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### Appendix

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SECTION 01110

SUMMARY OF WORK

PART 1 - GENERAL

1.1 LOCATION AND DESCRIPTION OF WORK

A. The Work is located in Phoenix, Arizona. A portion of the Work will be completed within the City of Phoenix Right-of-Way, Maricopa County Right-of-Way, and Arizona Department of Transportation (ADOT) Right-of-Way.

B. The Contract Documents include the following:
   • Volume 1 of 3 Division 0 Specifications
   • Volume 2 of 3 Divisions 1 Through 15 Specifications
   • Volume 3 of 3 Drawings

C. Hazardous Environmental Condition: The responsibility for clean-up of Hazardous Environmental Conditions, in which conditions are described in reports referenced in the Supplementary Conditions, is within the Scope of Work, belongs to CONTRACTOR and shall be coordinated with the General Conditions, Supplementary Conditions and Section 01413, CONTRACTOR’S Hazardous Materials Management Program.

1.2 CONTRACT

A. The Work shall be constructed under one prime contract. The Drawings and Specifications for the Work include the following:
   • Approximately 9,700 linear feet of 18”, and 20” or 21” gravity sewer
   • Approximately 33 sanitary sewer manholes
   • Steel casing structure crossings under existing storm drains, Carefree Highway and ADOT’s I-17
   • Approximately 20 linear feet of 10” HDPE single barrel force main and 26” HDPE double barrel force main
   • An acid resistant polymer force main discharge structure
   • Pavement removal and replacement along the gravity sewer alignment

1.3 OTHER CONSTRUCTION CONTRACTS

A. Other construction contracts have been or will be awarded by the OWNER that are in close proximity to or border on the Work of this Contract. Work under these other contracts is briefly described as follows:
   1. City of Phoenix West Anthem Lift Station No. 76 and Force Main Project Nos. WS90400067 and WS90501005.

01110-1 10/11/2018
1.4 CONTRACTOR’S USE OF PREMISES

A. Sole responsibility for obtaining and paying all costs in connection with any additional work area, storage sites, access to the site or temporary right-of-way which may be required for proper completion of the Work, belongs to CONTRACTOR.

B. It shall be understood that responsibility for protection and safe-keeping of equipment and materials on or near the site will be entirely that of CONTRACTOR and that no claim shall be made against the OWNER or his authorized representatives by reason of any act. It shall be further understood that should any occasion arise necessitating access to the sites occupied by these stored materials or equipment, the ENGINEER shall direct CONTRACTOR owning or responsible for the stored materials and equipment to immediately move the same. No materials or equipment may be placed upon the property of the OWNER, other than in the designated areas as shown on the Drawings, or as described in the specifications, unless the ENGINEER has agreed to the location contemplated by CONTRACTOR to be used for storage. All stored materials shall be labeled according to the appropriate contractor or subcontractor with the manufacturer's label as well. Appropriate material safety data sheets (e.g., MSDS) shall be provided.

C. Required to share use of the premises with other contractors whose services the OWNER has obtained or will obtain for construction of other facilities on the site.

1.5 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way determined by the OWNER to be required to perform the Work will be provided by OWNER. Confine construction operations within the limits indicated on the Drawings. Use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies in order to avoid damage to property and interference with traffic. Do not enter any private property outside the designated construction easement boundaries without written permission from the ENGINEER and the owner of the property. Any private property or rights-of-way owned by other than the OWNER, which CONTRACTOR wishes to utilize during the performance of the Work, shall be provided by CONTRACTOR.

B. Within Highway and Railroad Rights-of-Way: Permits will be obtained by CONTRACTOR. All Work performed and all operations of CONTRACTOR, its employees, or subcontractors within the limits of railroad and highway rights-of-way shall conform to the requirements and be under the control of the railroad or highway authority owning, or having jurisdiction over and control of, the right-of-way.
1.6 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent properties and utilities when prosecution of the Work may affect them.

B. When it is necessary to temporarily obstruct access to property, or when any utility service connection must be interrupted, give notices sufficiently in advance to enable the affected persons to provide for their needs. Conform notices to any applicable local ordinance and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

C. Utilities and other concerned agencies shall be notified at least 5 days prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

1.7 SALVAGE OF EQUIPMENT AND MATERIALS

A. Existing equipment and materials removed, and not shown or specified to be reused as a part of the Work, shall become CONTRACTOR’S property, except the items which shall remain OWNER’S property as indicated in Contract Documents.

B. Existing equipment and materials removed by CONTRACTOR shall not be reused in the Work, except where so specified or indicated.

C. Carefully remove, in a manner to prevent damage, all equipment and materials specified or indicated to be salvaged and reused or to remain the property of OWNER. Store and protect salvaged items specified or indicated to be reused in the Work. Replace in kind or with new items any items damaged in removal, storage, or handling through carelessness or improper procedures.

D. Furnish and install new items, with ENGINEER’S approval, instead of those specified by OWNER or indicated to be salvaged and reused, in which case such removed items will become CONTRACTOR’S property.

1.8 COMPLIANCE WITH SECTION 404 PERMIT AND SECTION 401 CERTIFICATION

A. The CONTRACTOR shall comply with the permit/certification. The Section 404 permit and Section 401 certification requirements included in Appendix A of the technical specifications.

B. The permit must be on site during any activities in Waters of the U.S. and all applicable conditions must be followed.
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

SECTION 01111

SCHEDULE OF COMPLETION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commence the Work promptly upon the date established in the Notice to Proceed and shall pursue it to completion in accordance with the Agreement (Section 00500) as described in this Section.

B. The Schedule of Completion describes selected project components only and is not intended to describe all project Work or constraints, interrelationships, or sequentially required Work.

D. Contract times, as well as liquidated damages for failure to Substantially Complete the Schedule of Completion specified in this Section, are defined in the Agreement (Section 00500).

1.2 SCHEDULE OF COMPLETION

A. Submit Shop Drawings in accordance with Section 01332, Shop Drawing Procedures, and the individual specification Sections. Submit early Shop Drawings as noted and as required to meet the Schedule of Completion.

B. The Schedule of Completion for the West Anthem Gravity Sewer Improvements – Phase 1 Project shall be as follows:

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<td>West Anthem Gravity Sewer Improvements – Phase 1</td>
<td>Construct gravity sewer, sanitary sewer manholes, steel casing, force main, acid resistant polymer discharge structure, and pavement removal and replacement.</td>
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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

SECTION 01141

WORK IN HIGHWAY RIGHTS-OF-WAY

PART 1 - GENERAL

1.1 SCOPE

A. Conform with all applicable Maricopa County Department of Transportation and Arizona Department of Transportation Standards, Rules, and Regulations.

B. Work may be installed by the jacking method, however, traffic flow shall be maintained. A minimum of two lanes of traffic shall be kept flowing.

C. Take all means necessary to prevent accidents. Sufficient flagmen, barricades, lights, signs and all other precautions necessary shall be furnished to provide safe conditions at all times.

D. Work shall be located as shown, and install materials, pipe, fittings, and adapters that are required to implement crossings of existing pipe lines, utilities or other structures. A supply of pipe fittings, adapters and short lengths shall be on hand to expedite the crossings.

E. Pavement: When backfill is stabilized in accordance with Arizona Department of Transportation requirements and these Specifications, replace the street pavement and base per contract requirements. Pavement and base shall be constructed in complete accordance with the requirements of Contract documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
CITY OF PHOENIX: Water Services Department  
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1  
PROJECT NUMBER: WS90500276

SECTION 01271

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The items listed below, beginning with Article 1.4, refer to and are the same pay items listed in the Bid Form. They constitute all of the pay items for the completion of the Work. No direct or separate payment shall be made for providing miscellaneous temporary or accessory works, plant services, CONTRACTOR’S or ENGINEER’S field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and Record Drawings, water supplies, power, traffic maintenance, removal of waste, watchmen, bonds, insurance, or all other requirements of the General Conditions, Supplementary Conditions, and the Contract Requirements. Compensation for all such services, items and materials shall be included in the prices stipulated for the lump sum and unit price pay items listed herein.

B. Each lump sum and unit bid price shall be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR’S overhead and profit for each separately identified item.

1.2 ENGINEER’S ESTIMATE OF QUANTITIES

A. ENGINEER’S estimated quantities for unit price pay items, as listed in the Bid Form, are approximate only and are included solely for the purpose of comparison of Bids. OWNER does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required shall correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as OWNER may deem necessary. Not entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions or deductions caused by changes or alterations in the Work directed by OWNER.

1.3 RELATED PROVISIONS

A. Payments to CONTRACTOR: Refer to General Conditions and Agreement.

B. Changes in Contract Price: Refer to General Conditions.
C. Schedule of Values: Refer to Section 01291, Schedule of Values.

D. Pay Application: Refer to Section 01331, Reference Forms.

1.4 GENERAL

A. Item 1.0 - All Work under the Bid Documents, except those items listed separately below:
   1. A lump sum (LS) payment for Item 1.0 will be full compensation for completing the Work, as shown and specified. Not included in Item 1.0 are Items 2.0 through 24.0, and Alternate Items 1.1 and 2.1.

B. Item 2.0 - Mobilization / Demobilization:
   1. A lump sum (LS) payment for Item 2.0 includes Mobilization and Demobilization, insurance and bonds complete in every detail and all inclusive, as specified in Bid Documents. A maximum payment of 4% of total extended prices will be made for this item.

C. Item 3.0 – Furnish and Install Temporary Traffic Control:
   1. A lump sum (LS) payment for Item 3.0 will be full compensation for installing and removing all temporary traffic control materials and devices (including off-duty Police Officers), as specified in Bid Documents.

D. Item 4.0 – Furnish and Install Asphalt (Type A Pavement Replacement – City of Phoenix Right-of-Way):
   1. A per square yard (SY) payment for Item 4.0 will be full compensation for asphalt installation. This item includes sawcut, removal, and disposal of existing asphalt and related earthwork such as compaction of subgrade and fill as specified in Bid Documents.

E. Item 5.0 – Furnish and Install Asphalt (Type B Pavement Replacement – City of Phoenix Right-of-Way):
   1. A per square yard (SY) payment for Item 5.0 will be full compensation for asphalt installation. This item includes sawcut, removal, and disposal of existing asphalt and related earthwork such as compaction of subgrade and fill as specified in Bid Documents.

F. Item 6.0 - Furnish and Install Asphalt (Pavement Replacement – MCDOT ROW):
   1. A per square yard (SY) payment for Item 6.0 will be full compensation for asphalt installation. This item includes sawcut, removal, and disposal of existing asphalt and related earthwork such as compaction of subgrade and fill as specified in Bid Documents.
G. Item 7.0 – Furnish and Install Micro Seal:
   1. A per square yard (SY) payment for Item 7.0 will be full compensation for micro seal installation. Crack seal costs are included with this item and payment to be as specified in Bid Documents.

H. Item 8.0- Furnish and Install 10-inch Force Main:
   1. A per linear foot (LF) payment for Item 8.0 will be full compensation for pipe materials, fittings, appurtenances, excavation, bedding, backfill, compaction, bypassing, and testing as specified in Bid Documents.

I. Item 9.0 – Furnish and Install 26-inch Force Main:
   1. A per linear foot (LF) payment for Item 9.0 will be full compensation for pipe materials, fittings, appurtenances, excavation, bedding, backfill, compaction, bypassing, and testing as specified in Bid Documents.

J. Item 10.0 – Furnish and Install 18-inch Sanitary Sewer Pipe:
   1. A per linear foot (LF) payment for Item 10.0 will be full compensation for pipe materials, fittings, appurtenances, excavation, bedding, backfill, compaction, bypassing, and testing as specified in Bid Documents.

K. Item 11.0 – Furnish and Install 20-inch or 21-inch Sanitary Sewer Pipe:
   1. A per linear foot (LF) payment for Item 11.0 will be full compensation for pipe materials, fittings, appurtenances, excavation, bedding, backfill, compaction, bypass, and testing as specified in Bid Documents.

L. Item 12.0 – Furnish and Install 36-inch Steel Casing:
   1. A per linear foot (LF) payment for Item 12.0 will be full compensation for all labor, equipment, materials, submittals, casing, spacers, end seals, excavation of jacking/receiving pits (complete in place), bedding, backfill and compaction, disposal of excess materials, surface restoration, and surveying information as specified in Bid Documents. Measurement for installation of steel casing shall be made horizontally, on a linear foot basis from casing end to end.

M. Item 13.0 – Furnish and Install 54-inch Steel Casing:
   1. A per linear foot (LF) payment for Item 13.0 will be full compensation for all labor, equipment, materials, submittals, casing, spacers, end seals, excavation of jacking/receiving pits (complete in place), bedding, backfill and compaction, disposal of excess materials, and surveying information as specified in Bid Documents. Measurement for installation of steel casing shall be made horizontally, on a linear foot basis from casing end to end.
N. Item 14.0 – Adjust Existing Manhole Frame & Covers:
   1. A per each (EA) payment for Item 14.0 will be full compensation for all costs for labor, equipment, and materials to adjust existing manholes as specified in Bid Documents.

O. Item 15.0 – Adjust Existing Type “A” Water Valve:
   1. A per each (EA) payment for Item 15.0 will be full compensation for all costs for labor, equipment, and materials to adjust existing Type “A” water valves as specified in Bid Documents.

P. Item 16.0 – Furnish and Install Connection to Existing Sanitary Sewer Pipe:
   1. A lump sum (LS) payment for Item 16.0 will be full compensation for all costs for labor, equipment, and materials to connect to existing sewer pipe as specified in Bid Documents (does not include manhole).

Q. Item 17.0 – Furnish and Install Thermoplastic Striping in MCDOT ROW:
   1. A per linear foot (LF) payment for Item 17.0 will be full compensation for thermoplastic striping (exclusive of gaps, legends, symbols) as specified in Bid Documents.

R. Item 18.0 – Native Plant Salvage:
   1. A lump sum (LS) payment for Item 18.0 will be full compensation for all native plant salvage work as specified in Bid Documents. Price includes clearing, grubbing, grading, excavation, fencing, piping, watering, metering, permits, tagging, plant storage, security, lighting, plant removal, plant relocation, and plant protection as specified in Bid Documents.

S. Item 19.0 – Furnish and Install 5-Foot Diameter Concrete Sanitary Sewer Manhole:
   1. A per each (EA) payment for Item 19.0 will be full compensation for furnishing and installing concrete sewer manholes as specified in the Bid Documents. Price includes dewatering, excavation, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, utility repairs, protective coating system, adjustment rings, frame, cover, and all appurtenances within manhole footprint as shown and specified in Bid Documents.

T. Item 20.0 – Furnish and install 5-Foot Diameter Acid Resistant Polymer Manhole:
   1. A per each (EA) payment for Item 20.0 will be full compensation for furnishing and installing sewer acid resistant polymer manholes as specified in the Bid Documents. Price includes dewatering, excavation, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, utility repairs, adjustment rings, frame, cover, and all appurtenances within manhole footprint as shown and specified in the Bid Documents.
U. Item 21.0 – Furnish and Install 5-Foot Diameter Manhole Drop Connections:
   1. A per each (EA) payment for Item 21.0 will be full compensation for furnishing and installing deep (5-foot or greater) 5-foot diameter manhole drop connection as specified in the Bid Documents. Price includes dewatering, excavation, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, protective coating system, utility repairs, paving, and all appurtenances within manhole drop connection footprint as shown and specified in Bid Documents.

V. Item 22.0 – Furnish and Install Acid Resistant Polymer Discharge Structure:
   1. A lump sum (LS) payment for Item 22.0 will be full compensation for furnishing and installing discharge structure as specified in the Bid Documents. Price includes dewatering, excavation, concrete, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, protective coating system, utility repairs, adjustment rings, frame, cover, and all appurtenances within discharge structure footprint as shown and specified in Bid Documents.

W. Item 23.0 – Remove and Replace Guardrail System
   1. A per linear foot (LF) payment for Item 23.0 will be full compensation for all work, personnel, materials, and equipment necessary to remove and replace guardrail system as specified in Bid Documents.

X. Item 24.0 – Furnish and Install Pipe Encasement
   1. A per linear foot (LF) payment for Item 24.0 will be full compensation for all work, personnel, materials, and equipment necessary to provide pipe encasement as specified in Bid Documents.

A.1 Item 1.1 – Furnish and Install Acid Resistant Polymer Manhole
   1. A per each (EA) payment for Item 1.1 will be the increase/decrease cost for furnishing and installing acid resistant polymer manholes in place of the precast concrete manholes as specified in the Bid Documents. Price includes dewatering, excavation, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, utility repairs, adjustment rings, frame, cover, cleaning, testing, and all appurtenances within manhole footprint as shown and specified in Bid Documents.

A.2 Item 2.1 – Furnish and Install Concrete Discharge Structure
   1. A per each (EA) payment for Item 2.1 will be the increase/decrease cost for furnishing a concrete discharge structure in place of the acid resistant polymer discharge structure as specified in the Bid Documents. Price includes dewatering, excavation, temporary supports, grading, bedding, backfill, compaction, sheeting and shoring, utility repairs, protective coating, frame, cover, cleaning testing, and all appurtenances within discharge structure footprint as shown and specified in the Bid Documents.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01291

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Preliminary Schedule of Values is an itemized list that establishes the value or cost of each major part of the Work and the division of Work between CONTRACTOR and subcontractors.

B. The Preliminary Schedule of Values shall include all items of Work in the Contract Documents.

C. The Schedule of Values is a detailed itemized list that establishes the value or cost of each detailed part of the Work. It and the Progress Schedule updates specified in Section 01321, Progress Schedule, shall be used as the basis for preparing progress payments. The Schedule of Values may be used as a basis for negotiations, concerning additional work or credits, which may arise during the construction. Quantities and unit prices shall be included in the schedule, when approved by or required by the ENGINEER.

1.2 PREPARATION

A. The Preliminary Schedule of Values:
   1. Preliminary Schedule of Values shall show all work.
   2. Preliminary Schedule of Values shall show the division of Work between CONTRACTOR and subcontractors by two methods, one for each Section of the Specifications and also one for each structure.
   3. Preliminary Schedule of Values shall show breakdown of labor, materials equipment and other costs used in preparation of the Bid for CONTRACTOR and subcontractors.
   4. Costs shall be in sufficient detail to indicate separate amounts for each Section of the Specifications and for each structure.
   5. May include an item for bond, insurance, and temporary facilities.
   6. Preliminary Schedule of Values shall be prepared on 8-1/2-inch by 11-inch white paper.
   7. Use Table of Contents of the Specifications as basis for Preliminary Schedule of Values format and identify each item with number and title in the Table of Contents. Also, use each structure as basis for Schedule of Value format. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
7. When requested by ENGINEER, support values with data that will substantiate their correctness.

8. The sum of the individual values shown on the Preliminary Schedule of Values shall equal the total Contract Price.

9. Each item shall include a directly proportional amount of CONTRACTOR’S overhead and profit.

B. The Schedule of Values:

1. Schedule of Values shall show breakdown of quantities, labor, materials, equipment, and other costs used in preparation of the Bid for each item in the Schedule of Values.

2. Costs shall be prepared by two methods, one for each Section of the Specifications and one for each structure. They shall be in sufficient detail to indicate separate amounts for each Section of the Specifications and subsections therein and also separate amounts for each structure. Amounts shall be included for each type of Work specified, in a manner approved by the ENGINEER.

3. Include separate pay items for Mobilization and Demobilization, as specified in the Contract Documents.

4. Fifteen percent of the total cost of each item is allotted to the cost of Shop Drawing preparation, Operation and Maintenance Manuals, Testing and Training. This amount will be released upon approval, by the ENGINEER, three percent is apportioned to Testing and four percent each to the remaining items.

5. Schedule of Values shall be prepared on 8-1/2-inch by 11-inch white paper.

6. Use Table of Contents of the Specifications and the form included with Section 01330, Submittals, as basis for Schedule of Values format and identify each item with number and title in the Table of Contents. Also, use each structure as basis for schedule format. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.

