homogeneous concrete securely anchoring the lock extensions into the concrete.

In removing forms, care shall be taken to protect the liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. All holes, cuts, torn or seriously abraded areas in the liner plate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. Larger patches may consist of smooth liner plate applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound liner plate adjoining the damaged area.

The Contractor shall take all necessary measures to prevent damage to installed liner plate from equipment and materials used in or taken through the work.

The applied lining shall be free from bubbles due to poor workmanship, and the Contractor shall cut out said bubbles and weld a similar sheet in place of the bubble, unless otherwise directed by the Engineer.

Application on Concrete Pipe-Special Requirements: Type P-1 joint, liner plate shall be set to within ¼ inch of the inner edge of the bell or groove end of a pipe section and shall extend to within ¼ inch of the spigot or tongue end. Type P-2 joint, liner plate shall be set to within ¼ inch of inner edge of the bell or groove end of a pipe section and shall extend a minimum of 3 inches beyond the spigot or tongue end.

Wherever concrete pipe that are protected with liner plate join structures not so lined, such as brick structures, concrete pipe, cast-in-place structures or clay pipe, the liner plate shall be extended over and around the end of the pipe and back into the structure for not less than 2 inches.

Where a pipe spur not of plastic-lined concrete is installed through lined concrete pipe, the liner plate shall be returned not less than 2 inches at the surface of contact. The seal between the liner plate and the spur shall be made using an approved adhesive material and strapped in place. If the joint space is too wide or the joint space surface too rough to allow satisfactory sealing with this adhesive, the joint space shall be filled with 2 inches of densely caulked lead wool or other approved caulking material.

Lined concrete may be cured by standard curing methods. Care shall be exercised in handling, transporting and placing lined pipe to prevent damage to the liner plate. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable forklift lifting the pipe only from the exterior.

No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the Engineer.

741.5 FIELD JOINTS

The Contractor shall obtain the services of qualified and approved personnel to weld the liner plate field joints. Pipe joints must be dry before the liner plate joints are made. All mortar and other foreign material shall be removed from liner plate surfaces adjacent to the pipe joint, leaving them clean and dry.

No field joint shall be made in liner until the lined pipe or structure has been backfilled and 7 days have elapsed after the flooding, jetting or other means of compaction have been completed. Where groundwater is encountered, the joint shall not be made until pumping of groundwater has been discontinued for at least 7 days and no visible leakage is evident at the joint. The liner at the joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made. When the pipe liner coverage is 360 degrees, 6 to 8 inches of the downstream side of the joint strip or flap at the pipe invert shall not be welded.

Heated joint compound shall not be brought in contact with liner.

No coating of any kind shall be applied over any joint, corner or welding strip, except where nonskid coating is applied to liner surfaces.

Field joints in the liner plate at pipe joints may be either of the following described types:

Type P-1 joint shall be made with a separate 4-inch joint strip and two (2) 1-inch welding strips. The 4-inch strip shall be centered over the joint, secured to the liner plate by heat sealing with hot air and welded along each edge to adjacent liner plate with a 1-inch weld strip. The width of the space between adjacent liner plate sheets shall not exceed 2 inches. The 4-inch joint strip shall lap over each liner plate a minimum of 1 inch.

Type P-2 joint shall be made with an integral joint flap with locking extensions removed, extending a minimum of 3 inches beyond the spigot end of the pipe. The flap shall overlap the adjacent lined pipe and shall be heat sealed to this lining and then welded on the edge to the adjacent liner with 1-inch weld strip. Care shall be taken to protect the flap from damage. Excessive tension and distortion while bending the flap back to facilitate laying and joint mortaring shall be avoided. Heat shall be applied to straighten the PVC flaps as needed to prevent cracking of the PVC.

Any flap that has been bent back and held shall be allowed to return to its original shape and flatness well in advance of making the liner joint.

If joints are to be mortared, field joints on liner at pipe joints shall not be made until the mortar in the pipe joint has been allowed to cure for at least 48 hours and the pipe has successfully passed the leakage tests.

741.6 INSTALLATION OF WELDING STRIP

Welding strips shall be fusion welded to joint strips and liner by welders approved by the Engineer, and trained by the manufacturer, using only approved methods and techniques.

Adequate ventilation shall be maintained during all welding operations.

Hot air welding tools shall provide clean effluent air at constant pressure to the surfaces to be joined within a temperature range between 260ºC and 315ºC (500ºF and 600ºF).

For lap welds, the welding strip shall be positioned so that approximately 1/3 of the width is placed on the high side of the lap and properly fused. The weld strip shall be completely fused across its entire width, except for a small allowable gap in the center. Incomplete fusion, charred, or blistered welds will be rejected by the Engineer.

741.7 JOINT REINFORCEMENT

A 12-inch-long welding strip shall be applied as reinforcement across each transverse joint, weep channel, or return that extends to the lower terminal edge of liner. These reinforcement strips shall be centered over the joint being reinforced and located as close to the edge of liner as possible.

741.8 TESTING AND REPAIRING DAMAGED LINER SURFACES

After the pipe is installed in the trench, all surfaces covered with liner plate shall be tested with an approved electrical holiday detector set at a minimum of 20,000 volts. All welds shall be physically tested by a non-destructive probing method. All patches over repairs to the liner plate wherever damage has occurred shall be done in conformance with the instructions and recommendations of the liner plate manufacturer.

The Contractor shall provide adequate ventilation, ladders for access, barricades or other traffic control devices and shall be responsible for opening and closing entrances and exits. All areas of liner failing to meet the field test shall be properly repaired and retested. The electrical holiday detector shall be supplied by the Contractor and shall be a Tinker & Rasor Holiday Detector (Model AP-W).

The Contractor, at his expense, shall have an independent inspection service perform the visual inspection and the probing of all weld joints. The independent inspection service and the inspection and probing procedures shall be approved by the Engineer. In addition, the independent inspection service shall witness the spark testing and any repairs performed by the Contractor. Inspectors employed by the independent inspection service to test the welds

shall have passed the qualification welding test specified in Section 741.3. Upon completion of all liner testing and inspection, the Contractor shall submit certification by the independent inspection service that all installation and weld joints have been tested and inspected and are in compliance with the Specifications. However, this certification shall not relieve the Contractor of the responsibility to correct defective work.

741.9 PAYMENT

Payment for plastic liner materials, their installation and testing shall be included in the price bid for the pipe or structure to which they are applied.

-End of Section-

SECTION 742
PRECAST MANHOLES

Subsection 742.1 GENERAL: Delete this Subsection in its entirety and replace with the following:

This specification covers requirements for precast manhole sections except precast manhole bases. All precast manhole manufacturers shall be National Precast Association (NPCA) certified and shall provide all NPCA certifications upon request. Loading criteria for the precast manhole sections shall meet or exceed the AASHTO HS20-44 loading requirements. All precast manhole risers shall be monolithically cast to ensure watertightness and have a certified structural design, and the manhole sections shall be cast in a fashion to achieve watertightness.

Subsection 742.2.2 Precast Sections: Delete the first sentence and replace with the following:

Precast sections shall conform to ASTM C478 (except Section 15 and 16) and AASHTO M199 (except Sections 15 and 16).

Subsection 742.3 MANHOLE PENETRATIONS: Delete the title of this Subsection in its entirety and replace with the following:

MANHOLE BASES

Subsection 742.3 MANHOLE PENETRATIONS: Delete this Subsection in its entirety and replace with the following:

Sanitary sewer manhole bases shall be cast-in-place concrete in accordance with MAG Standard Details 420-1and 420–2.

Storm drain manhole bases shall be cast-in-place concrete in accordance with COP Standard Details P1520 and P1560.

Subsection 742.5 GASKETS: Delete this Subsection in its entirety and replace with the following:

Sanitary sewer manhole joints shall have gaskets and cement mortar in accordance with MAG Standard Details 420-1 and 420-2.

Storm drain manhole joints shall have grouted joints in accordance with MAG Standard Detail 522 and COP Standard Details P1520 and P1560.

Subsection 742.6 LIFTING POINTS: Delete this Subsection in its entirety and replace with the following:

Lifting points shall be designed and evaluated by a registered professional engineer and have a minimum safety factor of four. After installation, the lifting holes shall be thoroughly packed with an approved commercial-source, non-shrink, non-metallic patching grout with an approved bonding agent. Bent reinforcing steel bars shall not be used as lifting devices. Through lifting holes will not be allowed.

SECTION 745
PVC SEWER PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 750
DUCTILE IRON WATER PIPE AND FITTINGS

Delete the title of this SECTION in its entirety and replace with the following:

DUCTILE IRON PIPE AND FITTINGS FOR WATER AND SEWER

Subsection 750.1 DUCTILE IRON WATER PIPE: Delete the title and SUBSECTION in its entirety and replace with the following:

750.1 DUCTILE IRON PIPE

The manufacturer shall have a minimum of 5 years of experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation of similar diameters, lengths and pipe class required for the work.

750.1.1 Ductile Iron Water Pipe

All ductile iron pressure water pipe shall be furnished by a single manufacturer and fully manufactured in the USA, including casting, testing and all applicable linings and coatings. The supplier shall be responsible for the provisions of all test requirements specified in AWWA C151 as applicable. In addition, all ductile iron pressure water pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the contracting agency. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract will be borne by the contracting agency.

Ductile iron water pipe shall be of minimum pressure class as follows in accordance with AWWA C-150:

14 inches and smaller	350
16 through 24 inches	250
30 inches and larger	150

The wall thickness of all flanged and grooved end pipe shall be minimum Class 53 except where the specified pressure requires heavier pipe.

All ductile iron water pipe shall be cement-mortar lined and seal coated in accordance with AWWA C-104.

Pipe shall be asphaltic seal coated or zinc coated per ISO-8179 with an asphalt top coat.

For ductile iron pipe 18 inches and larger, a manufacturer's pipeline layout shall be submitted showing the line layout with each fitting specified and detailed. Numbering of each standard joint is not required.

All ductile iron pipe shall have polyethylene wrap per Section 610.

750.1.2 Ductile Iron Sanitary Sewer Pipe

All ductile iron pipe for conveying sewerage shall be in accordance with AWWA C-150:

14 inches inside diameter and smaller shall be Pressure Class 350
16 inches inside diameter through 24" inside diameter shall be Pressure Class 250
30 inches inside diameter and larger shall be Pressure Class 150

Ductile iron pipe with a minimum wall thickness of Class 50 may be substituted in lieu of the above.

Ductile iron sewer pipe shall be lined in accordance with Section 751.

750.1.2.1 Repair of Existing DIP with Protecto 401 Lining: Repair of the damaged sections of the lining shall be in accordance with the lining manufacturer's recommendation or as specified by the agency so that the repair area is equal to the undamaged lined area in all respects. Repair materials and method shall be approved by the agency. All damaged lined areas and holidays shall be repaired immediately after discovery.

Holiday testing may be required by the Engineer before pipe assembly when deemed appropriate. All cost for such repairs will be the responsibility of the Contractor.

There will be no other provision for repair of the lining of DIP.

750. 1.2.2 Protective Collar: In order to protect the exterior spigot end against abrasion and damage during shipping and handling, the manufacturer shall install temporary collars on the exterior of each spigot end of each pipe section. The manufacturer shall secure the collars to the pipe to prevent accidental removal during shipping and normal handling by the Contractor. The collars are not to be removed from the pipe until right before the pipe section is to be installed or field cut.

Subsection 750.2 JOINT REQUIREMENTS: Add the following to the end of this Subsection:

Joints for piping located in vaults shall be flanged unless mechanical clamp-type couplings or flange adapters are shown on the drawings.

Bolts and nuts for joints shall conform to ANSI B18.2.1 and ANSI B18.2.2, respectively. Exposed and buried bolts and nuts shall be ASTM A 307, Grade B, with buried bolts and nuts coated with a petroleum-based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

Approved integral restrained joint ductile iron pipes, approved restrained joint glands for mechanical joint pipe and fittings, and approved split restrained joint or wedge glands are provided on the Water Services Department Approved Products List (https://www.phoenix.gov/waterservices/publications).

Split restrained joint glands for mechanical joints or wedge action restrained joint glands for push (non-mechanical) joints are only allowed for connection or repair to existing installed pipe.

All pipeline valves and fittings shall have thrust blocks as shown or referenced on the drawings designed for the working pressure in addition to the above restraining systems.

Flanged joints are allowable for aboveground piping installations only, except for locations where valves are connected. Buried flanged joints shall be coated with a petroleum-based mastic and wrapping tape system Denso Paste primer and Densyl Tape finish as manufactured by Denso, or approved equal.

Weld-on boss outlets are not acceptable.

750.2.1 Welded-On Outlets for Ductile Iron Pipe Larger Than 16 Inches

750.2.1.1 Scope: Welded-on outlets shall be limited to branch outlets having a nominal diameter not greater than 50% of the nominal diameter of the main line pipe or 12 inches, whichever is smaller (see Table 750-1). Welded-on outlets may be provided as a radial (tee) outlet, or lateral outlet fabricated at a specific angle to the main line pipe, as indicated on the drawings. Welded outlets for ductile iron pipe are not acceptable for a tangential configuration unless shown on the plans or approved by the Engineer. No welding shall be permitted within 24 inches from the end of the pipe. Spacing of welded outlets shall not be closer than two times the diameter of the largest outlet. The pipe manufacturer or fabricator shall have a minimum of 5 years' experience in the fabrication and testing of outlets of similar size and configuration.

TABLE 750-1	
MAIN LINE NOMINAL DIAMETER VERSUS MAXIMUM NOMINAL BRANCH OUTLET DIAMETER	
Main Line Nominal Diameter	**Maximum Nominal Branch Outlet Diameter**
18 inches	8 inches
20 inches	10 inches
24 inches	12 inches
30 inches	12 inches
36 inches	12 inches
42 inches	12 inches
48 inches	12 inches
54 inches	12 inches
60 inches	12 inches
64 inches	12 inches

750.2.1.2 Outlet Joint Types: The joints on welded-on branch outlets shall meet, where applicable, the requirements of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15.

750.2.1.3 Design: Weldment for welded-on outlets shall be based on the method described in Section VIII of the ASME Unfired Pressure Vessel Code. Reinforcing welds shall be placed using Ni-Rod FC 55o cored wire or Ni-Rod 55o electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties). Carbon steel electrodes are not acceptable.

Parent pipe and branch outlet pipe shall be centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured in accordance with ANSI/AWWA C151/A21.51. Minimum classes shall be Special Thickness Class 53 for sizes 4 inches through 54 inches and Pressure Class 350 for sizes 60 inches through 64 inches.

Welded outlets require submittal and approval of design calculations, welding procedures and actual structural testing results for both hydrostatic pressure as well as transverse and axial loading imposed on the outlet itself.

750.2.1.4 Testing: All welded-on outlets shall be rated for a working pressure of 250 psi and must have a minimum safety factor of 2.0 based on proof of design hydrostatic test results. The manufacturer shall, at the request of the Owner or Owner's engineer, provide representative proof test data confirming hydrostatic test results and safety factors.

Prior to the application of any coating or lining in the outlet area. all weldments for branch outlets to be supplied on this project shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any leakage shall be detected by applying an appropriate soapy water solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer's written procedures.

750.2.1.5 Quality Assurance: The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the Guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedure specification (WPS), procedure qualification (PQR), and welder performance qualification test (WPQR) records as well as appropriate air test logs documenting air leakage tests. The manufacturer shall have ISO 9001 or 9002 registration.

Prior to the start of manufacturing, any proposed manufacturer not meeting ISO 9001 or 9002 registration requirements shall submit to the Owner or Owner's engineer the name of an independent inspection agency and the agency's qualifications. Submitted qualifications shall include but are not limited to the following:

(A) List of project references for projects of similar type and size

(B) Resumes for inspection and testing personnel

(C) Capacities for chemical and mechanical testing of material specimens

(D) Frequencies for all instrument and testing equipment certifications

The independent inspection agency shall be responsible for all of the following:

(A) Verify compliance to written WPS and PQR

(B) Verify qualification of all welders' WPQRs per ANSI/AWS D11.2 criteria

(C) Document use of Ni-Rod FC 55o cored wire or Ni-Rod 55o electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties)

(D) Witness and document all air testing of outlet welds

750.2.1.6 Field Welding: No field welding or field repairs shall be allowed. Should a leak be detected at a welded-on outlet after installation, the piece shall be removed and returned to the pipe manufacturer's facility where it was originally produced for repair.

Subsection 750.3 FITTINGS: Delete the second paragraph in its entirety and replace with the following:

Mechanical joint fittings shall conform to AWWA C110, and flange fittings shall conform to AWWA C110 and C115. AWWA C153 compact fittings are acceptable for use unless otherwise specified. Long-radius elbows shall be provided where specified.

Fittings for water pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104.

SECTION 750 DUCTILE IRON PIPE AND FITTINGS FOR WATER AND SEWER: Add the following Subsection:

750.4 CATHODIC PROTECTION

All ductile iron pipe 16 inches and larger shall have cathodic protection. Pipelines less than 16 inches shall have cathodic protection where called for in the plans and specifications or directed by the Engineer.

750.4.1 Bonded Joints: Bond wires shall be provided across all non-conductive ductile iron pipe joints to ensure electrical continuity. Joint bonds shall be installed as shown on the drawings. Joint bonds shall be made utilizing #4 AWG type HMWPE stranded conductors. Bond wires shall not exceed 18 inches in length. Joint bond wires shall be installed as shown on the plans. Connections shall be made utilizing the exothermic weld process per Section 750.5.2.

750.4.2 Exothermic Welds: Exothermic welds shall be provided for wire to structure connections in strict accordance with the manufacturer's recommendations. Connections shall be made at locations shown on plans. Exothermic welds shall be "Cadweld" as manufactured by Erico Products, Inc., "Thermoweld" as manufactured by Continental Industries, Inc., "Pin Brazing" by BAC, or approved equal. Duxseal packing as manufactured by Johns-Manville or approved equal shall be used where necessary to prevent leakage of molten weld metal.

The shape and charge of the exothermic weld shall be chosen based on the following parameters:

- Pipe material
- Pipe size
- Wire material
- Number of strands to be welded

- Orientation of weld (vertical or horizontal)

The type of exothermic weld to be used shall be submitted to the construction manager for approval. Copper sleeves specifically designed for the purpose shall be crimped on all bare wire ends of all stranded wires prior to exothermic welding to improve mechanical strength and thermal capacity.