7. When requested by ENGINEER, support values with data that will substantiate their correctness.

8. The sum of the individual values shown on the Schedule of Values shall equal the total Contract Price.

9. Each item shall include a directly proportional amount of CONTRACTOR’S overhead and profit.

10. Schedule of Values shall show the purchase and delivery costs for materials and equipment that CONTRACTOR anticipates he shall request payment for prior to their installation.

11. Include a separate pay item for Maintenance of Plant Operations (MOPO) Work for each major Work area.

12. Include a separate pay item for: Construction Photographs; Temporary Facilities; Temporary Controls; Progress Schedule; General Conditions; and Field Engineering.

13. Include a separate pay item for all Allowances and Extra Unit quantities.
14. The Schedule of Values shall be prepared to a level of detail equal to or greater than required by the Supplementary Conditions.

1.3 SUBMITTALS

A. Submit two copies of the Preliminary Schedule of Values to ENGINEER for review within (--10--) days after the Notice to Proceed.

B. Submit two copies of the Schedule of Values to ENGINEER for review within (--15--) days after the Notice to Proceed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01301

PRE-CONSTRUCTION CONFERENCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Date, Time and Location: Conference will be held after notice of award of the Contract. ENGINEER will fix the date, time and location of the meeting, within seven days of notice of award.

B. ENGINEER shall prepare agenda, preside at meeting, and prepare and distribute a transcript of proceedings to all parties.

C. Provide data required, contribute appropriate items for discussion, and be prepared to discuss all items on agenda.

D. Unless previously submitted to ENGINEER, bring to the conference a preliminary schedule of each of the following:
   1. Progress Schedule.
   2. Shop Drawing and Sample submittals.
   3. Schedule of Values.

1.2 REQUIRED ATTENDANCE

A. Conference shall be attended by CONTRACTOR’S Project Manager, its superintendent and its major subcontractors and major equipment suppliers as CONTRACTOR deems appropriate.

B. OWNER’S representative.

C. ENGINEER.

D. Representatives of governmental agencies having any degree of control or responsibility, if available.

E. Utility company representatives.
1.3 PURPOSE

A. The purpose of the Pre-construction conference is to designate responsible personnel and establish working relationships. Matters requiring coordination will be discussed and procedures for handling such matters will be established. A complete agenda will be furnished to CONTRACTOR prior to the Pre-construction conference date. However, be prepared to discuss all of the following; but will not necessarily be limited to the following:

1. Designation of responsible personnel.
2. Subcontractors.
3. Coordination with other contractors and projects.
4. Progress schedule.
5. Processing of Shop Drawing Submittals.
6. Schedule of Shop Drawing submittals.
7. Processing of Field Orders, Requests for Information and Clarification and Change Orders.
8. Requirements for copies of Contract Documents.
10. Schedule of values.
11. Processing and Schedule of Payments.
12. Use of premises.
13. CONTRACTOR responsibility for safety and first aid procedures.
15. Housekeeping.
16. Field Offices.
17. Maintaining Record Drawings.
18. Letter of Notice to Proceed.
19. Permits.
20. Emergency Telephone Numbers.
22. Temporary Utilities.
23. I&C Inspection & Testing Services Coordination
24. Electrical Arc Flash Coordination
25. Any other project related items.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01311

PROJECT COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. As more fully set forth in of the General Conditions, sole responsibility for coordination of all of the Work, belongs to CONTRACTOR. Supervise, direct and cooperate fully with all subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the Work within the Contract Time.

B. As more fully set forth in of the General Conditions, Cooperate with and coordinate the Work with the work of any other contractor, including the following, utility service companies or OWNER’S employees performing work at the site.

C. Not be responsible for damage done by contractors not under CONTRACTOR’S jurisdiction. Will not be liable for any such loss or damage, unless it is through the negligence of CONTRACTOR.

D. Coordinate the Work with the work of others to assure compliance with schedules.

E. Attend and participate in all project coordination or progress meetings and report on the progress of all Work and compliance with schedules.

F. Maintain sufficient competent personnel, drafting and CADD equipment and supplies at the site for the purpose of preparing layout, coordination and Record Drawings. These drawings shall supplement the Contract Documents, and the working and Shop Drawings as necessary to correlate the Work of various trades. Where such drawings are to be prepared by the mechanical, electrical, plumbing, or heating and ventilating subcontractors, ensure that each subcontractor maintains the required personnel and facilities at the site.

G. It is the duty of the CONTRACTOR to determine that all necessary permits have been obtained. The CONTRACTOR, at his own expense, obtain, maintain and close all the required permits which have not been furnished. Permits include MCDOT permit and any other permits required for the project.
SECTION 01312

PROGRESS MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Date and Time:
   1. Regular Meetings: Every week on a day and time agreeable to OWNER, ENGINEER and CONTRACTOR.
   2. Other Meetings: As needed and/or required in other specific specification sections.

B. Place: CONTRACTOR'S field office at Project site, or other mutually agreed upon location.

C. The ENGINEER shall conduct weekly progress meetings, record and distribute minutes of the meeting to all attendees and others as requested. At a minimum, the agenda will include: Requests for Information (RFI) and submittal status, past week’s progress and a 3-week look-ahead schedule to include upcoming inspections, current issues, long lead items, critical issues and the next scheduled meeting date.

D. Provide data required and be prepared to discuss all items on agenda.

1.2 MINIMUM ATTENDANCE

A. CONTRACTOR:
   1. When needed for the discussion of a particular agenda item, require representatives of subcontractors or suppliers to attend a meeting.

B. ENGINEER.

C. OWNER'S representative, if required.

D. Others, as appropriate.

E. Representatives present for each party shall be authorized to act on their behalf.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to the following:
   1. Transcript of previous meeting.
2. Progress since last meeting.
   a. CONTRACTOR’S.
   b. Subcontractors’.
3. Completion status.
4. Planned progress for next period including a 3-week look-ahead schedule to include upcoming inspections.
5. Document and track to correction and closure any problems, conflicts, issues, and observations that are voiced by anyone of the project team.
6. Status of Shop Drawings, submittals, long lead items, RFI and RFAs.
7. Change Orders (Work Change Directives).
8. Pay Requests.
10. Schedules, updated Project Schedules, including off-site fabrication and delivery schedules; corrective measures, if required.
11. Coordination between parties.
13. Safety concerns.
15. Record Drawings.
16. Warranty Requests.
17. Punch List Status.
18. Other business.
19. Next meeting date.
20. Instruction to Contractor Log
21. Traffic Control Plans and Permits
22. Utility Conflicts and Scheduled Shutdowns and/or Relocates

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01321

PROGRESS SCHEDULE (CPM)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes the Progress Schedule requirements to ensure that interim milestone dates will be met and completion of the Work will be accomplished within the time established. ENGINEER’S opinions concerning the various scheduling documents and reports are not controlling CONTRACTOR’S independent judgement concerning means, methods, and sequences of construction CONTRACTOR employs. Sole responsibility for meeting the Contract time(s) given in these Contract Documents, belongs to CONTRACTOR.

B. No later than 30 calendar days after the Notice to Proceed, submit a Preliminary Progress Schedule. The Preliminary Progress Schedule shall be referenced to time. The balance of Work leading to Substantial Completion of the Project shall be included, in a summary format.

C. No later than 14 calendar days after the Notice to Proceed, submit to the ENGINEER a 90-day Bar Chart Schedule prepared in accordance with Article 1.1 through 1.6, herein. The 90-day Bar Chart Schedule shall detail the first 90 calendar days of the Project.

D. No later than 45 calendar days after the Notice to Proceed, submit to the ENGINEER a full Progress Schedule prepared in accordance with Articles 1.1 through 1.7, herein. Upon review and acceptance, the CONTRACTOR’S submitted full progress schedule, described in this paragraph, will be deemed to be the “Baseline Schedule”. (The use of the term “Baseline Schedule” refers to the early dates; the late dates are for the purpose of calculating float, and do not represent the schedule). This Baseline Schedule shall be used by the CONTRACTOR for planning, scheduling and executing the Work and for monitoring and reporting progress to the ENGINEER. No changes to the Baseline Schedule may be made by the CONTRACTOR without the approval of the ENGINEER.

E. To ensure completion of the Work within the contract times established, all of CONTRACTOR’S activities shall be scheduled and monitored by use of a Critical Path Method (CPM) Progress Schedule. Provide a CPM Schedule for Work done under this Contract, in accordance with this Section, and the sequence and progress of Work requirements included under Section 01110, Summary of Work, and Section
F. The Progress Schedule shall be prepared by CONTRACTOR using the Critical Path Method (CPM) utilizing the latest version of Primavera Project Planner software with Primavision (Primavera Project Planner and Primavision are U.S. registered trademarks of Primavera Systems, Inc., Bala Cynwyd, PA), or approved equal as determined by the OWNER and ENGINEER, conforming to the requirements hereinafter described.

1.2 SCHEDULING CONSULTANT

A. Engage, at his expense, a Scheduling Consultant or a qualified CONTRACTOR’S employee who has experience and is skilled in the time and cost application of CPM network techniques using Primavera on 5 construction projects to assist in the preparation of the Project Schedule. Prior to engaging a Scheduling Consultant or a qualified CONTRACTOR’S employee, Submit to the ENGINEER:

1. The name and address of the proposed Scheduling Consultant or qualified CONTRACTOR’S employee and the names of those persons who would be dedicated to this Project.

2. Sufficient information to show that the proposed Scheduling Consultant or qualified CONTRACTOR’S employee and the persons dedicated to this Project, have the qualifications to meet the Progress Schedule requirements.

B. The ENGINEER shall have the right to approve or disapprove the proposed Scheduling Consultant or qualified CONTRACTOR’S employee and will notify CONTRACTOR of his decision within 14 calendar days from receipt of information. In case of rejection, CONTRACTOR shall submit qualifications of another consultant within 14 calendar days for renewed considerations. Such approval or disapproval does not release CONTRACTOR from his obligations under this Contract.

1.3 LOGIC DIAGRAM

A. CONTRACTOR’S Scheduling Consultant or qualified CONTRACTOR’S employee shall prepare and submit a complete reproducible set of pure logic diagrams as generated by Primavera on 24-inch by 36-inch, or 11-inch by 17-inch drawings. The logic diagrams shall be grouped by Area and show the order and interdependence of activities and the sequence and quantities in which the Work is to be accomplished. Interrelationships to or from activities outside the area shown will be depicted by an activity symbol with activity number and description shown from the Primavera program. The basic concept of Precedence Diagramming Method (PDM) network scheduling shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and how its completion may affect the start of
following activities. The level of schedule detail shall define the day-to-day activities of the construction Work. No construction activity duration shall be longer than Ten (10) working days without prior approval.

B. The critical path shall be distinguished from other paths on the network. The logic diagrams shall be banded by major work systems, including one system for procurement and by specific area within each system. Logic diagrams shall include the following:
1. Activity number.
2. Activity description.
3. Activity duration (work days).
5. Slack or float of each activity.
7. Area code.
8. Responsibility code (e.g., CONTRACTOR, subcontractors, trades, operations, suppliers, ENGINEER, or other party responsible for accomplishment of an activity).
9. Shift number (if more than one shift per day is to be employed).

C. In addition to construction activities, network activities shall include the submittal and approval of samples of materials, shop and working drawings, and fabrication of special materials. It shall include all documents and proofs of compliance required by the Contract Documents for Final Inspection and Acceptance of the Work.

D. The Schedule Document shall include a System and Acceptance schedule within the project CPM schedule. This schedule will identify all equipment and systems that require testing, training and acceptance by the City of Phoenix. The durations and sequences of the systems testing and acceptance must be as specified in the various sections of the contract specification. Each system will contain, but will not be limited to, all of the following activities and constraints:
1. Interface between the construction activities and their respective system.
2. CONTRACTOR’S pre-testing work.
3. Submittal and Approval of the CONTRACTOR’S Pre-testing Data and checklist, as appropriate.
4. Sufficient notification time to the City of Phoenix prior to system testing.
5. Submittal and Approval of the Preliminary and Final As-Built Drawings.
6. Submittal and Approval of the Preliminary and Final O&M Manuals.
7. Submittal and Approval of Testing Procedures.
8. All other systems that are required to be tested and accepted prior to the specific system being tested.
9. System Testing by the City of Phoenix.
10. Other outside agencies, utilities, etc., that are required to test, witness and accept the system.

E. All activities of the ENGINEER/OWNER that affect progress and special dates required by the Contract shall be shown.

1.4 MATHEMATICAL TABULATIONS

A. The mathematical tabulation of the network diagram shall include tabulation of each activity shown on the detailed network diagram.

B. The information listed below shall be furnished as a minimum for each activity. All submittal and updates shall consist of Three (3) copies of the reports described below and two sets of compact discs (CD’s) containing Primavera schedule backups. The minimum required information includes:
   1. Activity number.
   2. Activity description.
   3. Activity duration (work days).
   4. Earliest start date (calendar date).
   5. Earliest finish date (calendar date).
   6. Latest start date (calendar date).
   7. Latest finish date (calendar date).
   8. Slack or float of each activity.
   9. Quantities involved for each construction activity with manhour requirements and dollar values.
   10. Critical path activities denoted.
   11. Work days calendar which extends for not less than the length of the contract, plus six months.

C. The mathematical tabulation shall be in the form of computer-generated reports. The reports shall be bound in booklet form, indexed, and separated by tabbed dividers. Computer-generated reports, of the following sorts, provided by CONTRACTOR:
   2. Critical Path Activities Report by Early Start.
   3. Area Schedule Report for each System by Area/Early Start/Total Float.
   5. 60-Day Look-Ahead Report by Area for Each System, then by activity number (with update line).
   6. Man-hour Resource Reports:
      b. Monthly Projected Man-hour Flow Report (Tabular) with Manpower Resource Graphic on 24-inch by 36-inch, or 11-inch by 17-inch Sheet.
1.5 NARRATIVE REPORT

A. Prepare, and include with his original Progress Schedule submission, a narrative report describing the contract requirements and objectives and CONTRACTOR’S plan and schedule for achieving those requirements and objectives. The narrative shall describe the methods of operation, the resources to be employed, time frames for the construction of each of the major systems on the project, and time frames for accomplishment of the specified milestones and project completion.

B. It shall also include, but not be limited to:
   1. A justification and identification of activities that were worked out of sequence.
   2. A description of problem areas.
   3. Current and/or anticipated delaying factors and their potential impact.
   4. An explanation of corrective action (recovery plan) either taken or proposed for all critical areas.
   5. A listing of all intermediate contractual milestones with their respective float and schedule analysis.
   6. Define activities that were not started or completed as scheduled and provide explanation.
   7. Identify and discuss planned manpower versus actual manpower usage and provide projections by Subcontractor.
   8. Identify outstanding “Requests for Information (RFI’s)” and discuss their schedule impact.

1.6 MAN-HOURS LOADING REPORTS

A. After acceptance of the original Progress Schedule, assign labor resources to each construction activity within each responsibility code in man-hours. Resource schedule reports will be required and resource leveling may be employed as required.

1.7 PROGRESS SCHEDULE SUBMITTAL

A. No later than 14 calendar days after the Notice to Proceed, submit to the ENGINEER a 90-day Bar Chart Schedule. During this period CONTRACTOR and the Scheduling Consultant shall meet with the ENGINEER and the OWNER for a minimum of a 1 day workshop session to review technical requirements and schedule development methods and procedures. The 90-day Bar Chart Schedule will be reviewed by the ENGINEER within 14 calendar days of receipt or request for adjustment. A meeting, or meetings, may be required with CONTRACTOR’S Scheduling Consultant during this period in order to expedite acceptance or adjustment. Any adjustments required after this period shall be made and resubmitted by CONTRACTOR within 14
B. No later than 30 calendar days after the Notice to Proceed, 15 calendar days after the complete Progress Schedule has been accepted by the ENGINEER, CONTRACTOR submit to the ENGINEER a full Progress Schedule prepared in accordance with Articles 1.1 through 1.5, above. During this period the ENGINEER, CONTRACTOR and CONTRACTOR’S Scheduling Consultant shall meet biweekly to review the progress of the development of the full Progress Schedule. Lack of progress in the development of the Progress Schedule shall be cause for suspension of any Progress Payment. The complete Progress Schedule will be reviewed by the ENGINEER within 14 calendar days of receipt or request for adjustment. A meeting, or meetings, may be required with CONTRACTOR’S Scheduling Consultant during this period in order to expedite acceptance or adjustment. Any adjustments required after this period shall be made and resubmitted by CONTRACTOR within 14 calendar days.

C. No later than 30 calendar days after the complete Progress Schedule has been accepted by the ENGINEER, CONTRACTOR submit to the ENGINEER a CPM Progress Schedule with man-hours in accordance with Articles 1.4 and 1.6, above. The Progress Schedule shall be reviewed by the ENGINEER within 14 calendar days of receipt or request for adjustment. Any adjustments required after this period shall be made and resubmitted by CONTRACTOR within 14 calendar days.

D. If, in the preparation of the Progress Schedule, CONTRACTOR reflects a completion date or milestone date different than that specified in the Contract, this in no way voids the dates set therein. The dates as specified in the Contract govern. Where the Progress Schedule reflects a completion date or milestone date earlier than specified, the ENGINEER may accept such schedule with CONTRACTOR specifically understanding that no claim for additional Contract Time or compensation shall be brought against the OWNER as the result of failure to complete the Work by the earlier date shown on the Progress Schedule.

### 1.8 FAILURE TO SUBMIT

A. Should CONTRACTOR fail to submit the Progress Schedule in the form indicated within the required time frames shall be cause for suspension of any Progress Payment.

### 1.9 UPDATING THE PROGRESS SCHEDULE

A. Updates:
   1. Monthly updates to the mathematical tabulation are the CONTRACTOR’S responsibility. The updated mathematical tabulation shall include the following data for each activity:
a. Actual start date (for started activities).
b. Actual finish date (for completed activities).
c. Percent complete.
d. Current projected early/late start/finish dates (for activities not started).
e. Current early/late finish dates (for uncompleted activities).
f. Current Total float.
g. Critical path activities noted.

2. CONTRACTOR’S Schedule Update shall include a narrative report which shall include a description of the current progress/status of each area of the project, a description of the progress for the period, a description of the critical path, a discussion of current or potential delays, Change Orders (pending or approved), or other problems.

3. Provide the ENGINEER with five updated hard copies of schedule data and two software backup copies on CD’s. Network diagrams shall be submitted with the tabulation if there are any proposed revisions to network logic, interim milestones, contract completion, or as directed by the ENGINEER. The updated tabulations shall reflect the current status of activities, as outlined on the baseline network diagram. The updated tabulation reports shall reflect all changes in dates, remaining durations, and float time. If any delays have occurred, these shall be noted for time consideration.

B. Monthly Schedule Meeting:
   1. Recording the start and completion dates of each scheduled work activity with the remaining duration for activities started but not completed, including procurement activities is the CONTRACTOR’S responsibility. On one day each month, at least one week prior to the monthly progress meeting, CONTRACTOR and the Scheduling Consultant shall meet with the ENGINEER to tour the site and review and updated information gathered by CONTRACTOR during the month. After acceptance of CONTRACTOR’S updated data, CONTRACTOR’S Scheduling Consultant shall use this information to update the mathematical tabulations and to generate a Monthly Schedule Update.

C. Network Revisions:
   1. Conditions may develop that require revisions to logic or durations of the original network. If during the progress of the Work events develop that necessitate changes in the original Progress Schedule, propose such changes so as to depict the current mode of operation and provide the ENGINEER with a revised network diagram. Any revision to the original logic or original durations must be accepted by the ENGINEER, in writing. After acceptance, logic/duration revisions will be incorporated into the Progress Schedule and will be addressed in the monthly narrative report by means of both a description of the revisions and a listing of those network elements affected by such change. All changes resulting from Change Order(s), additions or deletions,
will be fully incorporated into the Progress Schedule on the first update after the Change Order approval, including all adjustments to the man-hours.

2. Revisions and additions to the accepted network diagrams and mathematical tabulations shall be submitted in three (3) copies of the reports, two (2) software back-up copies on CD of the schedule and a reproducible set of the 24-inch by 36-inch pure logic diagrams.

3. The list of revisions and additions will include the following, when applicable:
   a. Addition and deletion of activities.
   b. Addition and deletion of relationships.
   c. Changes to activity descriptions and durations.
   d. Changes to relationship types and lag codes.
   e. Changes to contract milestone dates and approved constraint dates.
   f. Changes to dollar values resulting from approved Change Orders.
   g. All other revisions to the network logic.

1.10 TIME IMPACT ANALYSIS FOR CHANGE ORDERS, DELAYS, AND TIME EXTENSIONS

A. Change Orders, Delays, and Time Extensions:
   1. When a Change Order(s) is (are) proposed by the ENGINEER or CONTRACTOR, or delays are experienced, submit a Time Impact Analysis (TIA) illustrating the influence of each Change Order or delay on any specified intermediate milestone date(s) or contract completion date. Each TIA shall include a sketch (fragnet) demonstrating how CONTRACTOR proposes to incorporate the change(s) or delay(s) into the current Progress Schedule. The fragnet will include all logic changes and additions required as a result of said Change Order(s) or delay(s).

   2. This fragnet will show all CPM Logic revisions for the Work in question and its relationship to other activities in the network plan. Additionally, the analysis shall demonstrate the time impact, based on the date the change was given to CONTRACTOR, the status of construction at that point in time, and the activity duration of all affected activities. The activity duration used in this analysis shall be those included in the latest update of the Progress Schedule, closest to the time of delay as adjusted by mutual agreement in writing.

B. Submission:
   1. Each Time Impact Analysis shall be submitted within 10 calendar days after a delay occurs or a notice of change or Change Order is given to CONTRACTOR. In cases where CONTRACTOR does not submit a Time Impact Analysis for a specific change or delay within the specified period of time, it shall be mutually agreed that no time extension is required.

C. Evaluation:
   1. Final evaluation of each Time Impact Analysis by the ENGINEER shall be...
made within 10 calendar days after receipt, unless subsequent meetings and negotiations are necessary. Adjustments in the Contract time for performance shall be made only by written Change Order. Upon acceptance by the ENGINEER, fragments illustrating the influence of changes and delays shall be incorporated into the current schedule by CONTRACTOR during the first update after agreement is reached.

2. The time difference between the Early Finish date and the Late Finish date is defined as “float.” The “float” belongs to the Project and may be used by CONTRACTOR or the OWNER to benefit the Project. Changes or delays that influence activities in the network with “float” and do not extend the Critical Path (the sequence of activities with zero days float) shall not be justification for an extension of Contract time for performance.

1.11 RECOVERY SCHEDULE

A. In the event that the Progress Schedule update mathematical analysis indicates that the Project, or progress towards any interim milestone requirement, falls 45 or more work days behind schedule and there is no excusable delay or change to support a time extension, prepare and submit a Recovery Schedule for acceptance by the ENGINEER. Also, revise logic or durations to cause the mathematical analysis to show the Project on schedule. The Recovery Schedule shall be submitted five (5) calendar days after the Progress Schedule Update is submitted.

B. Provide additional manpower, equipment, or materials or work additional shifts, or expedite procurement to complete activities within the accepted intermediate or Contract completion dates, at no additional cost the OWNER. Upon acceptance of the Recovery Schedule by the ENGINEER, incorporate the Recovery Schedule into the current Progress Schedule.

C. Lack of Action:

1. CONTRACTOR’S refusal, failure, or neglect to take appropriate recovery action or to submit a written recovery statement shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work, or separable part, with the diligence that will ensure its completion within the applicable Contract time. Such lack of action shall constitute sufficient basis for the ENGINEER to recommend the withholding of some or all of any payment due, or shall be considered grounds for termination by the OWNER.
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01323

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Retain a professional photographer or an acceptable person, as determined by the ENGINEER, to perform the services specified below.

B. General

1. It is the CONTRACTOR’s responsibility to provide pre-construction photographs so as to resolve any disputes which may arise regarding the considerations prior to and subsequent to construction, belongs to CONTRACTOR.

2. If a dispute arises where no Pre-construction photographs were provided, the disputed area shall be restored to the extent directed by the ENGINEER and to the complete satisfaction of the ENGINEER.

3. A high quality video of the site in digital format shall be made and submitted by the CONTRACTOR prior to any ground disturbance or construction activities. The CONTRACTOR shall video of the entire project area and submit (3) DVD’s or electronic files of pre-construction video to ENGINEER for approval. Recording shall be done by walking construction limits. Recording is not to be done while driving motor vehicles. Pre-Construction video to include still shots and panning to allow viewers adequate time to view general areas and specific details. CONTRACTOR to conduct video recording during lighted conditions. CONTRACTOR to obtain written authorization prior to encroaching on any private properties for video recording purposes. CONTRACTOR to notify each residence or property OWNER prior to obtaining video. All costs associated with pre-construction video shall be considered incidental to the cost of project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Submittal of documents described in the General Conditions, Supplementary Conditions and hereinafter are required prior to, during and at the end of the construction period. The submittals shall conform to the requirements described in this Section and all referenced Sections or Articles.

1.2 GENERAL SUBMITTAL REQUIREMENTS

A. A submittal shall be made for each complete system. Piece-meal submittals will not be accepted.
B. Submittals requiring ENGINEER review only will be processed within (--14--) calendar days after receipt from CONTRACTOR. Submittals requiring ENGINEER and OWNER review will be processed within (--14--) calendar days after receipt from CONTRACTOR.
C. CONTRACTOR shall maintain a file of all approved submittal documents at the work site.
D. CONTRACTOR shall show his executed internal review and approval marking. Submittals which are received from sources other than through CONTRACTOR’S Office or which have not undergone CONTRACTOR review will be returned “Rejected”.

1.3 PROCEDURE

A. Submit the following items at the pre-construction conference:
   1. Preliminary Schedule of Values: Prepare and submit in accordance with Section 01291, Schedule of Values.
   2. Preliminary Schedule of Shop Drawings and Sample Submittal in accordance with the General Conditions and Section 01332, Shop Drawing Procedures.
   3. Preliminary Progress Schedule: Prepare and submit in accordance with Section (01321), Progress Schedule.
   4. Emergency Contact List: Prepare and submit at pre-construction conference.

B. Submit the following items within (--14--) days after the Notice to Proceed. Location of information concerning each submittal is referenced.
   1. Schedule of Values: Prepare and submit in accordance with Section 01291, Schedule of Values.
2. Submittal Schedule: Prepare and submit schedule of all Shop Drawings in accordance with Section 01332, Shop Drawing Procedures.

3. Monthly payment schedule.

4. Ninety-day Bar Chart Schedule: Prepare and submit a 90-day Bar Chart Schedule in accordance with Section 01321, Progress Schedule.

C. Submit the following items within (--30--) days after the Notice to Proceed. Location of information concerning each submittal is referenced.

1. Progress Schedule: Prepare and submit a Progress Schedule within (--30--) days, in accordance with Section 01321, Progress Schedule.

D. Submit the following items at the Pre-construction Conference: Refer to Sections 01332, Shop Drawing Procedures, and Section 01521, ENGINEER’S Field Office.

E. Submittals Prior to Beginning the Work: Refer to the Contract Documents.

F. Submittals During Construction: During progress of the construction, provide the following submittals in a timely manner to prevent any delay in the Work schedule:

1. Updates to Progress Schedule: Provide an assessment of Work progress in relation to the Progress Schedule in accordance with Contract Documents.

2. Shop Drawings, Product Data and Samples: Submit Shop Drawings, product data and samples in accordance with Section 01332, Shop Drawing Procedures, and as required in various Sections of the Contract Documents.

3. Progress Payments: Submit applications for partial payments as specified in the General Conditions. MBE/WBE Utilization Form, included in Section 01331, Reference Forms, shall be submitted with each progress payment.

4. Request for Information: Submit a Request for Information (RFI), included in Section 01331, Reference Forms, when any of the following are required: an interpretation of the Specifications; additional details; information not shown on the Drawings or in the Specifications; or clarification of discrepancies is needed. Retain one copy and submit one electronic PDF format copy to the ENGINEER for response. Once the RFI is commented on by the ENGINEER, an electronic PDF format copy will be returned to CONTRACTOR and OWNER.

5. Change Orders: A proposal for a Change Order may be submitted by CONTRACTOR in accordance with the General Conditions. The Change Order Proposal must be in writing and must include sufficient information to assess the need for a change in the Work, the Contract time or the Contract amount. Whenever the ENGINEER determines the need for a Change Order, a Request for Change Order Proposal will be issued to CONTRACTOR. Upon receipt of a Request for Change Order Proposal Form or when CONTRACTOR determines the need for a Change Order, prepare and submit 1 electronic .PDF copy of a Change Order Proposal. The Change Order Proposal must be approved by CONTRACTOR, ENGINEER, and OWNER. When a Change Order Proposal
has been accepted, a Work Change Directive shall be submitted. Each Work Change Directive shall include a Change Order Pricing Sheet. After the Work Change Directive has been accepted by the OWNER, a Change Order will be prepared and executed. CONTRACTOR is not authorized to begin work on a Change Order until it is fully executed. Any Work done by CONTRACTOR prior to execution of a Change Order is entirely at his own risk.

6. Use of CONTRACTOR’S Contingency: Submit the CONTRACTOR’S Contingency Usage Request including a description for use of the contingency and costs associated for review by the ENGINEER and acknowledgement by the OWNER. CONTRACTOR’S Contingency Usage Requests to be included with all applicable monthly pay application requests.

7. CONTRACTOR’S Daily Report: CONTRACTOR and each subcontractor shall prepare and submit a daily report on forms approved by ENGINEER. The report shall contain, as a minimum, information on the location and description of the Work being performed, size, quantity and description of materials and equipment installed or delivered, coordination or scheduling concerns, requests for clarifications, and any discrepancies noted in the Contract Documents or on the as-built conditions. The report shall also contain CONTRACTOR’S daily workforce count by craft, general weather conditions, any Work performed other than during established working hours, and any other pertinent items relative to the Work, and as required by ENGINEER. The report is due at the ENGINEER’S office by 9:00 a.m. on the following Work day and shall be signed by a responsible member of CONTRACTOR’S staff.

8. Submittal Schedule: Submit an updated Shop Drawing, Product Data and Sample Submittal Schedule with each Progress Payment Request.

9. Construction Photographs: Submit Construction Photographs with each month’s Progress Payment Request

H. Submittal At Project Closeout: With a written Notice of Completion, submit the following items in the proper form as a condition of Final Acceptance of the Work:

1. Project Record Documents (Red-Line Drawings), Survey Notes, Construction Photographs, Warranties, Guarantees, and Bonds as required by Contract Documents

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01331

REFERENCE FORMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section contains the required forms for CONTRACTOR use in documenting testing Work and other Work required under this Contract. This Section supplements but does not supersede specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. Forms will include, but will not necessarily be limited to the list below. The forms provided indicate minimum requirements. If desired to use a supplemental form the document must be submitted for review and approval by the ENGINEER.

<table>
<thead>
<tr>
<th>Form No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>00800-A</td>
<td>Certificate of Substantial Completion</td>
</tr>
<tr>
<td>00800-B</td>
<td>Contractor’s Affidavit Regarding Settlement of Claims</td>
</tr>
<tr>
<td>01143-A</td>
<td>Extended Construction Work Hours Permit Application</td>
</tr>
<tr>
<td>01330-A</td>
<td>Schedule of Values</td>
</tr>
<tr>
<td>01330-B</td>
<td>Shop Drawings, Product Data and Sample Submittal Schedule</td>
</tr>
<tr>
<td>01330-C</td>
<td>Authorized Signatures Form</td>
</tr>
<tr>
<td>01330-D</td>
<td>Application for Payment</td>
</tr>
<tr>
<td>01330-E</td>
<td>MBE/WBE Utilization Form</td>
</tr>
<tr>
<td>01330-F</td>
<td>Request for Change Order Proposal</td>
</tr>
<tr>
<td>01330-G</td>
<td>Change Order Proposal</td>
</tr>
<tr>
<td>01330-H</td>
<td>Work Change Directive</td>
</tr>
<tr>
<td>01330-I</td>
<td>Change Order Pricing Sheet</td>
</tr>
<tr>
<td>01330-J</td>
<td>Change Order</td>
</tr>
<tr>
<td>01330-K</td>
<td>Request for Information</td>
</tr>
<tr>
<td>01330-L</td>
<td>Request for Alteration</td>
</tr>
<tr>
<td>01330-M</td>
<td>Contractor’s Daily Construction Report</td>
</tr>
<tr>
<td>01330-N</td>
<td>TV Inspection Request</td>
</tr>
<tr>
<td>01330-O</td>
<td>Contractor Submittal Review Checklist</td>
</tr>
<tr>
<td>01330-P</td>
<td>Submittal Review Form</td>
</tr>
<tr>
<td>01330-Q</td>
<td>Contractors Contingency Usage Request</td>
</tr>
<tr>
<td>01332-A</td>
<td>Submittal Transmittal Form</td>
</tr>
<tr>
<td>01332-B</td>
<td>Shop Drawing Review Checklist</td>
</tr>
<tr>
<td>01415-A</td>
<td>Confined Space Data Sheet</td>
</tr>
<tr>
<td>01415-B</td>
<td>Confined Space Entry Permit</td>
</tr>
</tbody>
</table>
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
# Application for Payment

**Project Name:** West Anthem Gravity Sewer Improvements – Phase 1  
**Project Number:** WS90500276

**CITY OF PHOENIX: Water Services Department**

**Form 01330-D**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Contract Amount</th>
<th>Estimated Amount This Period</th>
<th>Amount Pre-Invoiced</th>
<th>Amount Completed To Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ATTACHMENTS:** Schedule of Values

- RETAINAGE - 10%
- SECURITIES - 10%

**GROSS AMOUNT DUE:** $xx,xxx,xxx.xx

**RETAINAGE - 10%**

**SECURITIES - 10%**

**NET AMOUNT DUE TO DATE:**

**LESS AMOUNT PRE-INVOICED PAID:**

**AMOUNT DUE THIS APPLICATION:** $xx,xxx,xxx.xx

**Notice To Proceed Date:** MM/DD/YY

**Contract No.:** XXXXXX

**Name of Contractor:** NAME OF CONTRACTOR

**Telephone:** (XXX) XXX-XXXX

**Fax:** (XXX) XXX-XXXX

**Address:** CONTRACTOR'S ADDRESS

---

**To:** Project Manager  
200 W. Washington Street, 8th Floor  
Phoenix, Arizona 85003

**PAYMENT PERIOD:** From mm/dd/yy to mm/dd/yy

**Payment Period:** From mm/dd/yy to mm/dd/yy

**GROSS AMOUNT DUE:** $xx,xxx,xxx.xx

**RETAINAGE - 10%** $xx,xxx,xxx.xx

**SECURITIES - 10%** $xx,xxx,xxx.xx

**NET AMOUNT DUE TO DATE:**

**LESS AMOUNT PREVIOUSLY PAID:**

**AMOUNT DUE THIS APPLICATION:** $xx,xxx,xxx.xx

---

**To:** Project Manager  
200 W. Washington Street, 8th Floor  
Phoenix, Arizona 85003

**APPLICATION FOR PAYMENT**

**Progress Payment No. __**

---

**Attachment:** Schedule of Values

---

**GROSS AMOUNT DUE:** $xx,xxx,xxx.xx

---

**To:** Project Manager  
200 W. Washington Street, 8th Floor  
Phoenix, Arizona 85003

---

**Attachment:** Schedule of Values

---

**GROSS AMOUNT DUE:** $xx,xxx,xxx.xx
CERTIFICATION OF CONTRACTOR:  I certify that all items and amounts shown on the face of this Application for Payment are correct, that to the best of my knowledge and belief all work has been performed and/or material supplied in full accordance with the requirements of the referenced contract and/or duly authorized deviations, substitutions, alterations, and/or additions that the foregoing is true and correct statement of the contract account up to and including the last day of the period covered by this Application that no part of the "Amount Due This Application" has been received and that the undersigned and subcontractors have:

- [ ] a. Complied with all labor provisions of said contract.
- [ ] b. Complied with all labor provisions of said contract except in those instances where a dispute exists with respect to said labor provisions. (If "b" is checked, include attachment briefly describing nature of dispute.)

Contractor Representative Date
Title

CERTIFICATION OF ENGINEER: I certify that all work described was inspected and that to the best of my knowledge and belief the work was performed and/or supplied in full accordance with the requirements of this contract.

Resident Project Representative Date

I certify that I have checked and verified the above and foregoing Application for Payment; that to the best of my knowledge and belief it is a true and correct statement of work performed and/or material supplied by the contractor; that all work and/or material included in this Application has been inspected and that it has been performed and/or supplied in full accordance with the requirements of the referenced contract and that payment claimed and requested by the Contractor is correctly computed on the basis of work performed and/or material supplied to date.

Project Manager/Engineer Date
Firm

CITY USE ONLY BELOW THIS LINE

RECOMMENDED BY: Project Manager Date
APPROVED BY: Superintendent Date
<table>
<thead>
<tr>
<th>ITEM N.</th>
<th>DESCRIPTION</th>
<th>CONTRACT AMOUNT</th>
<th>ESTIMATED AMOUNT THIS PERIOD</th>
<th>AMOUNT PREVIOUSLY INVOICED</th>
<th>AMOUNT COMPLETED TO DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTRACTOR</td>
<td>RFI#</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requested By</td>
<td>Directed to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>Date Received</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spec. Section</td>
<td>Date Transmitted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawing References</td>
<td>Date Reply Received</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date Reply Needed</td>
<td>Date Reply Transmitted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INFORMATION NEEDED:

Date ___________________ Signature ___________________

REPLY:

Date ___________________ Signature ___________________
Form 01330-N
TV INSPECTION REQUEST

CITY OF PHOENIX
WATER SERVICES DEPARTMENT

DATE__________________________  REQUESTOR__________________________  PHONE #__________________________  LOCATION__________________________

REASON FOR INSPECTION__________________________

☐ S.__________________________

(PLEASE PROVIDE COPY OF SECTION TO BE INSPECTED)

LINEAL FT. TO INSPECT__________________________  ☐ C-O-MH__________________________  ☐ TO C-O-MH__________________________  

PIPE DIAM.__________________________

PIPE TYPE__________________________

DEPT. OF FL. W.__________________________ IN.

MH DEPTH__________________________

DATE WHEN LAST CLEANED MAIN__________________________

COMMENTS__________________________

FOR TV SECTION ONLY

DATE RECEIVED__________________________

ASSIGNED TO__________________________  DATE_________  EQUIP_________

COMPLETED__________________________  DATE_________

COMMENTS__________________________
Form 01415-C
Confined Space Hot Work Permit

Division: ___________________________ Facility: ___________________________

Specific Confined Space Being Entered: __________________________

Date: ___________________________ Time: ___________________________

Expected Job Duration (days/hours): __________________________

Purpose of Entry (Describe the Work):
__________________________________________________________________
__________________________________________________________________

Explain Why Work Cannot Be Done Outside Of The Confined Space:
__________________________________________________________________
__________________________________________________________________

Safety Equipment Required:

Fire Extinguishers: Yes □ No □ Number:______ Type:____________________

Respirators: Yes □ No □ Number:__________ Type:____________________

Other Equipment:
__________________________________________________________________
__________________________________________________________________

Authorizing Supervisor:

Print Name:________________________________________

Signature:________________________________________

Date Signed:______________________________________
SECTION 01332

SHOP DRAWING PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The submittal of Shop Drawings shall conform to requirements of General Conditions and procedures described in this Section. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of Shop Drawings on various items using a single transmittal form shall be permitted only when the items taken together constitute a manufacturer’s “package” or are so functionally related that expediency indicates review of the group or package as a whole.