Exothermic weld connections shall be installed in the manner and at the locations shown on the plans. Coating materials shall be removed from the surface over an area of sufficient size to make the connection. The steel surface shall be cleaned to shiny metal by grinding or filing prior to welding the conductor. The use of resin-impregnated grinding wheels will not be allowed. The conductor shall be welded to the pipe by the exothermic welding process with a copper sleeve fitted over the conductor. Only enough insulation shall be removed such that the copper conductor can be placed in the welding mold. After the weld has cooled, all slag shall be removed and the metallurgical bond tested for adherence to the pipe or casing. All defective welds shall be removed and replaced. All exposed surfaces of the copper and steel shall be covered with insulating materials as shown in the detail drawings. No connections to the piping shall be buried prior to inspection and approval of the Engineer. Connections made in violation of this requirement shall be rejected.

Welds shall be primed with an elastomer resin-based primer, covered with a weld cap, and then over-coated with bitumastic.

750.4.3 Weld Caps: Welds to be buried or submerged shall be primed with an elastomer resin-based primer then be covered with a 100% solids mastic filled plastic cap. Use the plastic cap on dielectric coated-pipe following the manufacturer's instructions. Primer shall be Roybond Primer 747 as manufactured by Royston Laboratories, or equivalent. Weld caps shall be Royston Handy Cap as manufactured by Royston Laboratories, Inc. Thermit Weld Cap; or as manufactured by Phillips Petroleum Co.; or an approved equal.

750.4.4 Testing: The Contractor shall be responsible for testing the corrosion monitoring and cathodic protection systems. All testing shall be performed by or under the direct supervision of a corrosion engineer. All field tests shall be performed at the expense of the Contractor. This testing shall include all insulators, wires, continuity testing and cathodic protection system activation. The tests shall be conducted in the presence of the Owner or its representative. The Contractor shall correct, at his expense, all deficiencies in the installation observed by these tests and inspections.

The Contractor shall pay for all retests made necessary by the corrections.

(A) Services of Corrosion Engineer: Contractor shall obtain the services of a corrosion engineer to inspect, activate, adjust, locate electrical discontinuities and evaluate the effectiveness of the cathodic protection system. The corrosion engineer is herein defined as a registered Professional Engineer with certification or licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by NACE International at the level of Corrosion Specialist or Cathodic Protection Specialist (i.e., NACE International CP Level 4). Such a person shall have not less than 5 years' experience inspecting pipeline cathodic protection systems.

(B) Services of Cathodic Protection Technician: If necessary, obtain the services of a cathodic protection technician to inspect, activate, adjust and evaluate the effectiveness of the cathodic protection system. The cathodic protection technician is herein defined as a person accredited or certified by NACE International as a Cathodic Protection Level 2 Technician. Such a person shall have not less than 5 years' experience inspecting pipeline cathodic protection systems and shall be under the direct supervision of the corrosion engineer.

Upon completion of installation of all components in accordance with these specifications, testing shall be performed to demonstrate that the installation has been completed and is in working order in conformance with the plans and specifications. In no case shall the testing be less than those outlined herein unless requested in writing by the Contractor and approved by the construction manager. The testing described herein shall be in addition to and not a substitution for any required testing of individual items at the manufacturers' plant. The Contractor shall

provide testing of the system. The test data shall be submitted to the Engineer for acceptance to demonstrate that the system is in proper working order. The cost of the testing shall be borne by the Contractor, including any additional expenses that result from retesting due to equipment or installation that is not in conformance with these specifications and drawings.

750.4.4.1 Exothermic Weld Testing: Exothermic welds shall be tested by the Contractor for adherence to the pipe or casing and for electrical continuity between the pipe or casing and wires. Test completed weld by striking weld with a hammer and pulling on wire. A 22-ounce hammer shall be used for adherence testing by striking a blow to the weld. Care shall be taken to avoid hitting the wires.

750.4.4.2 Joint Bond Testing: After installation, all joint bonds shall be tested for effectiveness. The testing shall be performed prior to backfill of the pipe and shall be verified upon completion of backfilling operations. Prior to backfilling, current shall be circulated through the pipe and the measured resistance shall be compared to the theoretical resistance of the pipe and bond cables. The resistance measured shall not exceed 120% of the theoretical resistance. Once backfilling operations have been completed, the testing shall be repeated to ensure continued effective continuity. All data shall be tabulated and submitted upon completion of testing and prior to final acceptance of the Contract.

SECTION 751
CURED-IN-PLACE PIPE LINER FOR DUCTILE IRON SANITARY SEWER LINES

Add the following Section in its entirety:

751.1 DESCRIPTION

Newly installed sanitary sewer lines constructed of ductile iron pipe (DIP) materials typically used in residential, non-industrial sanitary sewer applications operating under gravity flow conditions shall include cured-in-place pipe (CIPP) protective lining conforming to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

751.2 SANITARY SEWER PIPE LINING

Ductile iron gravity sewer pipe shall be installed in accordance with Section 750 and American Society for Testing and Materials (ASTM) A746. All newly installed DIP shall be lined using a CIPP conforming to the requirements of Section 751.4.

CIPP liner shall be provided in accordance with ASTM D5813 – Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems (Type III - Fully Deteriorated Host Pipe). Acceptable CIPP lining systems include isophthalic polyester resin, epoxy vinyl ester resin, reinforced fiberglass liner or approved equal.

CIPP liner shall be installed per ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of Resign-Impregnated Tube or ASTM F2019 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic Cured-in-Place (GRP-CIPP) Using the UV-Light Curing Method, or ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).

751.2.1 SUBMITTALS

The following submittals shall be provided to the city or city's representative a minimum of 10 working days prior to ordering CIPP lining materials for approval:

1. Shop drawings which detail short- and long-term properties (providing all supporting test data) of all component materials.
2. Representative cured liner sample (1 foot in length) for each diameter size of the same resin and felt/fiberglass liner proposed for the project depicting all material components and final quality of workmanship that can be expected on this project.
3. Structural calculations of CIPP liner thickness displaying the Professional Seal of a Civil Engineer in the State of Arizona for each CIPP liner not depicted in Section 751.4.
4. 10,000-hour third-party 50-year Flexural Creep Modulus test data. Test shall be in accordance with ASTM D2990 at 10,000 hours. If approved 10,000-hour tests are not available, a minimum 50% reduction (50% retention) of Flexural Modulus of Elasticity (per ASTM F1216) shall be used for all design calculations.
5. Detailed description of method for quality control test sampling.
6. Independent laboratory test reports of CIPP sample(s) and tests as specified in Section 106.
7. Remote visual inspection video and reports as specified in Section 751.6
8. Liner manufacturer's recommended installation procedures per ASTM F1216, ASTM F1743 or ASTM F2019. Recommendations for material storage and temperature control, CIPP liner handling, insertion, curing, trimming and finishing.
9. Liner manufacturer's recommended maximum pulling force to be applied to the liner (if pulled-in-place method employed) or maximum inflation pressure (if inversion method employed).

10. Resin manufacturer's proposed rate of cure temperature change (heating and cooling) and the target temperature and duration for cure of resin along with the maximum rate and target temperature for cool down prior to the termination of the cure process.

11. Resin manufacturer's proposed exposure time to ultraviolet (UV) light and recommended travel speed of UV light train for wattage of light bulbs used.

12. Certification obtained within the previous 6 months of the Contractor UV lightbulbs wattage output.

13. Certification showing the Contractor is currently licensed by the appropriate licensor to perform CIPP installation. Certification shall be given to the city or city's representative before any materials are delivered to the jobsite.

14. A certified affidavit signed by an officer of the installation company shall be provided stating that the on-site superintendent has received proper training in the manufacturer's recommendations for CIPP liner installation methods and procedures.

15. Certification stating CIPP tube and resin have been manufactured in accordance with ASTM F1216, ASTM F2019, ASTM D578 and ASTM D5813 and is suitable for its intended use.

16. Test results for chemical resistance performed on a previously prepared sample of the finished product proposed for this project. The Contractor shall submit a certified affidavit signed by an officer of the company stating that the resin the tests apply to and the resin submitted for this project are the same.

17. The Contractor shall submit a method of measuring defects and an outline of specific repair or replacement procedures as recommended by the tube manufacturer for potential defects removal that may occur in the installed CIPP. Potential defects within the CIPP that cannot be repaired shall be clearly defined by the Contractor based on the manufacture's recommendations, accompanied by a proposal for compensation to the city.

18. Manhole connection (liner termination) detail and material proposed to seal annular space between the liner and host pipe.

19. Lateral connection detail and material proposed to seal the interface between the lateral opening and CIPP liner.

20. Warranty information and certificates.

21. Safety Data Sheets (SDS) for all hazardous chemicals used or expected to be on-site. At a minimum, sheets for the resin, catalyst, cleaners and repair agents should be submitted.

751.3 CIPP LINER QUALITY ASSURANCE

1. Sample shall be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a similar diameter pipe or other restraining system that will be held in place by a suitable heat sink such as sandbags per ASTM F1216 or ASTM F2019.

2. CIPP liner samples taken shall be sent to an independent laboratory for quality control testing, accompanied by FORM A: CHAIN OF CUSTODY.

3. Samples taken for testing shall be individually labeled and logged to record the following:

   a. Sanitary sewer owner's name

   b. Project title

   c. Unique sample number

   d. Pipe segment number (upstream / downstream manhole number)

   e. Date and time sample was taken

   f. Name of Contractor

   g. Date, location, and name of person by whom the sample was taken

4. Sample Testing: The cured sample shall be tested by an independent testing laboratory approved by the city or city's representative. Project approval will not be made until acceptable test results are received by the city or city's representative. The Contractor shall be responsible for any deviation from the specified physical properties and those evaluated through testing. Failure to meet the specified physical properties will result in the CIPP liner being considered defective work, which will be handled in accordance with MAG Section 106. The Contractor shall be responsible for all costs associated with the testing of the liner physical properties and repair of any defective work.