B. The term “Shop Drawings” as used herein shall be understood to include detailed design calculations, fabrication and installation drawings, lists, graphs, test data, operating instructions, preventive maintenance tasks instructions, and other items which shall include, but are not necessarily limited to:
   1. Drawings and catalog information and cuts.
   2. Specifications, parts list, suggested spare parts lists, and equipment drawings.
   3. Applicable certifications.
   4. Anchor bolt templates, mounting instructions and mounting design calculations as required.
   5. Other technical, installation, and maintenance data as applicable.
   6. Unloading and handling methods and storage requirements.
   7. Note, highlight, and explain proposed changes to the Contract Documents.
   8. Paint submittal showing type of paint and the mils thickness of coating system used. Drawings showing CONTRACTOR field verifications illustrating all field dimensions. Field verify all dimensions and existing materials shown on the Drawings. Any modifications required shall be at CONTRACTOR’S expense.
   9. A Certificate of Compliance with NSF/ANSI 61 STANDARD or with Arizona Administrative Code R18-4-213 for materials or products which can contact drinking water as part of a Water Treatment Process or Water Supply System.

C. Preliminary Submittal Schedule: CONTRACTOR, shall prepare and submit to the ENGINEER a Preliminary Submittal Schedule at the Pre-Construction conference. Identify on his Preliminary Submittal Schedule all of the submittal items required by the Contract Documents governing the Work.
D. Submittal Schedule: CONTRACTOR, within 14 days after the Notice to Proceed, shall prepare and submit to the ENGINEER a comprehensive Submittal Schedule. Identify on his Submittal Schedule all of the submittal items required by the Contract Documents governing his Work. Indicate, for each submittal item on his Submittal Schedule the following:

1. The date by which that item will be submitted to the ENGINEER.
2. Whether the submittal is for a substitute or “equal” item. Complete submittal for all substitute or “equal” items shall be made to the ENGINEER, in accordance with the Contract requirements. Identification by the CONTRACTOR of substitute or “equal” items does not relieve CONTRACTOR of his responsibility to furnish equipment and materials that meet all the requirements of the Contract Documents. Items of manufacturers’ equipment listed with CONTRACTOR’S Bid Proposal shall not be replaced with any substitute or “equal” items as part of this Submittal Schedule process. Procedure for substitutions is specified under the General Conditions.
3. Whether the submittal is for review or “for record only”.
4. The date by which response is required.
5. The date by which the material or equipment must be on site in order not to delay the progress of the Work.

E. In preparing his Submittal Schedule, consider the nature and complexity of each submittal item and shall allow ample time for review, revision or correction. Submittal will normally be returned to CONTRACTOR within 14 calendar days following receipt of the submittal. Complex submittals may require additional review time. Identify submittal(s) for which long review periods are anticipated.

F. The ENGINEER will review CONTRACTOR’S Submittal Schedule to determine its completeness and compatibility with the Progress Schedule. A Submittal Schedule which is incompatible with the Progress Schedule or a review schedule which places extraordinary manpower demands on the ENGINEER will be sufficient reason(s) to reject the Submittal Schedule. It shall be understood that certain submittals will take longer than 14 days to review and that these particular submittals will be identified during the review of the Submittal Schedule, by the ENGINEER to allow for very complex submittal reviews. Also, identify submittal for which he anticipates long review periods.

G. CONTRACTOR’S Submittal Schedule shall be consistent with the Progress Schedule as described in Section 01321, Progress Schedule.

H. Approval of the Submittal Schedule shall be required prior to processing of the first progress payment.
1.2 PROCEDURE

A. Submit Shop Drawings to ENGINEER

B. A letter of transmittal shall accompany each submittal. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.

C. All letters of transmittal shall be submitted in duplicate.

D. At the beginning of each letter of transmittal, provide a reference heading indicating the following:
   1. OWNER’S Name ____________________________
   2. Project Name ______________________________
   3. Contract No. ______________________________
   4. Transmittal No. ____________________________
   5. Section No. ________________________________

E. If a Shop Drawing deviates from the requirements of the Contract Documents, specifically note each variation in his letter of transmittal.

F. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.

G. All Shop Drawings submitted shall bear the stamp of approval and signature of CONTRACTOR as evidence that they have been reviewed and verified to the completeness of the submittal by CONTRACTOR. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to CONTRACTOR. CONTRACTOR’S stamp contain the following minimum information:

   Project Name: ________________________________
   CONTRACTOR’S Name: ________________________
   Date: ________________
   Item: ________________________________
   Specifications:
   Section: ________________________________
   Page No.: ________________________________
   Para. No.: ______________________________
   Drawing No.: ________________ of ________________
   Location: ________________________________
H. In order to identify and track all submittals as separate and unique items, utilize the submittal identification numbering system as follows:

1. The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique item. The Submittal Number shall be a two part, eight character, alpha/numeric number assigned by CONTRACTOR in the following manner:
   a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.
   b. The second part of the Submittal Number shall consist of three digits (numbers 001 to 999) to number each separate and unique submittal submitted under each Specification Section.
   c. A dash shall separate the two parts of the Submittal Number.
   d. A typical Submittal Number for the third Working Drawing submitted under Section 15101, Ductile Iron Pipe, would be 15101-003.

2. The Review Cycle shall be a three-digit number indicating the initial submission or resubmission of the same submittal. For example:

   001 = First (initial) submission  
   002 = Second submission (first resubmission)  
   003 = Third submission (second resubmission)

3. An example of the typical submittal identification numbers for the first submission of the third submittal submitted under Section 15101, Ductile Iron Pipe is:

<table>
<thead>
<tr>
<th>Submittal Number</th>
<th>Review Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>15101-003</td>
<td>001</td>
</tr>
</tbody>
</table>

An example of the typical submittal identification numbers for the second submission of the third submittal submitted under Section 15101, Ductile Iron Pipe is:

<table>
<thead>
<tr>
<th>Submittal Number</th>
<th>Review Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>15101-003</td>
<td>002</td>
</tr>
</tbody>
</table>

I. Initially submit to ENGINEER a minimum of 1 ELECTRONIC .PDF format copy.
J. After ENGINEER completes his review, Shop Drawings will be affixed with a stamp and marked with one of the following notations:
   1. Approved.
   2. Approved as Corrected.
   3. Approved as Corrected, Resubmit.
   4. Revise and Resubmit.
   5. Not Approved.
   7. For Information Only.

K. If a submittal is acceptable, the ENGINEER will mark it “Approved” or “Approved as Corrected” and will forward 1 electronic PDF format copy of the submittal to the CONTRACTOR and OWNER.

L. Upon return of a submittal marked “Approved” or “Approved as Corrected”, CONTRACTOR may order, ship or fabricate the materials included on the submittal, provided it is in accordance with the corrections indicated.

M. If a Shop Drawing marked “Approved as Corrected” has extensive corrections or corrections affecting other Shop Drawings or Work, ENGINEER may require that CONTRACTOR make the corrections indicated thereon and resubmit the Shop Drawings for record purposes. Such Shop Drawings will have the notation, “Approved as Corrected - Resubmit.” The corrected Shop Drawing shall be a pre-condition for payment for the work item of the Shop Drawing.

N. If a submittal is unacceptable, 1 electronic .pdf copy will be returned to CONTRACTOR with one of the following notations:
   1. “Revise and Resubmit”
   2. “Not Approved”

O. Upon return of a submittal marked “Revise and Resubmit”, make the corrections indicated and repeat the initial approval procedure. The “Not Approved” notation is used to indicate material or equipment that is not acceptable. Upon return of a submittal so marked, repeat the initial approval procedure utilizing acceptable material or equipment.

P. Any related Work performed or equipment installed without an “Approved” or “Approved as Corrected” Shop Drawing will be at the sole responsibility of CONTRACTOR.

Q. Shop Drawings shall be submitted well in advance of the need for the material or equipment for construction and with ample allowance for the time required to make delivery of material or equipment after data covering such is approved. Assume the risk for all materials or equipment which are fabricated or delivered prior to the
approval of Shop Drawings. Materials or equipment will not be included in periodic progress payments until approval thereof has been obtained in the specified manner.

R. ENGINEER will review and process all submittals promptly; a reasonable time shall be allowed for this, for the Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to CONTRACTOR.

S. Responsibility belongs to CONTRACTOR to review submittals made by his suppliers and subcontractors before transmitting them to the ENGINEER to assure proper coordination of the Work and to determine that each submittal is in accordance with CONTRACTOR’S desires and that there is sufficient information about materials and equipment for ENGINEER to determine compliance with the Contract Documents. Incomplete or inadequate submittals will be returned for revision without review.

T. Furnish required submittals with complete information and accuracy in order to achieve required approval of an item within one submittal. Backcharges for resubmittals that account for a number greater than 20 percent of the total number of first time submittals and will be backcharged for all third submittals. The number of first time submittals shall be equal to the number of submittals agreed to by ENGINEER and CONTRACTOR. All costs to ENGINEER involved with subsequent submittal of Shop Drawings, Samples or other items requiring approval will be backcharged to CONTRACTOR at the rate of 3.0 times direct technical labor cost by deducting such costs from payments due CONTRACTOR for Work completed. In the event that CONTRACTOR requests a substitution for a previously approved item, all of ENGINEER’S costs in the reviewing and approval of the substitution will be backcharged to CONTRACTOR, unless the need for such substitution is beyond the control of CONTRACTOR.

U. The OWNER reserves the right to withhold monies, identified in the General Conditions, for Shop Drawing reviews beyond those described herein.

V. The ENGINEER will implement, if requested by CONTRACTOR, one special Shop Drawing Review Meeting. The purpose of the meeting is to expedite Shop Drawing reviews for the equipment and materials required for the first document of the Work. Requirements of this Section will not be waived, but could be expedited.

W. Mark each page of a submittal and each individual component submitted with the specification number, paragraph, and subparagraph. Arrange submittal information presentation to appear in the sequence in the Specification Section.
SECTION 01412

STORMWATER POLLUTION PREVENTION PLAN AND PERMIT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Comply with the terms and conditions of the Arizona Pollutant Discharge Elimination System (AZPDES) requirements under the Arizona Department of Environmental Quality (ADEQ) General Permit. Under provisions of that permit, CONTRACTOR is designated as permittee and responsible for providing necessary material and for taking appropriate measures to minimize pollutants in stormwater runoff from the Project. Obtain a DeMinimus discharge permit from ADEQ for any discharge that is to Waters of the U.S., and comply with the requirements of the permit.

B. The Contract Price shall include all material, labor and other permits and incidental costs related to:
   1. Preparing, updating and revising the Stormwater Construction Pollution Prevention Plan (SWPPP).
   2. Installing and maintaining all structural and non-structural items chosen by CONTRACTOR to comply with the construction SWPPP.
   3. Clean-up and disposal costs associated with clean-up and repair following storm events or CONTRACTOR caused spills on the Project.
   4. Implementing and maintaining Best Management Practices to comply with ADEQ and the OWNER’S stormwater codes.
   5. Preparing the Notice of Intent and Notice of Termination shall be covered by the AZPDES General Permit for Arizona.
   6. Obtaining and complying with DeMinimus permit requirements.
   7. Comply with City of Phoenix Environmental Services Department SWPPP and SWMP Requirements (see Exhibit A) within Contract Documents.

C. Coordinate the requirements under this Section with Section 02315, Excavation and Backfill, permit requirements. All necessary SWPPP controls and practices must be implemented prior to commencement of any construction activity.

1.2 SUBMITTALS

A. Submit at pre-construction conference completed and signed Notice of Intent forms to the State of Arizona at the following addresses:
1. Stormwater Program – Water Permits Section / NOI
   Arizona Department of Environmental Quality
   1110 West Washington, 5415B-3
   Phoenix, AZ 85007

B. Submit the following to the ENGINEER at pre-construction conference:
   1. Notice of Intent (NOI) to be covered by the AZPDES General Permit for Arizona, including certifications of signature.
   2. SWPPP for the Project, including certification of signature. Stormwater Pollution Prevention Plan shall include CONTRACTOR’S proposed temporary means for stormwater control during all phases of construction and include stormwater pumping/retention plans. This submittal shall be coordinated with CONTRACTOR’S Excavation Plan submittal, specified in Section 02315, Excavation and Backfill.
   3. A manual has been prepared by the Maricopa County Flood Control District to aid in CONTRACTOR’S preparation of the SWPPP. This manual, "Drainage Design Manual for Maricopa County Arizona, Volume III, Erosion Control" is available at the Flood Control District Office, 2801 West Durango Street, Phoenix, Arizona. The complete Construction General Permit is in the December 8, 1999, Federal Register available at local libraries and is also available from the ADEQ website at www.adeq.state.az.us/environ/water/permits/download/constgp.pdf.

C. Submit to the ENGINEER, , as part of the Construction SWPPP a construction site inspection report that includes the following:
   1. Inspection scope.
   2. Inspector qualifications.
   3. Observations of SWPPP non-compliance and corrective steps taken.
   4. Certificate of Compliance with SWPPP and the AZPDES General Permit for Stormwater Discharge in the event of no incidents. Inspection reports shall be submitted to ENGINEER with monthly progress payment requests, throughout the Contract duration.

D. Submit to ENGINEER,, upon project completion the Notice of Termination (NOT) of coverage under AZPDES General Permit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

01412-2 9/12/2018
SECTION 01413

CONTRACTOR’S HAZARDOUS MATERIALS MANAGEMENT PROGRAM

PART 1 – GENERAL

1.1 DESCRIPTION

A. Comply with all Federal, State, and local Laws and Regulations related to environmental protection and environmental safety including, but not limited, to the following:
   2. Title 40 Code of Federal Regulations, Environmental Protections.
   4. State Occupational Safety and Health Administration (OSHA).
   5. Arizona Department of Environmental Quality (ADEQ).
   6. Arizona Department of Water Resources (ADWR).
   7. Maricopa County Air Pollution Control Regulations.

B. In order to ensure the OWNER that CONTRACTOR is complying with the intent of the regulations stated in Paragraph 1.1.A, above, as they relate to the on site use of hazardous materials, hazardous wastes and other substances similarly defined in those regulations, develop and maintain a CONTRACTOR’S Hazardous Materials Management Program that includes as a minimum, but is not limited to the requirements specified herein. The interests of the OWNER are that accidental spills, site contamination, and injury of personnel on the site are avoided. OWNER will not enforce suspected violations of the rules and regulations referenced in Paragraph 1.1.A, above, however the OWNER will notify CONTRACTOR of suspected violations. If in the opinion of the OWNER, CONTRACTOR fails to address the suspected violations in a timely and appropriate manner, OWNER will notify Federal, State, or local regulatory agencies, report the suspected violations to them, and request that they inspect CONTRACTOR’S operations. Any fines that may be levied against OWNER for violations committed on the site by CONTRACTOR, as well as any costs to OWNER associated with cleanup of materials, shall be reimbursed immediately by CONTRACTOR. All documents required by the program shall be made available to the OWNER’S Environmental Representative immediately, upon request.

(The remainder of this page was left blank intentionally.)
C. Responsibility for any hazardous waste, as defined in any of the above listed regulations, and those generated by the CONTRACTOR, belongs to CONTRACTOR. If CONTRACTOR is going to generate, or has generated, a substance that qualifies as a hazardous waste, must obtain an EPA identification number, listing CONTRACTOR’S name and construction site address as the generator of the hazardous waste. Responsibility for the identification, analysis, profiling, transport and disposal of hazardous wastes generated, belongs to CONTRACTOR. The identification number can be obtained from the Arizona Department of Environmental Quality (ADEQ). This number shall be provided to the ENGINEER at the pre-construction conference, or before any hazardous materials are brought onto the site.

1.2 HAZARDOUS MATERIALS PROGRAM REQUIREMENTS

A. Within the regulations listed in Paragraph 1.1.A, above, terms such as hazardous material, hazardous wastes, and similar terms have varying definitions. To dispel confusion regarding what materials fall under the Program Requirements and for the purposes of this Article, Hazardous Material is defined as “any material, whether solid, semi-solid, liquid, or gas, which, if not stored or used properly, may cause harm or injury to persons through inhalation, ingestion, absorption or injection, or which may negatively impact the environment through the use or discharge of the material on the ground, in the water (including groundwater), or to the air.”

B. All chemicals brought onto the site must be approved by OWNER. Prior to bringing any chemical on site, request approval from OWNER’S Environmental Representative for each chemical CONTRACTOR proposes to bring on site. At the time of request, OWNER’S Environmental Representative may request and receive from CONTRACTOR, specific information associated with each chemical. The specific information may include, but is not limited to, MSDS, manufacture, vendor, container size(s), number of containers, minimum and maximum volume of material intended to be stored on site, as well a description to the process or procedures in which any requested chemical is to be used. OWNER, within 10 working days from receipt of the specific chemical information, will inform CONTRACTOR as to whether the chemical has been approved for use on site.

C. Maintain on site two notebooks containing (1) a chemical inventory, and (2) current (dated within the past two years) Material Safety Data Sheets for all materials being used on site, whether or not they are defined as a Hazardous Material in Paragraph 1.2.A, above. One notebook shall be kept in CONTRACTOR’S on-site office and the other shall be kept in a location specified by the OWNER’S Environmental Representative. These notebooks must be kept up-to-date as materials are brought onto and removed from the site. Copies of MSDS sheets for chemicals removed from the site shall be provided to the OWNER’S Environmental Representative.
D. Develop an emergency/spill response plan, for each hazardous material or class/group of materials. Emergency/Spill Response Plan to be submitted at pre-construction conference. As a minimum, the response plan must address the following:
   1. Provide a description of equipment on site available to contain or respond to an emergency/spill of the material.
   2. Notification procedures.
   3. Response coordination procedures between CONTRACTOR, OWNER, and ENGINEER.
   4. Provide a Site Plan showing the location of stored hazardous materials and location of spill containment/response equipment.
   5. Provide a description of the hazardous material handling and spill response training provided to CONTRACTOR’S employees.

E. In accordance with applicable Laws and Regulations, properly and safely store all hazardous materials, which shall include as a minimum, the following:
   1. Have a designated storage site for hazardous materials that includes secondary containment. The site must include barriers to prevent vehicles from colliding with the storage containers and offer protection from environmental factors such as weather.
   2. Provide signage in accordance with applicable Laws and Regulations, clearly identifying the hazardous materials storage site.
   3. All hazardous materials containers must bear the applicable Hazard Diamonds.

F. Properly label all containers of consumable materials, whether or not they are classified as Hazardous Materials under this Section. The name of CONTRACTOR or subcontractor shall be stenciled on any container containing a hazardous material and on any container over five-gallon capacity containing a non-hazardous material. Any container must have a label clearly identifying the contents. If any such unlabeled containers are discovered on the site, the OWNER’S Environmental Representative will notify CONTRACTOR. Responsibility to remove such containers belongs to CONTRACTOR. Containers will be properly labeled or removed from the site within one hour. Any containers that are filled from larger containers must also be properly labeled.

G. OWNER encourages storage of hazardous materials off site until the materials are needed on site.

H. Provide all documentation required herein available immediately upon request of OWNER’S Environmental Representative. CONTRACTOR’S Safety Representative will meet at least monthly with OWNER’S Environmental Representative to review CONTRACTOR’S Hazardous Materials Management Program documents, procedures, and inspect the storage site and job site to ensure the requirements specified herein are being complied with. Also, provide OWNER’S Environmental Representative and the ENGINEER with copies of all permits obtained from environmental regulatory agencies.
I. Provide documentation to ENGINEER and OWNER’s Environmental Representative that CONTRACTOR, subcontractors, or others hired by CONTRACTOR making deliveries of hazardous Materials (as defined in Title 49 CFR) to the site are in compliance with Title 49 CFR 172.800 – 172.804, which requires each person who offers for transportation in commerce or transports in commerce one or more of the following hazardous materials, as defined by Title 49 CFR, must develop and adhere to a security plan for hazardous materials that conforms to the requirements of this subpart.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01414

EARTHMOVING AND DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Obtain all earthmoving permits and any other permits required for earthmoving and dust generating operations related to the Work as required by the Maricopa County Air Pollution Control Regulations.