5. Sampling Frequency: The above-stated sampling shall be performed for each manufacturing lot of CIPP liner materials (per diameter size). A sample shall be taken every 3000 linear feet or one (1) delivery load of liner, whichever is less. The city or city's representative reserves the right to request one (1) additional test for every 3000 linear feet or one (1) semi-trailer load of CIPP liner delivered, whichever is less.

6. Grounds for rejection of installed CIPP liner include but are not limited to the following:

   a. CIPP sample sent to a testing laboratory that is missing city or city representative signature.

   b. CIPP sample sent to a testing laboratory that is missing the return of the completed Chain of Custody form.

   c. Chain of Custody form missing information or signatures of all those who handled or processed the sample, including the signature of the laboratory technician performing the testing.

   d. Laboratory test results not meeting minimum specification requirements.

7. Rejected length of liner is defined as the entire liner segment from upstream manhole to downstream manhole.

8. Contractor shall pay all costs and fees associated with the sampling, shipping and independent laboratory testing.

9. Each liner shall be labeled of the liner manufacturer with a permanent unique identification number that is referenced to accompanying documentation. Accompanying documentation shall include the following:

   a. CIPP liner manufacturer's company name

   b. Location the CIPP liner was manufactured

   c. CIPP liner felt or fiberglass supplier

   d. Resin manufacturer and supplier

   e. Date of resin impregnation into CIPP liner

   f. Unique identification number of CIPP liner

   g. Resin identification number

   h. Resin weight – pounds per foot

   i. Resin and felt weight – pounds per foot

   j. Manufactured CIPP liner lengths both "dry" and resin impregnated "wet"

   k. CIPP liner thickness – millimeters

   l. CIPP liner outside diameter – inches

10. Performance Requirements: Diameter and wall thickness of liner shall be manufactured to size such that when installed, it shall provide at least the minimum wall thickness as determined according to Section 751.4.

    Proposed liner material shall be inert to attack by domestic sewage and suitable for use in underground sanitary sewer environments. The chemical resistance tests should be completed in accordance with Test

Method ASTM D543. Exposure should be for a minimum of 1 month at 73.4°F. During this period, the CIPP test specimens should lose no more than 20% of their initial flexural strength and flexural modulus when tested in accordance with ASTM F1216 Appendix X2 when subjected to the following solutions:

Chemical Solution	Concentration (%)
Tap water (pH 6-9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

Liner material shall be manufactured in such manner as to result in tight-fitting liner after installation. There shall be no measurable continuous annular space between outside diameter of the liner and existing host pipe. Measurable annular space will result in the CIPP liner being considered defective work, which will be handled in accordance with MAG Section 106.

CIPP liner shall meet minimum liner tube length requirements. Excessive shrinkage or short CIPP liner is considered to be defective work and will be handled in accordance with MAG Section 106.

If any damage occurs to the host or lined pipe caused by construction activities, the Contractor shall perform repairs as recommended by the city or liner manufacturer as applicable at no additional cost to the city. Damage to the pipe will include but not be limited to gouging, marring and scratching that forms a clear depression in the pipe.

751.4 CURED-IN-PLACE PIPE LINING

Newly installed ductile iron pipe shall be cured-in-place pipe (CIPP) lined to provide corrosion protection. Installed liner thickness shall be provided per to the following tables according to the materials proposed. Depth of pipe shall take into consideration intermediate elevated areas (e.g., elevated road surfaces, hills) requiring adjustment of the reported depth of manhole closest to the raised elevation and adding the total elevated height to establish the new design minimum pipe depth at invert criteria.

751.4.1 FELT LINING MATERIAL

The minimum nominal CIPP thickness to be supplied for felt liner installed in pipes with inside diameter 15 inches and less per ASTM F1216 are as follows:

H-20 LOADING		
Pipe Diameter	**Pipe Depth at Invert (feet)**	**Nominal CIPP Thickness to be Supplied (millimeters)**
8	4 to 13.5	4.5
8	13.5 to 20	6
10	4 to 8	4.5
10	8 to 15.5	6
10	15.5 to 20	7.5
12	4 to 10	6

H-20 LOADING		
Pipe Diameter	**Pipe Depth at Invert (feet)**	**Nominal CIPP Thickness to be Supplied (millimeters)**
12	10 to 17	7.5
12	17 to 20	9
15	4 to 5.5	6
15	5.5 to 10	7.5
15	10 to 15.5	9
15	15.5 to 20	10.5

E-80 (RAILROAD) LOADING		
Pipe Diameter	**Pipe Depth at Invert (feet)**	**Nominal CIPP thickness to be supplied (millimeters)**
8	4 to 20	6
10	4 to 20	7.5
12	4 to 20	9
15	4	12
15	4 to 19	10.5
15	19 to 20	12

751.4.2 FIBERGLASS LINING MATERIAL

The minimum nominal CIPP thickness to be supplied for fiberglass liner installed in pipes with inside diameter 15 inches and less per ASTM F2019 are as follows:

H-20 LOADING		
Pipe Diameter	**Pipe Depth at Invert (feet)**	**Nominal CIPP thickness to be supplied (millimeters)**
8	4 to 10.5	3
8	10.5 to 20	4.5
10	4 to 5.5	3
10	5.5 to 16	4.5
10	16 to 20	6
12	4 to 10.5	4.5
12	10.5 to 20	6
15	4 to 5.5	4.5
15	5.5 to 12	6
15	12 to 20	7.5

E-80 (RAILROAD) LOADING		
Pipe Diameter	**Pipe Depth at Invert (feet)**	**Nominal CIPP thickness to be supplied (millimeters)**
8	4 to 20	4.5
10	4 to 20	6
12	4 to 20	7.5
15	4 to 5.5	9
15	5.5 to 15.5	7.5
15	15.5 to 20	9

751.4.3 LINING OF PIPES WITH DIAMETERS LARGER THAN 15 INCHES

The minimum nominal CIPP thickness to be supplied for liners installed in pipes with inside diameters greater than 15 inches shall be designed according to the materials proposed and in accordance with the procedures of ASTM F1216 Appendix X1 or ASTM D3567 or ASTM F2019 Appendix X1 and the following parameters.

All material properties used in design calculations shall be long-term (time-corrected) values. The Contractor shall familiarize himself with site conditions when preparing liner thickness design.

The following minimum parameters shall be assumed for the liner thickness design calculations.

1. Modulus of soil reaction, E'_s = 1,000 psi (**Type III fully deteriorated host pipe**)
2. Unit weight of soil = 140 pcf
3. The minimum ovality shall be 2.0%
4. Groundwater to ground surface elevation
5. AASHTO H20 Traffic loads or E80 (Railway Load)
6. Safety Factor = 2.0
7. Pipe depth at invert = Actual Depth

Design thickness calculations shall be professionally sealed by an Arizona Registered Professional Civil Engineer.

751.5 FINISHED AND CURED CIPP LINER PROPERTIES

The physical properties of the cured CIPP shall have minimum initial test values as given below for resin. Properties for these or any other enhanced resins shall be substantiated with test data.

STANDARD RESIN			
Test Property	**Test Value Felt Liner**	**Test Value Fiberglass Liner**	**Test Method**
Flexural strength	4,500 psi	6,500 psi	ASTM D790
Flexural modulus	300,000 psi	725,000 psi	ASTM D790
50-year flexural creep modulus	150,000 psi	362,500 psi	ASTM D2990

The Contractor shall provide CIPP liner terminations. If the CIPP liner fails to make a tight seal at the manhole walls, a seal consisting of a resin mixture compatible with the liner/resin system shall be applied in accordance with manufacturer specifications and approved by the city or the city's representative.

751.6 SERVICE LATERAL CONNECTION AND SEALING SYSTEM

a. After the CIPP liner curing in the main is complete, lateral connections shall be re-established internally using robotic cutters guided via closed-circuit television (CCTV) or computer-aided mapping. The cut CIPP liner shall have no jagged edges or obstructions that prevent proper installation of lateral connection seal and shall create a smooth transition from lateral to main.

b. The Contractor shall connect all service laterals installed in DIP pipe or as directed by the city. Edges of the lateral connection penetrations to the sewer main shall be sealed to minimize infiltration, ex-filtration and root intrusion.

c. The lateral connection shall be sealed using a resin-impregnated laminate manufactured by "Cosmic Top Hat™" system or approved equal. The liner shall extend 4 to 6 inches beyond the first lateral joint (per Detail P1440-1).

d. The Contractor shall be responsible for ensuring the proposed lateral connection material is compatible with materials installed to rehabilitate the sewer main and conducive to installation into the existing lateral material, connection geometry and diameter.

751.7 REMOTE CLOSED-CIRCUIT TELEVISION INSPECTION OF LINED SEWERS

The sewer interior shall be inspected using a camera capable of producing a color image for permanent record of inspection in digital format (MPEG or JPEG format). CCTV documentation shall be performed according to National Association of Sanitary Service Company (NASSCO) standards. The pipe shall be dewatered during CCTV inspection recording.