B. Not cause or allow any dust generating operation, earthmoving operation, use of property, or any other operation which causes fugitive dust emissions that exceed the 20 percent visible emission opacity limit in Rule 300 of Maricopa County’s Air Pollution Control Regulations.

C. If requested by the OWNER, ENGINEER, or Maricopa County representative, shall conduct opacity observations for visible emissions of fugitive dust in accordance with techniques specified in USEPA Reference Method 9.

D. In addition to earthmoving permits, obtain an approved Dust Control Plan from Maricopa County. At a minimum, the Dust Control Plan shall include the following information:
   1. Name(s), address(es) and phone number(s) of the person(s) responsible for the preparation, submittal, and implementation of the Dust Control Plan and responsible for the dust generating operations.
   2. A site plan that describes the total area of land surface to be disturbed (in acres); the operations and activities to be performed on the site; actual and potential sources of fugitive dust emissions; and the delivery, transportation, and storage areas for the site (including types of materials stored and appropriate size of material stock piles).
   3. Description of the Reasonably Available Control Measures (RACM) to be applied during all periods of dust generating operations at all actual and potential sources of fugitive dust.
   4. Description of dust suppressants to be applied including product specifications; method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant’s appropriate and safe use.
   5. Description of specific surface treatment(s) or RACM used to control material track-out where unpaved or access points join paved surfaces.
   6. Description of at least one alternative RACM for each actual and potential fugitive dust source shall be designated as a contingency measure.
E. Post a copy of all earthmoving permits as well as the approved Dust Control Plan in a conspicuous location at the worksite and provide a copy of each to the ENGINEER.

F. Maintain a daily written log that records the actual application or implementation of the RACMS described in the approved Dust Control Plan. Maintain this written log and supporting documentation on site and shall make available for review on request by ENGINEER, OWNER, or Maricopa County representative. Retain copies of the Dust Control Plan, RACM implementation records, and all supporting documentations for a minimum of three years.

G. At a minimum, provide all necessary equipment and materials to apply sufficient dust suppressants (e.g., water, etc.), properly clean (sweep, etc.) all track-out areas, and provide adequate physical stabilizations (e.g., gravel, recycled asphalt, etc.) to meet all requirements of the earthmoving permit and approved Dust Control Plan. Use these methods to control fugitive dust generation from all CONTRACTOR operations on all CONTRACTOR areas including, but not limited to:
   1. Construction areas.
   2. Vehicle and equipment parking areas.
   3. Material storage areas.
   4. Office and trailer areas.
   5. Haul and access roadways.
   6. Track-out areas.
   7. All other areas where CONTRACTOR work, storing, or parking of vehicles, equipment, and materials.

H. Pay all fines issued to the OWNER by the USEPA, ADEQ, or Maricopa County due to violation of CONTRACTOR’S earthmoving permit and Dust Control Plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +
SECTION 01415

CONFINED SPACE ENTRY PLAN

PART 1 - GENERAL

1.1 DESCRIPTION

A. OWNER has determined that portions of the Work site may constitute “confined spaces” as defined in 29 CFR §1926.21(b)(2) and 1910.146. Accordingly, incorporate into its Safety Plan for the Work site appropriate measures to protect the health and safety of all persons on the Work site or who may be affected by the Work, including, without limitation thereby, employees and representatives of CONTRACTOR, any subcontractor, OWNER, or ENGINEER while they are present and engaged in the performance of their duties on the Work site.

B. Comply with all local, State and Federal rules and regulations related to the protection of persons working or entering into confined spaces including, but not limited to the following:
   1. 29 United States Code §654.
   4. City of Phoenix, Confined Space Program

C. To assure OWNER that CONTRACTOR is complying with the intent of the regulations stated in Paragraph 1.1.A, above, as they relate to the protection of all persons on the Work site, CONTRACTOR’S Safety Plan, at a minimum, respond to the following requirements as they relate to Work in confined spaces:
   1. Conducting a Site-specific hazard assessment to identify confined spaces that should be characterized as “Permit Required Confined Spaces” within the meaning of 29 CFR §1926.21 (b)(6)(i) and 29 CFR §1910.146.
   2. Adopting as an element of its Safety Plan appropriate requirements for safeguarding access to “Permit Required Confined Spaces”.
   3. Providing training, personal protective or safety equipment and personnel as needed to perform the Safety Plan’s requirements for “Permit Required Confined Spaces.”
   4. Performing all record-keeping required for “Permit Required Confined Spaces”, including the required permits and confined space data sheets located in Section 01331, Reference Forms.
1.2 CONFINED SPACES SAFETY PLAN REQUIREMENTS

A. For purposes of the Safety Plan requirements listed in Article 1.1, above, “confined spaces” are those areas on or about the Work site that fall within OSHA’s definition as “any space having limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than four feet in depth such as pits, tubs, vaults, and vessels.”

B. Ensure that those persons who are required to enter a confined space are trained according to OSHA requirements set forth in 29 CFR §1926.21 (b)(6)(i).

C. If the confined space is a “Permit Required Confined Space”, then comply with the standards set forth in 29 CFR §1910.146. and the City of Phoenix, Confined Space Program.

D. “Permit Required Confined Space” means a confined space that has one or more of the following characteristics:

1. Contains or has the potential to contain a hazardous atmosphere.
2. Contains a material that has the potential for engulfing an entrant.
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or floors, or by a floor that slopes downward and tapers to a smaller cross-section.
4. Contains any other recognized serious safety or health hazard.

1.3 SUBMITTALS

A. Prepare and submit a site-specific Confined Space Entry Plan as a portion of the CONTRACTOR’S site-specific Health and Safety Plan.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01416

SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The following types of Work will be subject to Special Inspections, which may be performed by the ENGINEER or the Resident Project Representative, or by such other special inspector as the OWNER may employ:

1. High-Strength Bolting: During all bolt installations and tightening operations.
   a. Exceptions:
      1) The special inspector need not be present during the entire installation and tightening operation, provided he has:
         a) Inspected the surfaces and bolt type for conformance to plans and specifications prior to start of bolting, and "will, upon completion of all bolting, verify the minimum specified bolt tension for ten percent of the bolts for each connection, with a minimum of two bolts per connection".
      2) In bearing-type connections when threads are not required by design to be excluded from the shear plane, inspection prior to or during installation will not be required.

2. Concrete.
3. Reinforcing Steel.
4. Structural Welding.
5. Structural masonry.
7. Polyvinyl chloride liner and epoxy systems for concrete.

1.2 SPECIAL INSPECTOR

A. The special inspector shall be a qualified person who shall demonstrate his competence to the satisfaction of the regulatory authorities for inspection of the particular type of construction or operation requiring special inspection.

1.3 DUTIES AND RESPONSIBILITIES OF SPECIAL INSPECTOR

A. The special inspector shall observe the Work assigned to be certain it conforms to the Contract Documents.
B. The special inspector shall furnish inspection reports to the regulatory authorities, the ENGINEER and other designated persons. All discrepancies shall be brought to the immediate attention of CONTRACTOR for correction, then, if uncorrected, to the ENGINEER and regulatory authorities.

C. The special inspector shall submit a final signed report stating whether the Work requiring special inspection was, to the best of his knowledge, in conformance with the Contract Documents and the applicable workmanship provision of these codes.

1.4 PERIODIC SPECIAL INSPECTIONS

A. Some inspections may be made on a periodic basis and satisfy the requirements of continuous inspection, provided this periodic scheduled inspection is performed as outlined in the Contract Documents and approved by the regulatory authorities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +
SECTION 01420

REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Definitions of basic Contract terms are included in the General Conditions.

B. Definitions of terms commonly found in the Specifications are as follows:

1. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the other Contract Documents. Terms such as “shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference. There is no limitation on the location.

2. Installer (or applicator, or erector): An installer is CONTRACTOR or another entity engaged by CONTRACTOR, either as an employee or subcontractor to perform a particular construction activity, including installation, erection, application or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
   a. The term “experienced”, when used with the term “installer”, means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with the requirements of authorities having jurisdiction and of the Supplier of the product being installed.

3. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”. It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.

4. Assigned Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. Said specialists shall be engaged for those activities, and their engagement is a requirement over which CONTRACTOR has no option. These requirements shall not be interpreted to conflict with the enforcement of building codes and similar regulations governing the Work. Also, they are not intended to interfere with local trade-union jurisdictional settlements and similar conventions. Such assignments shall not relieve CONTRACTOR of its responsibility for fulfilling the requirements of the Contract Documents.
5. Equipment Identification: Several terms define the information attached to equipment.
   a. The term “CMMS Tag” means information attached to equipment pertaining to the City of Phoenix Water Services Department Computerized Maintenance Management System. CMMS Tags shall be provided by the CONTRACTOR. Refer to Section 01630, Equipment Identification Tag System for specifications regarding CMMS Tags.
   b. The term “Manufacturer Nameplate” means information attached to equipment by the manufacturer pertaining to equipment criteria, such as capacity, power supply requirement, model number, etc.

1.2 ABBREVIATIONS

A. Common abbreviations, which may be found in the Specifications, are:

- alternating current: AC
- Ampere: A
- ante meridiem: am
- Average: avg.
- biochemical oxygen demand: BOD
- brake horsepower: BHP
- British thermal unit: BTU
- Centigrade: C
- Company: Co.
- cubic inch: cu. in.
- cubic foot: cu. ft.
- cubic yard: cu. yd.
- cubic feet per minute: cfm
- cubic feet per second: cfs
- Decibel: DB
- degree Centigrade (or Celsius): °C
- degree Fahrenheit: °F
- Diameter: dia.
<table>
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<th>Term</th>
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mercury       Hg
milligram     mg
milligrams per liter mg/l
milliliter    ml
millimeter    mm
million gallons per day mgd
million gallon mil
minimum       min.
National Pipe Threads NPT
net positive suction head npsh
number        No.
ounce         oz
outside diameter OD
parts per million ppm
post meridiem  pm
pound         lb
pounds per square inch psi
pounds per square inch absolute psia
pounds per square inch gage psig
pounds per square foot psf
revolutions per minute rpm
second         sec.
specific gravity sp gr
square         sq
square foot    sq ft
square inch    sq in
square yard    sq yd
standard       std
1.3 APPLICABLE CODES

A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

1. American Association of State Highway and Transportation Officials (AASHTO).
2. American Concrete Institute (ACI).
3. American Gear Manufacturers Association (AGMA).
5. American Iron and Steel Institute (AISI).
7. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
8. American Society of Mechanical Engineers (ASME).
10. American Water Works Association (AWWA).
12. Concrete Reinforcing Steel Institute (CRSI).
13. Factory Mutual (FM).
14. Institute of Electrical and Electronics Engineers (IEEE).
15. National Electrical Manufacturer’s Association (NEMA).
18. Occupational Safety and Health Administration (OSHA).
20. Prestressed Concrete Institute (PCI).
22. All other applicable standards listed in the Specifications and the standards of utility service companies, where applicable.
23. Maricopa Association of Governments (MAG), Uniform Standard Specifications for Public Works Construction, as supplemented by the City of Phoenix. References to MAG Standard Details refer to the “Uniform Standard Details for Public Works Construction” sponsored and distributed by the Maricopa Association of Governments 2015, Arizona.
27. Uniform Building Code as supplemented by the City of Phoenix, Building Construction Code.
30. International Fuel and Gas Code, with City of Phoenix Amendments.
31. International Mechanical Code, with City of Phoenix Amendments.
32. Uniform Plumbing Code, with City of Phoenix Amendments.
33. National Sanitation Foundation (NSF-61) and Arizona Administration Code (AAC # 18-4-213)
   a. Incorporate the requirements NSF-61, Drinking Water System Components Health Effects and AAC # 18-4-213, Standards for Additives, Materials and Equipment on all potable water systems, water treatment facilities and water distribution facilities.

B. To ensure consistent application of standards and codes the following terminology definitions shall be applicable throughout the contract documents.

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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Phoenix Building Code</td>
<td>International Building Code with City of Phoenix Amendments</td>
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<tr>
<td>Phoenix Electrical Code</td>
<td>National Electric Code – NFPA 70 with City of Phoenix Amendments</td>
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<td>Phoenix Fuel and Gas Code</td>
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</table>

1.4 OWNER’S REFERENCE SPECIFICATIONS

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B. Maintain a complete copy of the Reference Specifications on the site.

1.5 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: For applicable publication dates, refer to General Conditions.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer to ENGINEER for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where standards are required to perform a required construction activity, obtain copies of same from the publication source.

E. Abbreviations and Names: Whenever in these Specifications or the other Contract Documents references are made to the standards, specifications, or other published data of international, national, regional or local organizations, such organizations may be referred to by their acronym or abbreviation only. The following acronyms or abbreviations, which may appear in the Specifications, shall have the meanings indicated herein.

1. AA Aluminium Association
2. AABC Associated Air Balance Council
3. AAMA American Architectural Manufacturers Association
4. AASHTO American Association of State Highway and Transportation Officials
5. ACI American Concrete Institute
6. ACS American Chemical Society
7. AFBMA Anti-Friction Bearing Manufacturers’ Association
8. AGMA American Gear Manufacturers Association
9. AI    Asphalt Institute
10. AIChE    American Institute of Chemical Engineers
11. AISC    American Institute of Steel Construction
12. AISI    American Iron and Steel Institute
13. AITC    American Institute of Timber Construction
14. ALS    American Lumber Standards
15. AMA    Acoustical Materials Association
16. AMCA    Air Movement and Control Association
17. ANSI    American National Standards Institute
18. APA    American Plywood Association
19. API    American Petroleum Institute
20. APHA    American Public Health Association
21. AREA    American Railway Engineering Association
22. ARI    Air Conditioning and Refrigeration Institute
23. ASA    American Standards Association
24. ASAE    American Society of Agricultural Engineers
25. ASTM    American Society for Testing and Materials
26. ASCE    American Society of Civil Engineers
27. ASHRAE    American Society of Heating, Refrigerating and Air Conditioning
28. ASME    American Society of Mechanical Engineers
29. AWI    Architectural Woodwork Institute
30. AWPA    American Wood Preservers’ Association
31. AWPB    American Wood Preservers Bureau
32. AWPI    American Wood Preservers’ Institute
33. AWS    American Welding Society
34. AWWA    American Water Works Associations
35. BHMA    Builders Hardware Manufacturers’ Association
36. CBMA    Certified Ballast Manufacturers’ Association
<table>
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<tr>
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<th>Acronym</th>
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<td>37.</td>
<td>CDA</td>
<td>Copper Development Association</td>
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<td>CGA</td>
<td>Compressed Gas Association</td>
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<td>CMAA</td>
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<tr>
<td>50.</td>
<td>HEW</td>
<td>Department of Health, Education and Welfare</td>
</tr>
<tr>
<td>51.</td>
<td>HI</td>
<td>Hydraulic Institute</td>
</tr>
<tr>
<td>52.</td>
<td>HMI</td>
<td>Hoist Manufacturers’ Institute</td>
</tr>
<tr>
<td>53.</td>
<td>HUD</td>
<td>Department of Housing and Urban Development</td>
</tr>
<tr>
<td>54.</td>
<td>ICBO</td>
<td>International Conference of Building Officials</td>
</tr>
<tr>
<td>55.</td>
<td>ICEA</td>
<td>Insulated Cable Engineers’ Association</td>
</tr>
<tr>
<td>56.</td>
<td>IEEE</td>
<td>Institute of Electrical and Electronic Engineers</td>
</tr>
<tr>
<td>57.</td>
<td>IES</td>
<td>Illuminating Engineering Society</td>
</tr>
<tr>
<td>58.</td>
<td>IFI</td>
<td>Industrial Fasteners Institute</td>
</tr>
<tr>
<td>59.</td>
<td>IRI</td>
<td>Industrial Risk Insurers</td>
</tr>
<tr>
<td>60.</td>
<td>ISA</td>
<td>The Instrumentation Systems and Automation Society</td>
</tr>
<tr>
<td>61.</td>
<td>ISO</td>
<td>Insurance Services Office</td>
</tr>
<tr>
<td>62.</td>
<td>MAG</td>
<td>Maricopa Association of Governments</td>
</tr>
<tr>
<td>63.</td>
<td>MIA</td>
<td>Marble Institute of America</td>
</tr>
<tr>
<td>64.</td>
<td>MS</td>
<td>Military Specifications</td>
</tr>
<tr>
<td>No.</td>
<td>Acronym</td>
<td>Organization Name</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>65.</td>
<td>MMA</td>
<td>Monorail Manufacturers’ Association</td>
</tr>
<tr>
<td>66.</td>
<td>NAAMM</td>
<td>National Association of Architectural Metal Manufacturers</td>
</tr>
<tr>
<td>67.</td>
<td>NACE</td>
<td>National Association of Corrosion Engineers</td>
</tr>
<tr>
<td>68.</td>
<td>NARUC</td>
<td>National Association of Railroad and Utilities Commissioners</td>
</tr>
<tr>
<td>69.</td>
<td>NBHA</td>
<td>National Builders Hardware Association</td>
</tr>
<tr>
<td>70.</td>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>71.</td>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>72.</td>
<td>NESC</td>
<td>National Electrical Safety Code</td>
</tr>
<tr>
<td>73.</td>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>74.</td>
<td>NHLA</td>
<td>National Hardwood Lumber Association</td>
</tr>
<tr>
<td>75.</td>
<td>NHPMA</td>
<td>Northern Hardwood and Pine Manufacturer’s Association</td>
</tr>
<tr>
<td>76.</td>
<td>NLMA</td>
<td>National Lumber Manufacturers’ Association</td>
</tr>
<tr>
<td>77.</td>
<td>NRCA</td>
<td>National Roofing Contractors Association</td>
</tr>
<tr>
<td>78.</td>
<td>NSF</td>
<td>National Sanitation Foundation</td>
</tr>
<tr>
<td>79.</td>
<td>NTMA</td>
<td>National Terrazzo and Mosaic Association</td>
</tr>
<tr>
<td>80.</td>
<td>NWWDA</td>
<td>National Wood Window and Door Association</td>
</tr>
<tr>
<td>81.</td>
<td>OECI</td>
<td>Overhead Electrical Crane Institute</td>
</tr>
<tr>
<td>82.</td>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>83.</td>
<td>PCI</td>
<td>Precast Concrete Institute</td>
</tr>
<tr>
<td>84.</td>
<td>PEI</td>
<td>Porcelain Enamel Institute</td>
</tr>
<tr>
<td>85.</td>
<td>PPI</td>
<td>Plastic Pipe Institute</td>
</tr>
<tr>
<td>86.</td>
<td>PS</td>
<td>Product Standards Section-U.S. Department of Commerce</td>
</tr>
<tr>
<td>87.</td>
<td>RMA</td>
<td>Rubber Manufacturers’ Association</td>
</tr>
<tr>
<td>88.</td>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
</tr>
<tr>
<td>89.</td>
<td>SCPRF</td>
<td>Structural Clay Products Research Foundation</td>
</tr>
<tr>
<td>90.</td>
<td>SDI</td>
<td>Steel Deck Institute</td>
</tr>
<tr>
<td>91.</td>
<td>SDI</td>
<td>Steel Door Institute</td>
</tr>
<tr>
<td>92.</td>
<td>SIGMA</td>
<td>Sealed Insulating Glass Manufacturing Association</td>
</tr>
</tbody>
</table>
93. SJI Steel Joist Institute
94. SMACNA Sheet Metal and Air Conditioning National Association
95. SPI Society of the Plastics Industry
96. SSPC The Society for Protective Coatings
97. SWI Steel Window Institute
98. TEMA Tubular Exchanger Manufacturers’ Association
99. TCA Tile Council of America
100. UL Underwriters’ Laboratories, Inc.
101. USGS United States Geological Survey
102. USPHS United States Public Health Service
103. WCLIB West Coast Lumber Inspection Bureau
104. WWEMA Water and Wastewater Equipment Manufacturers Association
105. WWPA Western Wood Products Association

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
Section 01451

Testing Laboratory Services Furnished by Owner

Part 1 - General

1.1 Description

A. The Owner will, through the Engineer, employ and pay for an independent testing laboratory to perform the specified services.