CCTV equipment shall be digital, Panaramo 360 or approved equal for post-liner installation inspection. The CCTV cameras shall be capable of providing a 360-degree view of the pipe interior. A footage counter device, which measures the distance traveled by the camera in the sewer, shall be accurate to plus or minus 2 feet in 1000 feet. Video recording of all sewer line inspections shall be transferred on digital thumb drives or portable hard drives formatted to be compatible with Microsoft products.

Project name, date, pipe diameter and footage shall be permanently recorded on the inspection video. The camera image shall be down the center axis of the pipe when the camera is in motion. Points of interest shall also be documented and shall include, but not be limited to, defects, improper liner installation or defects in the liner (including but not limited to bumps, folds, tears, dimples, etc.). Final documentation shall be submitted after all repairs (if necessary) are completed as a record and approval of work performed.

FORM A: CHAIN OF CUSTODY

PROJECT:	
CITY:	
CITY CONTRACT NUMBER:	
PROJECT NUMBER:	

OWNERS REPRESENTATIVE:	
COMPANY NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	
CONTACT NAME:	

CONTRACTOR:	
COMPANY NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	

CONTACT NAME:	

TESTING LABORATORY:	
LABORATORY NAME:	
ADDRESS	
CONTACT PHONE NUMBER:	
FAX NUMBER	
CONTACT NAME:	

Date Sample Taken:	
Sample Number:	
Quarter Section No.	
Upstream Manhole No.	

Pipe Segment No.	
Pipe Diameter	
Liner Design Thickness:	
Resign Type:	
Downstream Manhole No.	

SAMPLE TAKEN BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

ENGINEER, RECEIVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

LABORATORY RECEIVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

TEST RESULTS, RECEIVED BY:	SIGNATURE:	
		DATE
	PRINT NAME:	

-End of Section-

SECTION 752
ASBESTOS-CEMENT WATER PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 753
GALVANIZED PIPE AND FITTINGS

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 755
POLYETHYLENE PIPE FOR WATER DISTRIBUTION

Delete the SECTION number, SECTION title and this SECTION in its entirety.

SECTION 756
DRY BARREL FIRE HYDRANTS

Subsection 756.3 HYDRANTS: Add the following after the first paragraph of this Subsection:

Approved fire hydrants are provided on the Water Services Department Approved Products List (https://www.phoenix.gov/waterservices/publications).

All fire hydrants shall be supplied to meet a 42-inch bury depth.

Subsection 756.3 HYDRANTS: Replace the 11th paragraph of this Subsection:

Hydrants shall have a cast iron weather shield or weather seal at the operating nut to protect the clearance area between the top casting and the operating nut.

Subsection 756.3 HYDRANTS: Add the following paragraph to the end of this Subsection:

Hydrants shall be constructed so that extension sections, rods and couplings can be added in 6-inch increments to increase barrel length. Nuts, bolts and extension section, rods and couplings shall be made of a corrosion-resistant material such as stainless steel or bronze or have a permanently applied noncorrosive finish such as nickel plating or fusion bonded epoxy coating.

SECTION 757
SPRINKLER IRRIGATION SYSTEM

Delete the title of this SECTION in its entirety and replace with the following:

LANDSCAPE IRRIGATION SYSTEM

Subsection 757.1 GENERAL: Add the following to this Subsection:

The manufacturer of component equipment shown on the drawings or specified in the special provisions form the basis of the irrigation design as well as the physical and operational standards for which the components were selected. Component equipment from other manufacturers may be submitted by the Contractor to the Engineer for approval. No equipment, however, is to be ordered without approved shop drawings.

All buried galvanized pipe and fittings shall be protected from corrosion by the application of a tight fitting, extruded or wrapped coating. Coatings shall be not less than 0.030 inch in thickness at any point. Extruded coatings shall be of polyethylene or polyvinyl chloride, Extrucoat, or equal. Wrapped coatings shall be of polyethylene, polyvinyl chloride, asphalt tape, Pretecto Wrap No. 200, Safe-t-Clad FOS No. 655, Tapecoat, Trantex VID-10 or E-12, Polyken No. 900, Scotchrap No. 50, or approved equal. Tape shall be edge lapped no less than 1/4 inch.

Subsection 757.2.1 Steel Pipe: Delete this Subsection in its entirety and replace with the following:

All steel pipe shall be newly galvanized, welded or seamless steel pipe conforming to the requirements of ASTM A53, standard weight, Schedule 40.

Subsection 757.2.2 Plastic Pipe: Delete this Subsection in its entirety and replace with the following:

Rigid plastic pipe shall be extruded from 100% virgin normal impact unplasticized polyvinyl chloride (PVC) Type I, Grade I or II resin 2000 psi (PVC 1120 or PVC 1220), design stress ASTM D1784, Department of Commerce PS-21-70, PS-22-70, Standard Dimension Ratio (SDR) 26 or less than 160 psi. Pipe shall conform to ASTM D-2241 and D-2672.

Testing of pipe: Provide written certificate by supplier that PVC pipe has successfully passed the following tests.

Acetone test: Immerse a sample of pipe in 99% pure anhydrous acetone for 15 minutes; at the end of this time there should be no evidence of flaking or delamination on the inner or outer walls of pipe. Evidence of softening or swelling shall not constitute failure.

Flattening: Cut a specimen 2 inches long from each end of the pipe sample. Flatten each test specimen from parallel plates of a press until the distance between the plates, in inches, is equal to 60% of the pipe O.D., and there shall be no evidence of cracking, splitting or breaking.

The pipe shall be homogeneous throughout, free from visible cracks, holes, or foreign materials. The pipe shall be free from blisters, dents, wrinkles or ripples and die and head marks.

Piping up to and including 2 1/2 inches size shall be SDR solvent welded.

Pressure mainline piping 3 inches in size and larger shall be gasket pocket type, as manufactured by the Swanson Co. or approved equal, and shall conform to ASTM F-477.

Continuously and permanently mark pipe with manufacturer’s name or trademark, kind and size (IPS) of pipe, material, manufacturer’s lot number, schedule or type and NSF seal of approval.

Subsection 757.2.3 Pipe Fittings and Couplings: Delete this Subsection in its entirety and replace with the following:

(A) Steel Pipe Fittings and Couplings: Steel pipe fittings and couplings shall be 150 psi pressure rated, banded, galvanized, malleable iron screwed fittings and couplings.

(B) Plastic Pipe Fittings and Couplings: For pipe fittings up to and including 2 1/2 inches in size, fittings and couplings shall be either threaded type or slip fitting tapered socket solvent weld type. Schedule 80 pipe will only be used for threaded joints. Tapered socket solvent weld fittings may be either Schedule 80 or Schedule 40, but in either case, will be equal to or greater than the schedule and pressure rating of the plastic pipe being joined. Tapered fittings shall be sized so that a dry, unsoftened taper cannot be inserted more than halfway into the socket. Plastic saddles and flange fittings are not permitted.

PVC fittings shall be marked with manufacturers name or trademark, type PVC, size and NSF seal of approval. Extruded couplings to be produced from NSF-rated raw materials and meet ASTM standards.

For pipe 3 inches and greater, fittings shall be ductile iron, Grade 80-55-06, in accordance with ASTM A-536. Fittings shall have mechanical joints with gaskets meeting ASTM F-477. Fittings shall have radii of curvature conforming to AWWA C110.

Subsection 757.2 PIPE AND FITTINGS: Add the following Subsection:

757.2.5 PVC Primer: The primer shall be specifically formulated for the pipe and type of connection as recommended by the pipe manufacturer.

Subsection 757.3.1 General: Add the following to this Subsection:

Valves on galvanized pipelines shall be all bronze, double disc wedge, non-rising stem with wheel handle on top, such as Jones J373 or equal, with bodies, bonnets, yokes and wedges made of material conforming to ASTM B62.

Subsection 757.3.4 Electrical Remote-Control Valves: Delete this Subsection in its entirety and replace with the following:

The electric remote-control valve listed on the plans or specifications and described by the manufacturer's most recent literature (catalog cut sheet) constitutes the quality and performance standards for the specified valve.

Subsection 757.3.7 Valve Boxes: Delete this Subsection in its entirety and replace with the following:

All valve boxes shall have stainless steel bolts and washers with lock-down covers. Valve boxes and covers shall be molded, non-corrosive plastic, ASTM D638, D-356, except when located in paved surfaces. These shall be concrete boxes with lock-down steel or concrete cover rated for traffic conditions to which it will be exposed.

Subsection 757.4 BACKFLOW PREVENTER ASSEMBLY: Delete this Subsection in its entirety and replace with the following:

The backflow preventer assembly shall consist of pressure-type or reduced pressure-type backflow preventer unit and associated components conforming to the governing code requirements and as shown on the plans or specifications. The backflow preventer unit shall be equal in quality and performance to the unit listed in the Contract documents.

757.4.1 Backflow Preventer Cage: Pre-manufactured units shall be approved for use by the Engineer. The Contractor shall submit catalog information. Pipe used to support the units shall be not less than 1 ¼ inches Schedule 40 and shall be ASTM A-53 Grade A electric weld pipe, expanded metal shall be ½-inch spacing, #13 gauge flattened diamond pattern steel. There shall be no exposed ends of expanded metal on the outside of the enclosure. The expanded metal shall be "die formed" for uniformity. Welds shall be a minimum of ¼ inch long weld on a 4-inch spacing. All units shall withstand a minimum of 200 pounds per square foot for 24 hours without deflection or distortion. The cage-locking mechanism shall be vandal resistant. The Cage shall be powder coated by electrostatic application to 1.5- to 2-mil thickness. The color shall be approved by the Engineer.

Subsection 757.5 SPRINKLER EQUIPMENT: Delete the last two paragraphs in their entirety and replace with the following:

Spray heads, impact sprinkler heads, rotor pop-up sprinkler heads, bubblers, emitters, etc., as shown on the plans or specifications and as described in the Manufacturer's latest literature (catalog cut sheets), constitute the performance and quality standards for this equipment.

Subsection 757.6.1 Conduit: Delete this Subsection in its entirety and replace with the following:

Conduit shall be as designated on the plans or specifications.

Subsection 757.6.3 Electro-Mechanical Controller Unit: Delete the title of this Subsection in its entirety and replace with the following:

Controller Unit and Assembly

Subsection 757.6.3 Electro-Mechanical Controller Unit: Delete this Subsection in its entirety and replace with the following:

The controller unit and assembly listed on the plans or specifications and as described in the manufacturer's latest literature (catalog cut sheets) constitute the quality, performance and operational standards for the specified controller.

SECTION 758
CONCRETE PRESSURE PIPE - STEEL CYLINDER TYPE

Subsection 758.1 GENERAL: Add the following before the first paragraph:

All pipe shall be designed for 150 psi working pressure plus 60 psi surge pressure unless otherwise specified. Test pressure shall be188 psi.

The pipe shall be designed to support the earth cover over the pipe as shown by the pipeline profiles on the plans. Where the earth cover over the pipe is less than 8 feet, the design shall be based on 8-foot minimum cover. When the plans show both existing and future surface profiles, the critical cover shall be used for design purposes.

Earth loads on pipe shall be calculated assuming the pipe is installed in a positive projecting embankment condition. The loading for positive projecting embankment condition shall be derived using a product of the projection ratio and the settlement ratio of 0.5. The Ku factor shall be 0.150. The soil unit weight shall be 140 pounds per cubic foot.

Pipe reinforced with ring stiffeners will not be permitted. Dimensions of fittings and specials shall conform to AWWA C-208.

Field joints for specials and fitting shall be as called for on the plans. Flanges shall be Class D steel ring flanges in accordance with AWWA C-207, unless otherwise specified.

Subsection 758.1 GENERAL: Delete the second and third paragraphs of Subparagraph (A) in their entirety and replace with the following:

Reinforced concrete cylinder pipe (CCP) may be furnished in pipe diameters of 24 inches through 60 inches.

Pipe and fittings shall be designed by the methods described in AWWA Manual M9 to resist the internal pressures and external loading conditions designated on the approved plans or in the project specifications.

The pipe shall be designed for the maximum stress to be encountered in place as indicated on the plans, whether it is internal pressure, external backfill load, H-20 truck load on the backfill or any combination of loading.

The pipe shall be designed to limit the deflection of the pipe, in inches, under the external loads specified to not more than the square of the diameter of the pipe in inches divided by 4000. Deflection shall be calculated by "Spangler's" formula using a bedding constant (K) of 0.1 and an appropriate modulus of soil reaction (E'). An E' value of 1500 psi may be used for pipe bedding material based on 90% Standard Proctor or 70% relative density for pipe cover depths between 5 and 15 feet. For pipe burial depths less than 5 feet or greater than 15 feet or alternative pipe bedding materials, the designer may use alternate E' values provided that the rationale for developing the alternate E' value is acceptable to the Owner. E' = 2,500 psi may be used for controlled low-strength material (CLSM).

The pipe shall be designed for external loading based on an H-20 truck loading and impact factors recommended by AASHTO for highway truck loads in "Standard Specifications for Highway Bridges."

Immediately after the cement-mortar coating has been placed, the ends of each section of pipe shall be tightly capped with waterproof covers to prevent the escape of moisture when water curing. When steam curing, waterproof covers may not be necessary until completion of cure, provided prompt application of steam is begun. The waterproof covers shall become a component part of the completed pipe section to protect the interior of the pipes and shall remain on the pipe until it is installed in the trench.

The minimum steel plate thickness for fittings and special pipe shall be 0.25 inch.

For fittings and special pipe, the minimum cement mortar or concrete lining thickness shall be 0.75 inch, and 0.75 inch shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any

design calculations. External or outside cement mortar coating shall be limited to a maximum of 1.25 inches for the purpose of resisting any external loads.

For standard pipe, the maximum allowable cement mortar coating shall be 1.25 inches, measured from the bar wrap.

Subsection 758.1: GENERAL: Add the following paragraphs to the end of Subparagraph (B):

Pipe shall be embedded cylinder type. Stress analysis of pipe shall be made using "Olander's" coefficients for a 120-degree bedding angle.

Prestressed concrete cylinder pipe (PCCP) may be furnished in 42-inch and larger diameters.

Except as otherwise provided in this section, fabricated steel plate fittings and specials shall be designed for internal pressure only. The internal pressure design shall be based upon a design stress of 15,000 psi. The minimum steel plate thickness shall be 1/4 inch.

Outlets, where specified on the plans, with an internal diameter of less than one-half the diameter of the mainline pipe may be installed on PCCP. Outlets with an internal diameter greater than one-half the diameter of the mainline pipe, or 24 inches, shall be designed and manufactured as a separate fabricated steel plate fitting.

The exterior of fabricated steel plate fittings and specials shall not be mortar coated but shall be shop painted as provided in this section.

All fabricated steel plate fittings and specials shall be encased in reinforced concrete as shown on the details in the plans.

At mainline valves, where a steel plate section is required to comply with plans and/or attach a companion flange for connection to the valve, the following shall apply to such plate sections:

(A) Design shall limit deflection to the square of the diameter in inches divided by 4000 for pipe diameters less than 60 inches. For pipe diameter 60 inches and greater, deflection is limited to 1 1/2% of the diameter.

(B) Unless otherwise specified, plate sections shall not be longer than 1 foot.

(C) Plate sections shall comply with all other applicable provisions, MAG Specifications, Phoenix supplement to MAG and AWWA Standards and AWWA Manual of Water Supply Practices-M9, second edition, with the following exception. For design, the minimum cement mortar or concrete lining thickness shall be 0.75 inch, and 0.75 inch shall be the maximum thickness allowed for resisting any external loads and shall be so used and shown in any design calculations. External or outside cement mortar coating shall not be considered for the purposes of resisting any external loads.

Subsection 758.2 MANUFACTURE: Add the following paragraphs to the end of this Subsection:

An affidavit of compliance as specified in Section 1.11 of AWWA C-301 and Section 1.11 of C-303 shall be furnished to the Engineer.

Cement used in manufacture of pipe shall conform to ASTM C-150, Type II, low alkali.

No concrete admixture shall be used except as approved in writing by the Engineer.

Liquid membrane-forming compounds shall conform to ASTM C-309, Type I, and shall be of such composition that after drying, they will not impart taste or odor to water flowing through the pipe nor will they contain any toxic materials. The use of such compounds shall be subject to the approval of the Engineer.

Rust inhibitors used for preventing rust on steel surfaces at holdbacks of mortar lining and/or coating shall be quick-drying material with good bonding properties to the steel and shall be tack-free and smooth within 4 hours after applying.

All joints shall be the Carnegie bell and spigot type with rubber gaskets. The joint rings for spigot ends for rubber gasket joints shall be Carnegie Shape M-3516, M-3818 or M-3836.

Openings, connections and outlets shall be cement mortar-lined and concrete coated as detailed on the plans.

Prestressing wire shall be wrapped directly over steel shorting straps (minimum of 4). Steel bars shall be welded between prestress anchor assemblies and joint rings.

Design steel cylinders and welds between cylinders and joint rings for the longitudinal thrust exerted by full test pressure. Minimum cylinder thickness for AWWA C 301 pipe shall be 10 gauge where restrained joints are required.

SECTION 758 CONCRETE PRESSURE PIPE - STEEL CYLINDER PIPE: Add the following Subsections:

758.3 MATERIAL DRAWINGS

The Contractor shall furnish the Engineer with six (6) copies of shop drawings, pipe layout diagrams, manufacturer's catalog data, and detailed information in sufficient detail to show complete compliance with all specified requirements, covering but not limited to fabricated pipe and specials, design calculations, field closures, reinforcing steel and concrete mix designs.

The manufacturer's complete design calculations shall be submitted to the Engineer for review prior to or with the joint detail submittal.

The procedure outlined in American Water Works Association Manual M-9 will be used in determining the length of pipe requiring welded joints. Joint restraints design shall be based on test pressures. Shop drawing submittal shall include calculations showing the length of welded joints, tensile stress to be resisted by, and design of joint welds and pipe longitudinal reinforcement. Minimum design parameters shall be as follows: soil unit weight is 110 pounds per cubic foot; soil friction coefficient 0.3, height of backfill over pipe—maximum 4 feet (or as shown on plans if less than 4 feet). Throat thickness of welds shall be based on an allowable stress of 8800 pounds per inch of throat thickness using an E60 low-hydrogen electrode. The allowable stress in the steel cylinder shall not exceed 15,000 psi.

Shop Drawings and Line Layout:

(A) The manufacturer's pipeline layout shall be furnished together with standard details for review. The line layout shall show each standard pipe joint and each special joint or fitting by number. Manufacturer's standard details shall be furnished in sufficient details to assure that the detail design of the pipe and specials will comply with the design concept and structural requirements of the project as presented in the Contract documents. Full details of reinforcement, concrete, cement, mortar, joint dimensions, etc. for the straight pipe, specials and connections shall be furnished. Layout drawings shall show stations and the invert elevations of the pipeline.