B. The Owner will pay for the testing, except for repeat testing which results from Contractor’s negligence or his repeated failure to meet Contract Document requirements.

C. Contractor shall pay for:
   1. Quality Control sampling and testing of asphalt materials by independent Certified Laboratory during paving operations per MAG Section 321.
   2. Tests made for Contractor’s convenience.
   3. Repeat tests required because of Contractor’s negligence or repeated failure, three or more tests for the same item, to meet Contract Document requirements.

D. The testing laboratory is not authorized to approve or accept any portion of the Work; rescind, alter or augment the requirements of the Contract Documents; or perform any duties of Contractor.

1.2 Qualifications of Laboratory

A. Where applicable, the testing laboratory will meet “Recommended Requirements for Independent Laboratory Qualification”, latest edition, published by American Council of Independent Laboratories and the basic requirements of ASTM E 329 “Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction”.

B. Testing equipment used by the laboratory will be calibrated at maximum twelve month intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

(The remainder of this page was left blank intentionally.)
1.3 LABORATORY DUTIES

A. The testing laboratory shall:
   1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
   2. Perform specified inspections, sampling and testing of materials and methods of construction; comply with applicable standards; and ascertain compliance with requirements of Contract Documents. Comply with City of Phoenix Street Department ACCEPTANCE SAMPLING/TESTING REQUIREMENTS (see EXHIBIT A in Contract Documents).
   3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies of Work that are observed during performance of services.
   4. Promptly submit 1 electronic .pdf copy of reports, inspections, and tests to ENGINEER, including:
      a. Date issued.
      b. Project title and number.
      c. Testing laboratory name and address.
      d. Date of inspection or sampling.
      e. Record of temperature and weather.
      f. Date of test.
      g. Identification of product and Specification Section.
      h. Location in Project.
      i. Type of inspection or test.
      j. Results of tests and observations regarding compliance with Contract Documents.
      k. Approximate station, offset, and depth of test.
   5. Perform additional tests and services, as required by OWNER.

1.4 CONTRACTOR’S RESPONSIBILITIES

A. CONTRACTOR:
   1. Cooperate with laboratory personnel and provide access to Work and to manufacturer’s operations.
   2. Provide to ENGINEER the laboratory the preliminary design mix proposed for concrete and other material mixes that require testing by the testing laboratory.
   3. Furnish labor and facilities:
      a. To provide access to Work to be tested.
      b. To obtain and handle samples at the site.
      c. To facilitate inspections and tests.
   4. Notify ENGINEER 72 hours in-advance of operations to allow for assignment of personnel and scheduling of tests.
5. Arrange with laboratory and pay for additional samples and tests required for CONTRACTOR’S convenience.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01452

TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Employ and pay for an independent testing laboratory to perform the specified services. Laboratory selected shall be subject to approval by the ENGINEER.

1.2 QUALIFICATIONS OF LABORATORY

A. Where applicable, meet “Recommended Requirements for Independent Laboratory Qualification,” latest edition, published by American Council of Independent Laboratories and the basic requirements of ASTM E329, “Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction.” Laboratory shall be authorized to operate in the State of Arizona.

B. Submit 1 electronic copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards, for the most recent tour of inspection, with memorandum of remedies of any deficiencies reported by inspection.

C. Testing Equipment:
   1. Calibrated, at maximum 12-month intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.
   2. Submit copy of certificate of calibration made by an accredited calibration agency.

1.3 LABORATORY DUTIES

A. Perform specified inspections, sampling and testing of asphalt paving materials during construction; comply with applicable standards; and ascertain compliance with requirements of Contract Documents. Comply with City of Phoenix Street Department ACCEPTANCE SAMPLING/TESTING REQUIREMENTS (see EXHIBIT A in Contract Documents).

B. Promptly notify ENGINEER and CONTRACTOR of any irregularities or deficiencies of Work that are observed during performance of services.
C. Promptly submit 1 electronic copy of reports of asphalt paving inspections and tests to ENGINEER, including:
   1. Date issued.
   2. Project title and number.
   3. Testing laboratory name and address.
   4. Name and signature of inspector.
   5. Date of inspection or sampling.
   6. Record of temperature and weather.
   7. Date of test.
   8. Identification of product and Specification Section.
   9. Location in Work.
  10. Type of inspection or test.
  11. Results of tests and observations regarding compliance with Contract Documents.

D. Perform additional tests and services as required by CONTRACTOR to ensure compliance with the Contract Documents.

1.4 CONTRACTOR’S COORDINATION WITH LABORATORY

A. Cooperate with laboratory personnel, and provide access to Work and to manufacturer’s plant operations for sampling and testing of materials.

B. Provide to laboratory representative samples of materials to be tested, in quantities required by the laboratory for testing.

C. Furnish labor and facilities:
   1. To provide access to Work to be tested.
   2. To obtain and handle samples at the site.
   3. To facilitate inspections and tests.
   4. For laboratory’s exclusive use for storage and curing of test samples.
   5. Forms for preparing concrete test beams and cylinders.

D. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.

E. Arrange with laboratory and pay for, additional samples and tests required for CONTRACTOR’S convenience.

1.5 PRODUCT TEST REPORTS

A. Furnish copies of product test reports where required by the Specifications or requested by ENGINEER.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>321, 710, 711</td>
<td>Asphalt Concrete Pavement</td>
<td>Volumetrics, Marshall, Rice &amp; Air Voids</td>
<td>Hot Plant or In Place</td>
<td>One per day’s production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oil Content (Nuclear/ Ignition)</td>
<td>Hot Plant or In Place</td>
<td>One per 350 tons or fraction thereof. Minimum one sample per day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compaction (Nuclear)</td>
<td>Roadway</td>
<td>One per 500 linear feet or fraction thereof for each lift and lane or paver pass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compaction (Nuclear)</td>
<td>Parking Lot</td>
<td>One per 2500 ft² per lift per day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compaction (Core)</td>
<td>In place</td>
<td>Cores will be taken at the discretion of the City of Phoenix Engineer or their representative</td>
</tr>
<tr>
<td></td>
<td>Cold Feed</td>
<td>Gradation</td>
<td>Hot Plant</td>
<td>One sample per day’s production</td>
</tr>
</tbody>
</table>

| 325, 326, 711, 717, 719 | Asphalt Rubber Asphalt Concrete (ARAC), Polymer Modified Asphalt Concrete (PMAC) | Volumetrics, Marshall, Rice & Air Voids | Hot Plant or In Place | One per day’s production |
|                        | Oil Content (Nuclear/ Ignition) | Hot Plant or In Place | One per 350 tons or fraction thereof. Minimum one sample per day |
|                        | Compaction (Nuclear) | Roadway | One per 500 linear feet or fraction thereof for each lift and lane or paver pass |
|                        | Compaction (Nuclear) | Parking Lot | One per 2500 ft² per lift per day |
|                        | Compaction (Core) | In place | Cores will be taken at the discretion of the City of Phoenix Engineer or their representative |
|                        | Cold Feed | Gradation | Hot Plant | One sample per day’s production |

Remarks:
1. All asphalt trench placement under 350 tons shall be sampled and tested at the discretion of a City of Phoenix representative. All asphalt trench placement 350 tons or more will be sampled at the asphalt plant by a City of Phoenix representative. Asphalt trench placement, regardless of tonnage, shall be tested for temperature and compaction during the duration of asphalt placement.
2. All Planning and Development Department (PDD) projects will have a Hot Plant Inspector provided by The City of Phoenix Materials Lab for plant sampling when the cumulative quantity for the project is 350 tons or more per day.
3. Asphalt deficient in oil content and/or density shall be cored 50’ maximum on both sides of failed section when deemed necessary by the City of Phoenix. The results of the 2 cores shall be averaged with the previous test results.
4. Minimum sampling and testing is required for each mix/plant per day.
5. The City of Phoenix Engineer or their representative reserve the right to modify sampling and testing requirements as needed to ensure quality of materials.
6. Asphalt is full time observation (CIP projects only): Technician must verify mix code, test asphalt temperatures, perform nuclear compaction tests and sample asphalt in accordance to appropriate testing and sampling procedures.
### EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

#### TABLE 2
#### CEMENTITIOUS MIXTURES

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>340, 725</td>
<td>Portland Cement Concrete (Flatwork)</td>
<td>Compressive Strength</td>
<td>At discharge</td>
<td>One set of six cylinders per 50 cubic yards or fraction thereof</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slump, Time &amp; Temperature</td>
<td>At discharge</td>
<td>One per set of cylinders</td>
</tr>
<tr>
<td>505, 725</td>
<td>Portland Cement Concrete (Structures)</td>
<td>Compressive Strength</td>
<td>At discharge</td>
<td>One set of six cylinders per structure per 50 cubic yards or fraction thereof</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slump, Time &amp; Temperature</td>
<td>At discharge</td>
<td>One per set of cylinders</td>
</tr>
<tr>
<td>604, 728</td>
<td>Controlled Low Strength Material (CLSM)</td>
<td>Compressive Strength</td>
<td>At discharge</td>
<td>One set of two cylinders⁴</td>
</tr>
<tr>
<td>776</td>
<td>Grout</td>
<td>Compressive Strength</td>
<td>At discharge</td>
<td>One set of four prisms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slump, Time &amp; Temperature</td>
<td>At discharge</td>
<td>One per set of prisms</td>
</tr>
<tr>
<td>776</td>
<td>Mortar</td>
<td>Compressive Strength</td>
<td>At batch site</td>
<td>One set of 6 cylinder or cubes</td>
</tr>
<tr>
<td>525</td>
<td>Shotcrete</td>
<td>Compressive Strength</td>
<td>At discharge</td>
<td>One panel per 50 cubic yards, nozzle man and/or shift (whichever is greater)</td>
</tr>
</tbody>
</table>

**Remarks:**
1. Concrete Specifications: Time in mixer (from batch time to finish unloading) is 90 minutes max; Allowable maximum concrete temperature is 95 degrees Fahrenheit.
2. If in the opinion of the City of Phoenix engineer or their representative, there is sufficient cause to question the quality of the mortar or grout being utilized, random field sampling and testing may be required.
3. Shotcrete test panel forms should be wood or steel and a minimum of 24" x 24" x 4", generally shot in a vertical position.
4. Minimum sampling and testing is required for each mix design/plant per day.
5. The City of Phoenix engineer or their representative reserve the right to modify sampling and testing requirements as needed to ensure quality of materials.
6. Concrete is full time observation (CIP projects only): Technician must verify mix code and plant on every load.
# EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

## TABLE 3

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>Trench Backfill (including lateral trenches)</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 8” lift for every 500 linear feet, per pipe run, or day’s production.</td>
</tr>
<tr>
<td>301, 304</td>
<td>Subgrade (Including Sidewalks)</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 500 linear feet or fraction thereof.</td>
</tr>
<tr>
<td>301</td>
<td>Subgrade (Parking Lot)</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 2500 ft² or fraction thereof.</td>
</tr>
<tr>
<td>340, 206</td>
<td>Slab on Grade (Including Driveways and Ramps)</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 1000 ft² or fraction thereof per slab per lift.</td>
</tr>
<tr>
<td>206, 301, 601</td>
<td>Structure Backfill</td>
<td>Gradation &amp; P.I.</td>
<td>In-Place</td>
<td>One per soil type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 500 linear ft. or fraction thereof per 8” lift per structure.</td>
</tr>
<tr>
<td>211</td>
<td>Roadway Fill &amp; Embankments</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 500 ft. or fraction thereof per 8” lift.</td>
</tr>
<tr>
<td>210</td>
<td>Import(^1)</td>
<td>Proctor Density, Gradation &amp; P.I.</td>
<td>Onsite</td>
<td>One per soil type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specific Gravity</td>
<td>Onsite</td>
<td>At the start of project and as material changes, per supplier/source and/or plant.</td>
</tr>
<tr>
<td>210, 211, 301</td>
<td>Native</td>
<td>Proctor Density, Gradation &amp; P.I.</td>
<td>Onsite</td>
<td>One per soil type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specific Gravity</td>
<td>Onsite</td>
<td>At the start of project and as material changes.</td>
</tr>
</tbody>
</table>

**Remarks:**

1. Import material shall meet the "X" value requirement (Shown in MAG Section 210.2).
2. Asphalt millings are not acceptable for use unless approved by engineer or their representative.
3. For material containing 25% or more rock larger than 6", refer to MAG Section 211.3.
4. The City of Phoenix engineer or their representative reserve the right to modify sampling and testing requirements as needed to ensure quality of materials.
5. For Planning and Development Department (PDD) projects only, testing frequencies are as follows:
   a) Sewer Services & Water Services (30%)
   b) Valley
   d) Dry Utility, Fire Hydrant, Fire Line and Storm Drain (100%)
### EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

#### TABLE 4

**AGGREGATE BASE (AB)**

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>701, 702</td>
<td>Aggregate Base Coarse (ABC)</td>
<td>Proctor Density</td>
<td>Onsite</td>
<td>At the start of project and as material changes, per supplier and/or plant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gradation, PI</td>
<td>Onsite</td>
<td>One per project, per source, and/or one per 1000 tons or fraction thereof.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specific Gravity</td>
<td>Onsite</td>
<td>At the start of project and as material changes, per supplier and/or plant.</td>
</tr>
<tr>
<td>206, 301, 306, 601, 701, 702</td>
<td>Roadway, Pipe Bedding, Trench Backfill</td>
<td>Compaction &amp; Moisture Content</td>
<td>Onsite</td>
<td>One per 500’ or fraction thereof per lift per lane.</td>
</tr>
<tr>
<td>211, 301, 310, 702</td>
<td>Parking Lot</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 2500 ft² or fraction thereof per lift.</td>
</tr>
<tr>
<td>206, 340, 701, 702</td>
<td>Slab on Grade (Including Driveways and Ramps)</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 1000 ft² or fraction thereof per slab per lift.</td>
</tr>
<tr>
<td>206, 301, 601</td>
<td>Structure Backfill</td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One per 8” lift per structure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gradation, PI</td>
<td>Onsite</td>
<td>One per project, per source, and/or one per 1000 tons or fraction thereof.</td>
</tr>
</tbody>
</table>

**Remarks:**
1. Asphalt millings are not acceptable for use as AB.
2. The City of Phoenix engineer or their representative reserve the right to modify sampling and testing requirements as needed to ensure quality of materials.

Revised Date: 5/31/18
<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADOT 241</td>
<td>Cement Stabilized Alluvium (CSA)</td>
<td>Proctor Density, SA, &amp; PI</td>
<td>Point of Placement</td>
<td>At start of production and as material changes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compaction &amp; Moisture Content</td>
<td>In-Place</td>
<td>One every 500 L.F. per lift and per lane pass or one per day’s production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compressive Strength</td>
<td>Point of Placement</td>
<td>One set of 3 per 1500 Cubic Yards or 1 set of 3 per day’s production</td>
</tr>
</tbody>
</table>

Remarks:
1. Maximum of 90 minutes between time of mixing and final mold fabrication.
2. A rock correction shall be used for + #4 material, greater than 10%, to obtain Max Proctor Density.
3. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.
### EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

#### TABLE 6

**REINFORCEMENT**

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>727</td>
<td>Steel Reinforcement</td>
<td>Certificate and/or Tests</td>
<td>Onsite</td>
<td>One sample for each size, grade &amp; heat number per shipment &amp; manufacturer. Certificate required.</td>
</tr>
<tr>
<td></td>
<td>Project Plans &amp; Specifications</td>
<td>Post-Tensioned Steel</td>
<td>On-Site</td>
<td>One sample for each size, grade &amp; heat number per shipment &amp; manufacturer. Certificate required.</td>
</tr>
<tr>
<td></td>
<td>Project Plans &amp; Specifications</td>
<td>Pre-Stressed Steel</td>
<td>Project or Fabrication Plant</td>
<td>One sample for each size, grade &amp; heat number per shipment &amp; manufacturer. Certificate required.</td>
</tr>
</tbody>
</table>

**Remarks:**

1. All steel and iron incorporated into Federal-Aid projects must conform to requirements of "Buy America" per 23 CFR 635.410.
2. The City of Phoenix engineer or their representative reserve the right to modify sampling and testing requirements as needed to ensure quality of materials.
<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADOT 1013-2</td>
<td>Elastomeric Bearing Pad (Grade 0)</td>
<td>ASTM D2240, D412, D573, D395-B, D1149, D746-B, D1043, D429</td>
<td>On-Site</td>
<td>Two Sample Bearing Pads Selected at Random by Engineer from every 100 Bearing Pads or Portion Thereof. Minimum of One Sample per Lot</td>
</tr>
<tr>
<td>ADOT 1013-2</td>
<td>Elastomeric Bearing Pad (Grade 2)</td>
<td>ASTM D2240, D412, D573, D395-B, D1149, D746-B, D1043, D429, D4014</td>
<td>On-Site</td>
<td>Two Sample Bearing Pads Selected at Random by Engineer from every 100 Bearing Pads or Portion Thereof. Minimum of One Sample per Lot</td>
</tr>
<tr>
<td>ADOT 1013-2</td>
<td>Elastomeric Bearing Pad (Grade 3)</td>
<td>ASTM D2240, D412, D573, D395-B, D1149, D746-B, D1043, D429, D4014</td>
<td>On-Site</td>
<td>Two Sample Bearing Pads Selected at Random by Engineer from every 100 Bearing Pads or Portion Thereof. Minimum of One Sample per Lot</td>
</tr>
</tbody>
</table>

Remarks:
1. Two sample bearing pads may be needed to complete the specified testing for smaller bearing pads.
2. Bearing pads will be selected at random by the Engineer at the project site for testing.
3. Bearing pads marked or otherwise presented as test bearing pads will not be tested.
4. Bearing pads must be made available for testing at least four weeks in advance of intended use.
5. Each bearing pad is to be marked in indelible ink or flexible paint. The marking shall consist of the order number, lot number, bearing identification number, and elastomer type and grade number. The marking shall be on the face that is visible after erection of the bridge.
6. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.