(B) Manufacturer's shop drawings shall be furnished for fabrication, inspection and record purposes in accordance with the "General Conditions." The manufactured pipe and specials shall conform to the approved standard details and shall meet all specified requirements unless otherwise approved in writing.

(C) Valves and fittings to be incorporated in the pipeline shall be considered when preparing the pipeline layout.

758.4 SHOP INSPECTION AND TESTS

(A) Inspection:

(1) The city and its representatives shall have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection during the manufacturing process.

(2) Inspection by the city or its representatives or failure of the city or its representatives to provide inspection shall not relieve the Contractor of his responsibility to furnish materials and perform work in accordance with this specification.

(3) Material, fabricated parts, and pipe which are discovered to be defective or which do not conform to the requirements of this specification will be subject to rejection at any time prior to final acceptance. Rejected material and pipe shall promptly be removed from the site of the work.

(B) Test and Materials:

(1) In advance of manufacture of the pipe, the Contractor shall furnish to the Engineer three (3) copies of the mill test certificate for all steel products incorporated in the pipe. Three (3) copies shall be furnished of mill test reports on each heat from which the steel is rolled.

(2) Methods of Tests for Cement, Mortars and Concrete:

(a) Mortar Lining: The mortar for all mortar-lined pipe shall be sampled and molded by the following procedure:

The mortar sample shall be taken directly from the transfer bucket between the mixer and the charging trough that injects the mixed mortar into the spinning pipe. A sufficient amount shall be extracted to make four (4) 4-inch by 8-inch cylinders and shall be placed in a wheelbarrow or other suitable container. The mortar sample material shall then be transported to the location at which the cylinder cans are to remain without moving for the next 24 hours. The mortar shall be thoroughly mixed immediately prior to pouring into the cylinders in order to prevent segregation. After the mortar has been thoroughly mixed, it shall be poured in a continuous stream into the cylinder cans. The cans shall immediately be capped and allowed to remain without disturbance for 24 hours.

(b) Mortar Coating: Mortar for all mortar-coated pipe shall be sampled by molding four (4) cylinders for compressive tests of the representative material being used to seat the pipe. The mortar sample shall be molded in 4-inch-diameter cylinders in accordance with applicable provisions of ASTM D-558.

(c) Curing of Test Cylinders: The curing of concrete, lining and coating cylinders for the first 24 hours shall be the same as that for the pipe, except that the mortar for coating cylinders shall be covered with a piece of damp burlap to retard the drying out or the low moisture content of the mortar coating. At the end of 24 hours, the cylinders shall be transported to a moist curing cabinet and cured in accordance with ASTM C-192.

(3) Strength of Cement Mortar Lining, Coating, Concrete and Steel:

(a) Mortar Lining: The average compressive strength, as per Subparagraph (C) below, of cylinders for mortar lining for the several types of pipe shall be as follows:

(i) Semi-Rigid Pipe: For steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 1700 psi at 7 days and 2300 psi at 28 days.

(ii) Rigid Pipe: for prestressed steel cylinder pipe, the average compressive strength of cylinders shall not be less than 3000 psi at 7 days and 4500 psi at 28 days. Steel cylinder pipe, double wrapped, shall not be less than 3000 psi at 7 days and 4500 psi at 28 days.

(b) Mortar Coating and Concrete for Prestressed Pipe:

(i) Semi-Rigid Pipe: For steel pipe and steel cylinder pipe, single wrap, pretensioned, the average compression strength of cylinders shall not be less than 3000 psi at 7 days and 4500 psi at 28 days.

(ii) Rigid Pipe: For prestressed steel cylinder pipe and steel cylinder pipe, double wrap pretensioned, the average compressive strength of cylinders shall not be less than 3000 psi at 7 days and 4500 psi at 28 days.

(c) To conform to these requirements (a and b, above), the average of any five (5) consecutive strength tests of the laboratory-cured specimens shall be equal to or greater than the specified strength, and no more than 20% of the strength test shall have values less than the specified strength. If any one cylinder falls below 80% of the specified strength at 7 days, an extra cylinder from the same batch shall then be broken, and if the strength of this cylinder also falls below 80% of the specified strength, then the entire production represented by these cylinders will not be accepted for use until the results of the28-day test is known. If it also falls below 80% of the specified strength, the above non-acceptance will become final. The expense of the required tests of cylinders and mortar shall be the responsibility of the Contractor.

(d) Testing of Steel Pipe Cylinders (Hydrostatic Pressure Test): Each steel pipe cylinder, prior to embedment in cement mortar or concrete shall by hydrostatically tested under a water pressure that stresses the steel to a unit stress of at least 22,000 psi after the bell and spigot ends have been welded in place, utilizing companion bell and spigot test heads. While under this stress, the welded seams shall be hammered vigorously with a 1-pound sledge hammer at 1-foot intervals and shall be thoroughly inspected.

All parts of the cylinder showing leakage shall be marked for rewelding. After rewelding, such cylinders shall be subjected to another hydrostatic test as stipulated above. The costs of hydrostatic pressure test shall be at the Contractor’s expense.

(e) Testing of Fittings and Specials: The seams in angle pipe, short-radius bends and special fittings shall be welded in two or more passes and each weld tested for tightness by the air-soap method or by the dye-penetrant method. However, if the fitting is fabricated from cylinders that have been previously tested hydrostatically, no further test is required for seams so tested. Hydrostatic testing of fittings to 150% of the design operating pressure may replace the tests described above. Any defect revealed under any of the alternate test methods

shall be rewelded and the weld tested again. The cost of these tests shall be at the Contractor's expense.

758.5 MARKING, HANDLING AND DELIVERY

(A) Marking: Identification markings for each type of water pipe as specified herein shall be placed on the pipes. These markings shall show the proper location of the pipe or special in the line by reference to layer drawings. All bends shall be marked on the ends with the angle of deflection and the plane through the axis of the pipe. All beveled pipe shall be marked with the amount of the bevel, and the point of maximum bevel shall be marked at the end of the spigot.

(B) Handling and Delivery: All pipe shall be manufactured, handled, loaded, shipped, unloaded and stored at the jobsite in such a manner as to prevent any damage to the pipe. Any pipe section that becomes damaged shall be repaired as directed by the Engineer if, in his opinion, a satisfactory repair can be made. Otherwise, it shall be replaced with an undamaged section, at the Contractor's expense. Lifting from the inside of the pipe will not be permitted.

758.6 CATHODIC PROTECTION

(A) Joint Bonding: Except where otherwise specified, all non-welded joints shall be bonded in accordance with the details shown on the drawings. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. The steel bonding clips (1.25 inches wide) shall be welded to the joint rings during installation. The total resistance of the bonds at the joint shall not be more than 150% of the linear resistance of a pipe section. A minimum of two bonding clips shall be furnished at each joint and installed at the pipe springline, one on each side of the pipe.

(B) Cathodic Protection: Corrosion mitigation and testing materials such as magnesium anodes, reference electrodes, test lead wires and test stations shall be installed where shown. See ***Water Services Department Guide Specifications*** Section 13110, Cathodic Protection Systems, for additional requirements

SECTION 760
COATING CORRUGATED METAL PIPE AND ARCHES

Delete the title of this SECTION in its entirety and replace with the following:

CORRUGATED METAL PIPE AND ARCHES

Subsection 760.1 GENERAL: Add the following paragraph to the end of this Subsection:

Corrugated metal pipe and arch utilization in public storm drain facilities is limited to culverts and catch basin connectors.

Subsection 760.2 MATERIALS: Delete this Subsection in its entirety and replace with the following:

Corrugated metal products covered by this specification shall be aluminum-coated Type 2 conforming to the requirements of AASHTO M-36 Type I or Type II as modified herein. No other coating is approved for use in the City of Phoenix.

Subsection 760.3 BASE METAL, SPELTER AND FABRICATION: Delete the title of this Subsection in its entirety and replace with the following:

FABRICATION

Subsection 760.3 BASE METAL, SPELTER AND FABRICATION: Delete this Subsection in its entirety and replace with the following:

The nominal pipe diameter shall meet the tolerances of this specification. Elliptical pipe and arches, when specified, shall be shaped after fabrication and coating have been completed.

Corrugated Metal Pipe and Arches: The pipe and arches shall be manufactured per AASHTO M-36, Type 1 or II. Nominal pipe sizes and corrugations furnished shall be in accordance with Table 6 of AASHTO M-36. Arches furnished shall be in accordance with Tables 2, 3, 4 and 5 of AASHTO M-36. Other shapes shall be as shown on the plans. Pipe and arches with helical corrugations shall have a continuous lock or weld seam extending from end to end of each length of pipe. The seams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

Subsection 760.4 COUPLING BANDS: Delete the first sentence of the first paragraph and replace with the following:

Watertight joints shall be fabricated for corrugated metal pipe by the use of couplers or connecting bands per AASHTO M-274, aluminum-coated Type 2, with each band overlapping by at least 2 inches.

Subsection 760.4 COUPLING BANDS: Add the following paragraph to the end of this Subsection:

The rubber O-ring gasket shall conform to the requirements of ASTM C-361. The sleeve gasket shall be a closed cell rubber in accordance with ASTM D-1056, grade SCE 43.

Subsection 760.5 PERMISSIBLE VARIATIONS IN DIMENSION: **Delete the last paragraph in its entirety.**

SECTION 775
BRICK AND CONCRETE MASONRY UNITS (BLOCKS)

Subsection 775.1.1 Manhole Brick: Delete the first paragraph in its entirety and replace with the following:

Manhole brick shall conform to the requirements of ASTM C216, Grade MW. Brick may be used for maintenance of existing brick manholes and for adjustment of manhole frames.

SECTION 787
GRAY IRON CASTING

Subsection 787.3 MANHOLE FRAME AND COVER SETS: Add the following to the end of this Subsection:

ASTM A-48 Class 35, gray cast iron manhole frames and covers are approved for use on improvements within dedicated public right-of-way and dedicated public easements. The weights of the 30-inch frame and cover castings shall be a minimum of 219 pounds for the frame and 207 pounds for the cover. The weights of the 24-inch frame and cover castings shall be a minimum of 170 pounds for the frame and 180 pounds for the cover. The Contractor shall provide manufacturer's certification that the product meets the required H-20 traffic loading.

The casting shall be tested in accordance with the method and procedure that is outlined in AASHTO M306 Section 7.0, proof load testing. The casting shall be tested on a suitable and calibrated load testing machine and the casting shall hold a 40,000-pound proof load for 1 minute without experiencing any cracks or detrimental permanent deformation. Any added costs for testing are assumed by the manufacturer.

A foundry certification shall be furnished to the Owner stating that the samples have been tested and inspected and are in accordance with these specifications.

SECTION 795
LANDSCAPE MATERIAL

Delete this SECTION its entirety and replace with the following:

795.1 GENERAL

Material used for landscaping purposes shall be in conformance with this Section.

795.2 TOPSOIL

Topsoil shall be a fertile, friable soil obtained from well-drained arable land and shall be free from nut grass, refuse, roots, heavy clay, clods, weed seed or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the Contractor shall furnish the Engineer, at no additional cost, with a soil sample from each source for analysis and tests.

Soil tests will be accomplished by an approved independent soil testing laboratory capable of doing the appropriate horticultural soil test. The results of the test will determine the acceptability of the soil. The testing laboratory may suggest ways to amend the soil to make it suitable to grow plants. The Contractor may be directed by the Engineer to provide the amendments at no additional cost.

To be acceptable, the pH factor shall not exceed 8.0 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 10 inclusive, and it shall contain between 1% and 2%, by dry weight, organic matter either natural or added.

Gradation shall be as follows:

TABLE 795-1

Sieve Size	Percent Passing
1/2 inch	100
No. 4	90–100
No. 10	70–100
No. 200	15–70

795.3 SOIL AMENDMENTS AND CONDITIONERS

795.3.1 Chemical Conditioners: Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. Fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. Material that has become caked or otherwise damaged shall not be used.

Fertilizing material for plants shall be similar to the product "Super Start," or approved equal, with the following additive ingredients (% by weight): 3% nitrogen, 10% sulfur, 4% iron, 1% zinc, 0.08% manganese, and 0.13% Viterra. All fertilizing material shall be in 40-pound packages with additive ingredient derived from:

1. Nitrogen from urea formaldehyde and M.A.P.
2. Sulfur from potassium sulfate
3. Iron from sequestrene 138 iron
4. Zinc from sequestrene zinc
5. Manganese from sequestrene manganese
6. Viterra from a synthetic, superabsorbent co-polymer

Slow-Release Fertilizer Plant Tablets: Shall be Agriform 21-gram tablets or equal with 20-10-5 analysis.

Fertilizing material for lawn areas or used in revegetation shall be a commercially approved brand or a mixture of standard commercial forms to meet the requirements recommended by horticultural test results.

Slow-Release Nitrogen: Shall be methylene urea (38-0-0) or equivalent. It is used to extend nitrogen availability over time on sites where long-term nitrogen availability is a limiting factor.

795.3.2 Organic Soil Amendments

General Soil Conditioner: Compost shall be naturally organic, free of weeds and weed seeds, and contain no plant growth inhibiting factors. This material shall be tested and meet the following minimum requirements.

Germination rate (full strength extract)	85% minimum
Maturity index (full strength extract)	50% minimum
Conductivity EC mmhos/cm	less than 8
Exchangeable sodium percentage	less than 15
Carbon/nitrogen ratio	less than 20:1
Total nitrogen (not added)	0.5% minimum
pH range of extract	5.5–8.0

When cow manure is used as a soil conditioner in turf areas, it shall be the product of yard-fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be treated with a non-toxic agent so as to be hydrophilic.

Plant Conditioner: Shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a pH not exceeding 7.5% and organic matter not less than 85%. Mulch gradation shall be treated with a non-toxic agent so as to be hydrophilic. Cow manure shall not be used as organic mulch in plant backfill mixes.

Bone Meal: Commercial grade product uniform in composition.

Sand: Shall be brown washed natural mortar sand passing at least a #7 screen, free of weeds, organic material, stones, deleterious materials, non-toxic to plant and human life and usable for backfill mixtures.

Hydromulch shall be packaged in units containing current labels, with the manufacturer's name, the net weight, and certification that the material meets the forgoing requirements. The mulch shall be dyed green to aid in the visual metering application. The dye shall be biodegradable and not inhibit plant growth.

(A) 100% Wood Cellulose Fiber Hydromulch: Shall be shall be used as mulch when hydroseeding turf grass.

Moisture content	10.0% + 3.0%
Organic Matter (Wood Cellulose Fiber)	99.3% + 0.2%
Ash content	0.7% + 0.5%
pH	4.9% + 0.5%
Water-holding capacity	10:1

(B) Cellulose Fiber Hydromulch: Shall be used as mulch when hydroseeding native seed. Cellulose fiber mulch shall consist of at least 70% specially prepared virgin wood cellulose fiber that has been thermo-mechanically processed for specific use as hydromulch. It shall contain no growth-inhibiting factors. It shall have the following properties:

Wood cellulose fiber	70% (minimum)
Recycled cellulose fiber	30% (maximum)
Ash content	0.8% + 0.3% (maximum)

pH	4.5% + 1.0%
Water-holding capacity ratio; water: fiber	10:1

Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption and percolation and shall cover and hold seed in contact with the soil.

Tackifier: Used in hydroseeding shall consist of a free-flowing, noncorrosive powder produced from the natural plant gum of Plantago insularis (desert indianwheat) applied in a slurry with water and wood fiber. The powder shall possess the following properties:

Protein content	1.6% + 0.2 %
Ash content	2.7% + 0.2%
Fiber	4.0% + 0.4%
pH 1% solution	6.5% – 8.0 %

The material used for mulch tackifier shall not contain any mineral filler, recycled cellulose fiber, clays or other substance which may inhibit germination or growth of plants.

Activated Charcoal: Agricultural-grade powdered activated charcoal is used in the hydromulching slurry to boost seed germination during cold weather as a soil colorant.

Granular humus-based soil conditioner used in hydromulching operations shall be tested and meet the following:

Total humus	50% minimum
Total humic acid	15% minimum

Liquid humic acid soil-based conditioner used in hydromulching operations shall be tested and meet the following:

Total humic acid	6% minimum

795.4 SEEDS

795.4.1 Native Seeds: Shall be certified to scientific name, lot number or other identification; origin of the seed; purity of the seeds as a percentage of pure live seed by weight; germination percentage and percentage of firm ungerminated seeds; and name and address of person who labeled or offers seed for sale.

Pure Live Seed (PLS) percentage = (% germination + % ungerminated firm seed) x (% purity). The seed rate specified is pounds of Pure Live Seed.

795.4.2 Turf Seed: Shall be fresh, clean seeds pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer’s name, guaranteed analysis and germination percentage. They shall have a certification or a stamp or a release accomplished by an agricultural commission.

795.5 PLANTS

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Plants shall be nursery-grown or plantation-grown stock conforming to ANSI 260-1 and shall be of the varieties specified in the plant list bearing botanical name listed. Plants shall meet the standards established by the Arizona Nursery Association Grower's Committee recommended specifications.

Planting stock shall be well broached and well formed, sound, vigorous and healthy; shall be free from disease, sun-scald, windburn, abrasion and harmful insects or insect eggs; and shall have a healthy, normal and unbroken root system that is neither root- nor pot-bound and is free of kinked or girdling roots. Plants shall have been grown under climate conditions similar to those at the project site.

795.6 SOD

The sod shall be Midiron Bermuda if not specified on the plans and meet state standards to ensure high quality and freedom from noxious weeds.

Sod shall be machine cut at a uniform soil thickness of 1/2 inch (plus or minus 1/4 inch) at time of cutting. Measurement excludes top growth and thatch.

Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 30% of the section.

Sod shall be free from disease, nematodes and soil-borne insects.

795.7 MISCELLANEOUS MATERIAL

795.7.1 Lumber: Lumber in contact with the earth shall be redwood heartwood, sized according to the drawing. When unit bid items that include headers or lumber are included in the proposal sheets, the unit prices quoted shall be per linear foot.

795.7.2 Clean fill: Clean fill shall be soil free of weeds, boulders, clods, heavy clay, aggregate base, asphalt or concrete or other deleterious material.

795.7.3 River Run Rock: Rock shall be clean, hard, durable, uniform in quality, free from seams and coatings, rounded and water-worn. The gradation shall be as specified and approved by the Engineer.

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