Revised Date: 5/31/18
# EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

## TABLE 8
### PIPE

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>743 (ASTM C-700)</td>
<td>Vitrified Clay Pipe (VCP)</td>
<td>Visual Inspection</td>
<td>Pipe Plant</td>
<td>Each pipe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydro Static</td>
<td>Pipe Plant</td>
<td>1 per year, per size and/or at the engineers discretion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shear Load</td>
<td>Pipe Plant</td>
<td>1 per year, per size and/or at the engineers discretion</td>
</tr>
<tr>
<td>759 (AWWA Standard)</td>
<td>Steel Cylinder Pipe (SCP)</td>
<td>Visual Inspection</td>
<td>On-Site / Plant</td>
<td>Per shop drawings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Certification</td>
<td>Pipe Plant</td>
<td>Per lot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydro Static</td>
<td>Pipe Plant</td>
<td>1 per year, per size and/or at the engineers discretion</td>
</tr>
<tr>
<td>735 (ASTM C-76)</td>
<td>Reinforced Concrete Pipe RGRCP</td>
<td>Visual Inspection</td>
<td>Pipe Plant</td>
<td>Each pipe &amp; reinforcing cages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D-Load</td>
<td>Pipe Plant</td>
<td>1 per 100 pipes cast, per size, per day's production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compressive Strength</td>
<td>Pipe Plant</td>
<td>One set of 6 cylinders when required by engineer or their representative.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slump, Time &amp; Temperature</td>
<td>Pipe Plant</td>
<td>When required by engineer or their representative.</td>
</tr>
</tbody>
</table>

**Remarks:**
1. All concrete/clay pipe shall be inspected, tested and marked with the City of Phoenix stamp, before shipment to site.
2. Annual plant inspection by City of Phoenix Materials Lab is required for each production plant.
3. Quarterly quality control inspection by City of Phoenix Materials Lab is required for each production plant.
4. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.
### EXHIBIT A - ACCEPTANCE SAMPLING/TESTING REQUIREMENTS

#### TABLE 9

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>330, 716 SPECIAL PROVISIONS</td>
<td>Aggregates Chip Seal (Roadway)</td>
<td>LA Abrasion</td>
<td>Source or Stockpile</td>
<td>One per source.</td>
</tr>
<tr>
<td></td>
<td>Soundness</td>
<td>Source or Stockpile</td>
<td>One per source.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bulk Specific Gravity</td>
<td>Source or Stockpile</td>
<td>One per source.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fracture Faces</td>
<td>Source or Stockpile</td>
<td>One per source.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gradation</td>
<td>Stockpile</td>
<td>One per weeks production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moisture Content</td>
<td>Stockpile</td>
<td>One per weeks production</td>
<td></td>
</tr>
<tr>
<td>712-1 SPECIAL PROVISIONS</td>
<td>MC-800TR</td>
<td>Application Rate</td>
<td>Surface</td>
<td>One per weeks production</td>
</tr>
<tr>
<td></td>
<td>Bituminous Material</td>
<td>Truck</td>
<td>One per weeks production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yield</td>
<td>Truck</td>
<td>One per days production</td>
<td></td>
</tr>
</tbody>
</table>

### Remarks:
1. Yield to be determined by the City of Phoenix inspector or their designated representative.
2. A split sample of all materials may be required at an interval of one every four weeks.
3. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.
### TABLE 10

**FRACTURED AGGREGATE SURFACE TREATMENT F.A.S.T. (FIELD)**

<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>330, 331, 712, 714, 716, SPECIAL PROVISIONS</td>
<td>Uncoated &amp; Coated Aggregates</td>
<td>Gradation</td>
<td>Stockpile</td>
<td>One per days production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moisture Content</td>
<td>Stockpile</td>
<td>One per days production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rotational Viscosity</td>
<td>Blending Plant</td>
<td>One per batch/blend.</td>
</tr>
<tr>
<td>711, 712, 713, 714, 716, SPECIAL PROVISIONS</td>
<td>Scrub Seal &amp; Modified Asphalt Rubber Binder</td>
<td>Resilience @ 77 Degrees F</td>
<td>Blending Plant</td>
<td>One per days production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cone Penetration @ 77 Degrees F</td>
<td>Blending Plant</td>
<td>One per days production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Softening Point</td>
<td>Blending Plant</td>
<td>One per days production.</td>
</tr>
<tr>
<td>330, 331, 714, 716, SPECIAL PROVISIONS</td>
<td>Asphalt Cement, Virgin Asphalt &amp; Admixtures</td>
<td>PG Grade Asphalt</td>
<td>Blending Plant</td>
<td>One per weeks production or lot.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CRM</td>
<td>Blending Plant</td>
<td>One per weeks production or lot.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polymer Additive</td>
<td>Blending Plant</td>
<td>One per weeks production or lot.</td>
</tr>
</tbody>
</table>

**Remarks:**
1. Design reviewing shall be completed prior to production.
2. A split sample of all materials may be required at an interval of one every four weeks.
3. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.
<table>
<thead>
<tr>
<th>MAG/COP SUPPLEMENTS</th>
<th>MATERIAL</th>
<th>TYPE OF TEST(S) REQUIRED</th>
<th>SAMPLING POINT</th>
<th>MINIMUM SAMPLING/TESTING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>330, 331, 714, 715, 716, Special Provisions</td>
<td>Aggregates</td>
<td>Gradation</td>
<td>Supplier Stockpile</td>
<td>Sampled daily, tested weekly, while in production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moisture Content</td>
<td>Production Stockpile</td>
<td>Sampled daily, tested weekly, while in production.</td>
</tr>
<tr>
<td>330, 331, 714, 715, 716, Special Provisions</td>
<td>Asphalṭic Emulsion</td>
<td>Resilience @ 77 degrees F</td>
<td>Blending Plant</td>
<td>Sampled daily, 1 sample tested weekly, while in production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cone Penetration @ 77 degrees F</td>
<td>Blending Plant</td>
<td>Sampled daily, 1 sample tested weekly, while in production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Softening Point</td>
<td>Blending Plant</td>
<td>Sampled daily, 1 sample tested weekly, while in production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kinematic Viscosity</td>
<td>Blending Plant</td>
<td>Sampled daily, 1 sample tested weekly, while in production.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Penetration @ 39 degrees C</td>
<td>Blending Plant</td>
<td>Sampled daily, 1 sample tested weekly, while in production.</td>
</tr>
<tr>
<td>330, 331, 714, 715, 716, Special Provisions</td>
<td>Application of Material</td>
<td>Application Rate</td>
<td>Roadway</td>
<td>Daily, while in production (on-site)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bituminous Liquid</td>
<td>Truck</td>
<td>Daily, while in production (on-site)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yield</td>
<td>Truck</td>
<td>Daily, while in production (on-site)</td>
</tr>
</tbody>
</table>

Remarks:
1. Design reviewing shall be completed prior to production.
2. A split sample of all materials may be required at an interval of one every four weeks.
3. City of Phoenix reserves the right to modify sampling and testing requirements as needed to ensure quality of materials.
EXHIBIT B - EQUIPMENT, FIELD TESTING & REPORTING REQUIREMENTS

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>TESTING EQUIPMENT REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>At all times, technician must have the following:</td>
<td>Yes</td>
</tr>
<tr>
<td>Calibrated sand cone equipment (sand and cone, jar, plate, calibrated sand)</td>
<td></td>
</tr>
<tr>
<td>Calibrated Speedy moisture gauge equipment (Speedy scale and reagent)</td>
<td></td>
</tr>
<tr>
<td>Calibrated scale(s)</td>
<td></td>
</tr>
<tr>
<td>Equipment to dig sand cone hole (spoon, screw driver, brush, hammer)</td>
<td></td>
</tr>
<tr>
<td>Screens (with acceptable opening tolerances): #10, #4, ¼”, 3” for rock corrections</td>
<td></td>
</tr>
<tr>
<td>Calibrated concrete equipment (slump cone, slump plate, 5/8” diameter rod, 3/8” diameter rod, measuring device, small and large scoop)</td>
<td></td>
</tr>
<tr>
<td>Calibrated one-point Proctor equipment (4” &amp; 6”(if applicable) diameter mold, 5-lb &amp; 10-lb (if applicable) Proctor hammer, metal straight edge, family of curves)</td>
<td></td>
</tr>
<tr>
<td>Calibrated nuclear density gauge (calibrated against sand cone and asphalt cores as required)</td>
<td></td>
</tr>
<tr>
<td>Shovels (square and spade)</td>
<td></td>
</tr>
<tr>
<td>Calibrated thermometers (asphalt and concrete)</td>
<td></td>
</tr>
<tr>
<td>Wheelbarrow</td>
<td></td>
</tr>
<tr>
<td>Sample containers (metal buckets for asphalt, plastic buckets/sample bags for soils, cylinder molds)</td>
<td></td>
</tr>
<tr>
<td>Sample plate for asphalt</td>
<td></td>
</tr>
<tr>
<td>Technician Expectations Packet</td>
<td></td>
</tr>
<tr>
<td>Current City of Phoenix card</td>
<td></td>
</tr>
<tr>
<td>Personal Protective Equipment: hard hat (ANSI/ISEA Z89.1), steel-toed boots (OSHA 1910.136), safety vest (ANSI/ISEA Z107-2004, Class 2 or 3), safety glasses (ANSI/ISEA Z87.1), gloves</td>
<td></td>
</tr>
</tbody>
</table>

Technician Signature: ____________________________

City of Phoenix Representative: ____________________

Notes: ____________________________________________

____________________________

Revised Date: 8/3/18
### EXHIBIT B - EQUIPMENT REQUIREMENTS

#### TABLE 2

<table>
<thead>
<tr>
<th>TESTING EQUIPMENT REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>At all times, technician must have the following:</td>
</tr>
<tr>
<td>Calibrated sand cone equipment (sand and cone, jar, plate, calibrated sand)</td>
</tr>
<tr>
<td>Calibrated Speedy moisture gauge equipment (Speedy scale and reagent)</td>
</tr>
<tr>
<td>Calibrated scale(s)</td>
</tr>
<tr>
<td>Equipment to dig sand cone hole (spoon, screw driver, brush, hammer)</td>
</tr>
<tr>
<td>Screens (with acceptable opening tolerances): #10, #4, ¾”, 3” for rock corrections</td>
</tr>
<tr>
<td>Calibrated concrete equipment (slump cone, slump plate, 5/8” diameter rod, 3/8” diameter rod, measuring device, small and large scoop)</td>
</tr>
<tr>
<td>Calibrated one-point Proctor equipment (4” &amp; 6” (when applicable) diameter mold, 5-lb &amp; 10-lb (when applicable) Proctor hammer, metal straight edge, family of curves)</td>
</tr>
<tr>
<td>Calibrated nuclear density gauge (calibrated against sand cone and asphalt cores as required)</td>
</tr>
<tr>
<td>Shovels (square and spade)</td>
</tr>
<tr>
<td>Calibrated thermometers (asphalt and concrete)</td>
</tr>
<tr>
<td>Wheelbarrow</td>
</tr>
<tr>
<td>Sample containers (metal buckets for asphalt, plastic buckets/sample bags for soils, cylinder molds)</td>
</tr>
<tr>
<td>Sample plate for asphalt</td>
</tr>
<tr>
<td>Technician Expectations Packet</td>
</tr>
<tr>
<td>Current City of Phoenix card</td>
</tr>
<tr>
<td>Personal Protective Equipment: hard hat (ANSI/ISEA Z89.1), steel-toed boots (OSHA 1910.136), safety vest (ANSI/ISEA Z107-2004, Class 2 or 3), safety glasses (ANSI/ISEA Z87.1), gloves</td>
</tr>
</tbody>
</table>

Revised Date: 8/3/18
REPORTING REQUIREMENTS

The daily inspection report is to include the number of hours on site and the type of tests performed and shall be turned in by the next working day. Paperwork shall be filled out completely & correctly, (including sample cards).

Daily inspection report is to include what was observed, means and methods used by the contractor to perform the work. (Example: what type of equipment, how many passes, moisture processing, concrete consolidation and placement methods, etc.)

Handwritten and/or incomplete paperwork submissions will not be accepted and shall be returned.

At all times keep City of Phoenix Materials Lab staff informed and involved as to what is happening on your projects either by phone, face to face communications, or on your daily reports.

Any changes made to specifications by the City of Phoenix inspection team shall be noted on your daily report. Provide the name of City Inspector and the directive that was given.

The same technician shall be maintained on a project. The City of Phoenix Materials Lab is to be notified of any substitutions prior to reassignments.

City of Phoenix Materials Lab contact information:

Asphalt Lab: (602) 495-2074  Soils Lab: (602) 495-5318  Concrete Lab: (602) 534-7076

Rob Duvall, Materials Supervisor (Field):  Cell (602) 448-9191  robert.duvall@phoenix.gov

Andrea Lynch, Materials Supervisor (Lab):  Desk (602) 495-2070  Cell (602) 819-3201  andrea.lynch@phoenix.gov
A Minimum Testing Schedule is to be created and submitted to the City of Phoenix Materials Lab within 3 business days of project assignment. Testing frequencies are to be calculated using an approved set of plans in conjunction with the bid tab items to create an accurate representation of the minimum testing needed for the project. Any notes, comments, special circumstances and/or assumptions made for quantity calculations should be listed at the bottom of the page.

**Final Report Should Include the Following:**

All laboratories must submit a Final Report after the completion of each project. Laboratories will be notified by the City of Phoenix Materials Lab, via email, that the project is complete and all lab results for soils, concrete & asphalt will be attached. A CD or USB drive and a hard copy of the final report must be delivered to the City of Phoenix Materials Lab within 5 business days from the date of the email notification.

Final reports are to include all field and lab tests/results, daily reports and samples taken for the entire project. **All final reports must be stamped and signed by a registered professional engineer** and shall verify that all materials, sampled and tested, were found to be in compliance with the latest City of Phoenix Standards and Specifications. Construction materials that fail to meet specification requirements, but were incorporated in the project, must be summarized in the final report with a detailed explanation listing penalties, corrective actions, or justification for acceptance.

<table>
<thead>
<tr>
<th>TABLE 4A</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM TEST SCHEDULE &amp; FINAL REPORT</td>
</tr>
</tbody>
</table>

**Minimum Testing Schedule:**

A Minimum Testing Schedule shall be created and submitted to the City of Phoenix PDD Inspector, during the pre-construction meeting. Testing frequencies are to be calculated using an approved set of plans, in conjunction with the bid tab items, to create an accurate representation of the minimum testing needed for the project. Any notes, comments, special circumstances and/or assumptions made for quantity calculations, should be listed at the bottom of the page.

**Final Report Should Include the Following:**

All laboratories must submit a Final Report at the completion of each project. A spiral bound copy of the Final Report must be delivered to the City of Phoenix PDD Inspector along with final record drawings of the project.

Final Reports shall include all field and lab tests/results (including any acceptance/deficiency test results from the City of Phoenix Materials Lab), daily reports and samples taken for the entire project. **All Final Reports must be stamped and signed by a registered professional engineer** and shall verify that all materials, sampled and tested, were found to be in compliance with the latest City of Phoenix Standards and Specifications. Construction materials that fail to meet specification requirements, but were incorporated in the project, must be summarized in the final report with a detailed explanation listing penalties, corrective actions, or justification for acceptance.
SECTION 01521

ENGINEER’S FIELD OFFICE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish, install, and maintain the field office, furnishings, and equipment for ENGINEER. Locate office near CONTRACTOR’S office in a location approved by ENGINEER. Provide office complete within 2 weeks after the Notice-to-Proceed.

B. Allocate 4 reserved parking spaces marked for use by the ENGINEER and OWNER. Reserved parking spaces shall be adjacent to ENGINEER’S field office and shall be graded and topped with gravel or paved.

C. The office shall be separate from all CONTRACTOR’S offices.

D. Pay for any permits that may be required.

E. Complete layout of office shall be submitted to the ENGINEER for approval.

F. Field office security shall be the responsibility of CONTRACTOR. Deliver 4 field office door keys and all furniture keys to ENGINEER upon installation of field office to site.

1.2 MINIMUM CONSTRUCTION

A. Mobile 1 office trailer in first class, new, condition acceptable to ENGINEER, which is specifically designed for this type of use and conforms to requirements above and below. Provide trailer by Pac-Van, GE Modular Space, or approved equal.

B. Concrete or boardwalk steps, landings and sidewalks of four feet minimum width for complete access to field office. Access to the office must comply with ADA (Americans with Disabilities Act) Standards, as applicable. Access doors shall be furnished with locking security bar doors as approved by the ENGINEER.
C. Completely weather tight and insulated.

D. Exterior finish acceptable to ENGINEER.

E. All interior finishes acceptable to ENGINEER.

F. Resilient floor covering in new condition.

G. Area: consisting of 2 offices, conference room, lavatories and work areas. Interior layout shall be as directed by the ENGINEER.

Windows: Ten percent of floor area with operable sash and screens. Windows shall be furnished with locks and exterior security bars approved by the ENGINEER. All windows shall be equipped with operable venetian blinds. All offices shall be furnished with a window.

1.3 MINIMUM SERVICES

A. Interior lighting of 50 foot candles at desktop height.

B. Exterior light at entrance(s) and at parking areas.

C. Automatic heating to maintain 75°F in winter. Furnish and pay for all fuel/electric.

D. Automatic cooling to maintain 70°F in summer. Furnish and pay for all fuel/electric.

E. Continuous electric service required and pay all charges.

F. A minimum of 12 electric duplex receptacle wall outlets that are accessible from six feet along any wall.

G. Provide continuous Internet and DSL service with all associated equipment within 14 days after Notice to Proceed, and configure Internet and DSL so service is available by all workstations.

H. One bottled water coolers with chilled and hot drinking water and cups. Supply bottled water and cups as required for the duration of the Contract.

I. Private sanitary facilities with one water closet, one lavatory, with hot and cold running water, medicine cabinet with mirror, one tissue paper holder and one paper towel holder. Supply tissue paper, hand soap and paper towels as required for the duration of the Contract.

J. All plumbing facilities and sewers required in accordance with local codes. Protect from freezing.
K. One new color copy machine, with document feeder, or approved equal, with reduction, enlargement, auto-document feed, auto stapler function, high capacity feeder, bypass tray, four paper trays, top tray, stacker tray, sorting capability. Provide service, warranty (including toner and replacement cartridges) and maintenance for the duration of the Contract. Provide 8-1/2-inch by 11-inch, and 11-inch by 17-inch copy paper for the duration of the Contract. Copier shall make copies and produce scanned color .PDF documents up to 11-inch by 17-inch copies. Copier shall copy at a rate no slower than 40 copies per minute.

L. Potable water hose bibb with 20 feet of hose and nozzle connected to potable water supply near main entrance to ENGINEER’S trailer.

M. For parking lot security lighting: Provide two pole mounted fixtures, 1000W each with photo cell control. Location to be determined by ENGINEER.

1.4 MINIMUM FURNISHINGS (NEW)

A. Field Office Furniture: Lease (or purchase) and install the following equipment for the duration of the Contract:

1. Furnishings for each individual office (--2--) offices total):
   a. One desk, 36-inches wide by 72-inches long table top with locking lap and 5-side drawers.
   b. One computer workstation, 29-inches high by 30-inches wide by 60-inches long, similar to Lit-Ning Adjustable Workstations, or approved equal.
   c. One 4-drawer locking legal size filing cabinet.
   d. One 6-shelve bookcase, 36-inches wide by 84-inches high by 12-inches deep.
   e. One cushioned swivel arm chair and two cushioned folding chairs.
   f. One 48-inches by 36-inches liquid marking board with two sets of compatible markers (six colors and one eraser per set).
   g. One standard size wastepaper basket.

2. Furnishings to be provided with conference room shall include:
   a. Two 30-inches by 96-inches folding tables.
   b. Two 30-inches by 72-inches folding tables.
   c. Twelve upholstered executive high-back chairs with cushioned seat and back, five-star base, wheels, arms, swivel, tilt control conference chairs.
   d. Two 48-inches by 60-inches liquid marking board with two sets of compatible markers (four colors and one eraser per set).
   e. One 48-inches by 60-inches cork bulletin board.
   f. One metal plan rack roller mounted, with 12 top mounted swivel type plan holders for 36-inches by 24-inches plan sheets.
   g. Two standard size wastepaper baskets.
3. General furnishings to be provided for hallways and other areas:
   a. Two folding reference tables, 30-inches wide by 72-inches long.
   b. Three standard size wastepaper baskets.
   c. Ten-pound ABC approved fire extinguishers (number as required by Phoenix Building Code).
   d. One OSHA approved first aid kit, Johnson & Johnson Model No. 8161, or approved equal.
   e. One standard size wastepaper basket.
   f. One water closet accessible to handicap with grab bars.
   g. One toilet paper and paper towel dispenser.
   h. One 8-inch ceiling mounted exhaust fan, 60 cfm, Marlite.
   i. Vinyl cove base on wall.
   j. One wastebasket.
   k. Provide paper products and sanitizing soap for the duration of the Contract.

B. Smoke detectors (number as required by Phoenix Building Code).

C. Identifying exterior sign, professionally lettered, at least 24-inches by 36-inches, with wording acceptable to ENGINEER.

D. Maximum-Minimum outdoor thermometer mounted in shade, but visible for easy reading from inside office. Location to be determined by ENGINEER. Provide Fischer Scientific Model No. 15-091, or approved equal.

E. Lockable closet for storing instruments.

F. Walk-off mats at all entrances.

G. Furnish and install a new complete computer system ready to operate. This system will consist of 1 new complete IBM compatible personal computers and 1 printer connected in a network. Each computer shall be able to access the other computers. They shall be able to share files and make use of the phone lines and printers.

        Provide continuous Internet and DSL service with all associated equipment. Configure Internet and DSL so service is available by all workstations.

H. Furnish office supplies, consumables, and service contracts for office and communications equipment for the duration of the Contract.
1.5 MAINTENANCE

A. Continuous maintenance of office and services. Cleaned not less than once per week.

B. Provide soap, paper towels, toilet tissues, cleansers, sanitary supplies, janitorial service (including vacuuming, washing floors, and cleaning toilets weekly) and implements.

C. Repair immediately any damage, leaks or defective service.

D. Maintenance shall be for the duration of the Contract.

E. Provide maintenance contract for the items described in Paragraphs 1.3.G., 1.3.K., and 1.6 for the duration of the Contract. Also, provide a 24-hour response, service contract, for equipment with a minimum of eight hours pre-paid service per month.

1.6 PROVISIONS

A. All items shall be furnished and maintained by CONTRACTOR from two weeks following Notice to Proceed to the date of Final Acceptance. The cost of these items shall be considered incidental to the cost of the Project. No separate measurement of payment shall be made for these items.

1.7 REMOVAL

A. The office, together with the equipment, furnishings and facilities thereof, except miscellaneous small supplies shall become the property of CONTRACTOR and shall be removed from the site of the Work upon OWNER Acceptance of the Project or when directed by ENGINEER.

B. At the completion of the Project, filing cabinets shall become the property of the CONTRACTOR.

C. At the completion of the Project, the ENGINEER and OWNER will return field office keys to CONTRACTOR.

D. Remove underground installations to minimum depth of 24-inches and grade to match surrounding conditions.

E. Restore existing facilities used during construction to specified or original condition.
PART 2 - PRODUCTS (NOT USED)

A. All materials or products which can contact drinking water or a water treatment chemical furnished and installed under this section, shall require NSF/ANSI 61, drinking water system components health effects, approval or comply with Arizona Administrative Code R18-4-119, standards for additives, materials, and equipment.

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all temporary construction roads, walks and parking areas required during the construction and for use of emergency vehicles. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR so as to be fully usable in all weather conditions.

B. Prevent interference with traffic and the OWNER’S operations on existing roads. Indemnify and save harmless the OWNER from any expenses caused by CONTRACTOR’S operations over these roads.

C. Roadway damage shall be restored to the original condition by CONTRACTOR subject to approval of the OWNER or ENGINEER.

D. Temporary roads, walks and parking areas shall be removed by CONTRACTOR, prior to Final Acceptance, and the ground returned to its original condition, unless otherwise required by the Contract Documents.

1.2 DESIGNATED PARKING

A. All CONTRACTOR’S employee vehicles shall park in an area specifically designated for that purpose, as more fully described in Section 01561, Security.

1.3 MAINTENANCE OF ROADS

A. At all times maintain approved access for trucks to loading areas of the plant and parking facilities for plant personnel. All parking of construction vehicles shall be in approved lots.

B. Have all paved roads swept by mechanical sweeper, a minimum 5 times a week or as directed by the ENGINEER. Keep roads serviceable at all times. Specific roads include:
   1. All roads within the limits of this Contract.
   2. Plant roads from entrance to work parking and work sites.
C. Dust resulting from construction shall be controlled by CONTRACTOR to prevent a nuisance on the site or in adjacent areas. Apply water or use other methods subject to the ENGINEER’S approval, which will keep dust in the air to a minimum. Use of water will not be permitted when it results in hazardous or objectionable conditions such as ice, mud, ponds and pollution, refer to Section 01414, Earthmoving and Dust Control.

D. Provide temporary heavy duty steel roadway plates to protect existing manholes, handholes, valve boxes and vaults.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01551

MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 - GENERAL

1.1 SEQUENCE OF CONSTRUCTION

A. The sequence of construction will conform to the requirements of the Special Traffic Regulations.

B. The project will follow a phasing plan approved by the Engineer. All lanes will be maintained on a paved surface at all times during construction. This may be accomplished by using existing, new, or temporary asphalt pavement. Trenches will be completely backfilled and either paved with temporary asphalt pavement, or covered with metal plating as necessary to comply with this requirement and the "Special Traffic Regulations".

C. Night work will not be allowed on this project.

D. The right to direct the sequence of construction is a function vested solely with the Engineer. Prior to commencement of the work, the Contractor will prepare and submit to the Engineer, a written phasing plan and work schedule for the project. This plan and work schedule will be submitted to the Engineer at the Preconstruction Conference for review.

E. When approved, the phasing plan and work schedule will not be changed without the written consent of the Engineer. Orderly procedure of all work to be performed under this contract will be the full responsibility of the Contractor. The work schedule will include the hours per day and the days per week that the Contractor plans to work on the project site.

1.2 TRAFFIC REGULATIONS

A. The following will be considered major streets:

   W. CAREFREE HIGHWAY
   NORTH VALLEY PARKWAY
   N. GAVILAN PEAK PARKWAY

The following will be considered collector streets:

   W. CLOUD ROAD
   W. PIONEER ROAD
B. All traffic and/or traffic control devices on this project will be provided, maintained and/or controlled as specified in the City of Phoenix Traffic Barricade Manual, 2007 edition, Maricopa County Department of Transportation Traffic Control Manual, and addendums thereof.

C. Permission to restrict City streets, sidewalks and alleys (street closure permits) will be requested as specified in Chapter 2 of the City of Phoenix Traffic Barricade Manual, 2007 edition, Maricopa County Department of Transportation Traffic Control Manual, and addendums thereof.

D. Unless otherwise provided for in the following "Special Traffic Regulations", all traffic on this project will be regulated as specified in Chapter 2 of the City of Phoenix Traffic Barricade Manual, 2007 edition, Maricopa County Department of Transportation Traffic Control Manual, and addendums thereof.

E. No deviation from the "Special Traffic Regulations" will be allowed or implemented unless submitted to the Engineer for review and approval at least 14 days prior to proposed work.

F. Only City of Phoenix certified contractors can set, move or remove temporary traffic control devices (signs, barricades, etc.). This annual certification can be scheduled by calling 602-262-6235.

G. Civil sanctions for temporary traffic control violations apply as follows:

<table>
<thead>
<tr>
<th>Civil Sanction Per Day</th>
<th>Violation Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,500</td>
<td>Creating an eminent risk of death or injury to the public within the public right-of-way</td>
</tr>
<tr>
<td>$1,000</td>
<td>Restricting the right-of-way without proper certification or a right-of-way temporary use permit</td>
</tr>
<tr>
<td>$1,000</td>
<td>Restricting traffic during peak traffic hours as described in the Traffic Barricade Manual without authorization</td>
</tr>
<tr>
<td>$1,000</td>
<td>Failing to correct or cure a violation, as listed in this table, within the time period stated on the warning notice</td>
</tr>
<tr>
<td>$1,000</td>
<td>Restricting traffic at signalized intersections without any work occurring</td>
</tr>
<tr>
<td>$500</td>
<td>Closing a sidewalk improperly or closing a sidewalk without proper</td>
</tr>
</tbody>
</table>
certification or closing a sidewalk without a right-of-way temporary use permit

$500 Violating the restriction limits, times and locations, of the right-of-way temporary use permit

$500 Missing or improper use of advance warning signs

$500 Missing or improper use of barricades and channelizing devices

$250 Leaving advanced warning signs facing traffic after restriction has been removed – per one traffic direction

$250 Leaving traffic control devices in the right-of-way twenty-four hours after right-of-way temporary use permit expires, unless a request for a permit extension is received by the City prior to the expiration of such permit

$250 Use of “unacceptable” quality traffic control devices as described in the Traffic Barricade Manual

$250 Rendering a bus stop inaccessible without relocating it or making other accommodations

H. The City has the authority to remove and store temporary traffic control devices in emergency situations or as a last resort if the barricade owner will not pick them up. The City will assess removal and storage fees accordingly.

1.3 SPECIAL TRAFFIC REGULATIONS

The Contractor shall be responsible to submit the traffic control plan to the Engineer for approval a minimum of 72 hours prior to the date of restriction. The traffic control plan shall be coordinated with sewer installation operations and project schedule. No two adjacent major signalized intersections shall be restricted at the same time. The following major streets on this project can be restricted as follows:

A. **W. CAREFREE HIGHWAY: N. VIA PUZZOLA TO BLACK CANYON FREEWAY**

W. CAREFREE HIGHWAY can be reduced, when construction requires, during the times indicated below: Maintain two lanes (one each way) plus left and right turn lanes at signalized intersections from 8:30 a.m. to 4:00 p.m. weekdays and during working hours on weekends.

B. **N. GAVILAN PEAK PARKWAY: APPROXIMATELY STATION 39+40 TO W. PIONEER ROAD**

N. GAVILAN PEAK PARKWAY can be reduced, when construction requires, during the times indicated below:
C. **N. VALLEY PARKWAY: W. CAREFREE HIGHWAY TO APPROXIMATELY STATION 39+40**

   N. VALLEY PARKWAY can be reduced, when construction requires, during the times indicated below:
   Maintain two lanes (one each way) plus left and right turn lanes at signalized intersections from 8:30 a.m. to 4:00 p.m. weekdays and during working hours on weekends.

D. **W. CLOUD ROAD: N. VALLEY PARKWAY TO N. 34th AVENUE**

   W. CLOUD ROAD can be reduced, when construction requires, during the times indicated below:
   Maintain two lanes (one each way) from 8:30 a.m. to 4:00 p.m. weekdays and during working hours on weekends.

**W. PIONEER ROAD:**

   W. PIONEER ROAD. Two-way traffic shall be maintained at all times. Flagging operation allows 8:30 a.m. to 4:00 p.m. weekdays or 7 A.M. – 5 P.M. weekends. All other times maintain 1 lane in each direction.

E. **W. CAREFREE HIGHWAY AND N. VALLEY PARKWAY INTERSECTION**

   Intersection work requiring major restrictions will be required to be performed on weekends, (when permitted) and/or on extended weekends. Type of traffic restrictions for this work will be as directed by City of Phoenix Street Transportation Department during this time period.

1.4 **PORTABLE VARIABLE MESSAGE BOARDS**

   Portable Variable Message Boards (VMB) will be provided on this project 24 hours per day, from at least 14 days prior to any roadway restrictions until all roadway traffic restrictions are removed. Portable Variable Message Boards (VMB) shall be placed as indicated on the Contractor’s required traffic control plan and as directed by City of Phoenix Street Transportation Department, Maricopa County Department of Transportation Department (MCDOT), and Arizona Department of Transportation (ADOT).

1.5 **POLICE OFFICER REQUIREMENTS**

   The Contractor will provide one off-duty police officer, as defined in the City of Phoenix Traffic Barricade Manual, 2007 edition, at signalized intersections affected from 6:00 a.m. to 7:00 p.m. weekdays, and during working hours nights and
weekends when traffic is restricted (as described in the City of Phoenix Traffic Barricade Manual, 2007 edition).

When construction activities do not restrict traffic through the intersections, police officer hours may be reduced or suspended at the direction of the Engineer.

1.6 SIGNALIZED INTERSECTION REQUIREMENTS

The Contractor will notify the Engineer and the City Traffic Signal Shop (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 will 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 will immediately notify the Traffic Signal Shop.**

1.7 TRAFFIC SIGNAL HEAD VISIBILITY REQUIREMENTS

The Contractor will maintain a 40-degree “cone of vision” 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 an angle no greater than 20-degrees either side of the straight-ahead position (40-degree cone of vision). If the traffic control setup cannot provide the required 20-degree cone of vision, the Contractor will immediately contact the City Traffic Signal Engineer at (602) 262-4693 for instructions prior to initiation of any work.
Figure 4D-2. Horizontal Location of Signal Faces

Location of signal heads within these areas:

- 200 mm (8 in) or 300 mm (12 in) signal lenses
- 300 mm (12 in) signal lenses, unless a near-side signal face is used
- 300 mm (12 in) signal lenses

* Minimum distance of signal faces from stop line.

** Maximum distance from stop line for 200 mm (8 in) signal faces, unless a near-side signal face is used.

*** Maximum distance from stop line for 200 mm (8 in) signal faces when near-side supplemental signal face is used.

**** Maximum distance from stop line for 300 mm (12 in) signal faces, unless a near-side supplemental signal face is used.
1.8 LOCAL ACCESS REQUIREMENTS

The Contractor will maintain local access to all side streets, access roads driveways, alleys, and parking lots at all times and will notify residents 72 hours in advance of any restrictions which will affect their access. The Contractor will restore the access as soon as possible. If the primary access cannot be restored in a timely manner, the Contractor will provide an alternative which will be pre-determined with the residents prior to imposing any restrictions. Any local street restrictions imposed will be such that local area traffic circulation is maintained.

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 great 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.

1.9 BUSINESS ACCESS REQUIREMENTS

Access will be maintained to adjacent businesses at all times during their hours of operation. Access may be maintained by such measures as constructing driveways in half sections, or by providing bridging over new concrete. Properties with multiple driveway access will not have more than one driveway access restricted at any given time. While the one driveway is restricted, access to the other adjacent driveways will be maintained and unrestricted. Each individual driveway access restriction will be no more than fourteen (14) calendar days. Any business restrictions will be coordinated with the affected business in writing at least fourteen (14) days prior to imposing restrictions.

2.0 PEDESTRIAN ACCESS REQUIREMENTS

The Contractor shall ensure that all sidewalks on this project remain in compliance with all the issues outlined by the American Disabilities Act of 1990, including all changes made by ADA Amendments to-date. All pedestrian-walking areas, whether paved or unpaved, shall be maintained open and safely or a suitable pedestrian detour route will be provided. Such measures as backfilling or ramping at a 12:1 slope 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, and/or covered pedestrian walkways to be installed at no additional cost to the City. Right-of-Way Management
representative(s) may also request an ADA/Pedestrian plan for any proposed sidewalk restrictions or closures. In addition, diversions shall conform to Figure 401-1.
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 COP 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 602-262-4482 or Luiz Moreno at 602-262-6565.

Sincerely,

[Signature]

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 2007 TRAFFIC BARRICADE MANUAL
2.1 **FRONTAGE ROAD ACCESS REQUIREMENTS**

Local access will be maintained at all times on frontage roads. Frontage roads will not be used for through traffic, equipment parking, material storage, or spoil stockpile area. Frontage road closures will follow the same special provisions as described in "Local Access Requirements".

2.2 **SCHOOL ACCESS REQUIREMENTS**

The Contractor will provide clean and safe school zones, crosswalks, and walkways for students attending nearby schools during all hours of school use. This may require backfilling trenches, temporary pavement, shoring, plating, or pedestrian bridges with handrails across open trenches. In addition to school zones and crosswalks, the Contractor will maintain accessibility to all school bus routes during all hours of school use. The Contractor will notify the school principal(s) and the school Transportation Director at least fourteen (14) days prior to any restrictions, and will restore access as soon as possible.

2.3 **CHURCH ACCESS REQUIREMENTS**

The Contractor will maintain a high level of access to churches during all hours of church use. The Contractor will coordinate any access restrictions with the clergy at least fourteen (14) days prior to any restrictions, and will restore access as soon as possible.

2.4 **HOSPITAL ACCESS REQUIREMENTS**

The Contractor will maintain the Emergency entrance to nearby Hospital by way of a paved lane for emergency vehicles at all times for the duration of the project. The Contractor will coordinate any access restrictions with the hospital administrator at least fourteen (14) days prior to any restrictions, and will restore access as soon as possible.

2.5 **FIRE STATION AND POLICE STATION ACCESS REQUIREMENTS**

The Contractor will maintain paved emergency vehicle access to and from all fire stations and police stations at all times. The Contractor will coordinate with the Fire Station and/or Police Station Commander at least fourteen (14) calendar days prior to any restrictions, and again at least 72 hours prior to any restrictions, and will restore full access as soon as possible.

2.6 **CITY PARK ACCESS REQUIREMENTS**

The Contractor will maintain access to all nearby parks during all hours of park use. Any restrictions will be coordinated with the appropriate Parks District Supervisor at
least fourteen (14) days in advance of any restrictions, and full access will be restored as soon as possible.

2.7 RECREATIONAL TRAIL CROSSING

The Contractor will maintain trail crossings at all times, and will maintain all special trail signs required.

2.8 CANAL ACCESS ROAD REQUIREMENTS

Canal access and maintenance roads will remain open at all times. Contractor shall coordinate any work that may impact this project with appropriate Agency contact as least fourteen (14) working days in advance of operations.

2.9 COORDINATION WITH OTHER AGENGY PROJECTS

The Contractor will coordinate and schedule work to minimize disruption or conflicts with other Agency projects. Any work that may affect this project will be coordinated with the appropriate Agency contact at least fourteen (14) days in advance.

3.0 SANITATION PICK-UP

The Contractor will provide sanitation pick-up for affected residents by relocating trash containers, or by providing alternative measures acceptable to the Public Works Department, Sanitation Division (602) 256-3310.

3.1 US POSTAL SERVICE

Contractor shall maintain mail delivery vehicle access at all times. Any restrictions shall be coordinated with the mail stations prior to implementing restriction.

3.2 SPECIAL EVENTS

There are no known special events scheduled to take place during the construction of this project. However, Contractor will coordinate any events with the construction schedule. No additional compensation for delays associated with special events will be considered.

3.3 SPECIAL SIGN REQUIREMENTS

The Contractor will provide, install and maintain advance notification; public informational; and directional access signs (for businesses, churches, hospitals, schools, etc.) that may be required by the Engineer. These signs may include, but are not limited to portable changeable message signs, radar/speed sensing trailers and
other applicable Intelligent Transportation System type devices. The cost will be included in the bid item for Traffic Control Devices.

3.4 BUS STOPS

The Contractor will maintain all existing bus stop locations on this project in a safe manner, or provide alternate bus stop locations and related directional signage as required by the Engineer. Not fulfilling this requirement can lead to civil sanctions.

3.5 FLAGGING OF TRAFFIC

If construction requires, flagging may be allowed from 8:30 a.m. to 4:00 p.m. weekdays or 7 A.M. – 5 P.M. Weekends on W. Cloud Road and Pioneer Road, (Collector Streets).

3.6 TRAFFIC CONTROL PLAN

The Contractor will submit a traffic control plan for approval, showing placement of all traffic control devices, including all conflicting signs to be covered/removed or relocated, or other features that may conflict with the placement of temporary signage. This plan will be professionally drawn on a 24” x 36” reproducible medium, and will be submitted to the Engineer at the Pre-Construction meeting or before. The Contractor will allow the Engineer fourteen (14) calendar days for review and approval of an acceptable plan.

3.7 TEMPORARY TRAFFIC CONTROL ZONE AND SAFETY

At the Pre-Construction conference, the Contractor will designate an employee, other than the Project Superintendent, who is knowledgeable in the principles and methods of proper traffic control and safety. This employee will be available on the project site during all periods of construction to coordinate and maintain safe, acceptable and effective temporary barricading whenever construction affects traffic. This person will be authorized to receive and fulfill instructions from the Engineer and will supervise and direct traffic control. Instructions and information given by the Engineer to this person will be considered as having been given to the Contractor.

Failure to maintain temporary traffic control devices in accordance with the City of Phoenix Traffic Barricade Manual, 2007 edition, the approved Traffic Control Plan, and directives by the Engineer will result in suspension of work and/or civil sanctions until deficiencies are corrected to the satisfaction of the Engineer.
3.8 SAFETY FENCING REQUIREMENTS FOR TRENCHES AND EXCAVATIONS

The Contractor will provide safety construction fencing around all open trenches and excavations during all non-working hours. The Contractor will provide for the safety and welfare of the general public by adequately fencing all excavations and trenches that are permitted by the Engineer to remain open when construction is not in progress. Fencing will be securely anchored to approved steel posts located six (6) feet on centers, having a minimum height of six (6) feet, and will consist of wire mesh fabric of sufficient weight and rigidity to adequately span a maximum supporting post separation of six (6) feet. The fencing, when installed about the periphery of excavations and trenches, will form an effective barrier against intrusion by the general public into areas of construction. Fencing will not create sight distance restrictions or visual obstructions. At all times when construction is not in progress, the Contractor will be responsible for maintaining the fencing in good repair, and upon notification by the Engineer, will take immediate action to rectify any deficiency. Prior to the start of any excavating or trenching required for the execution of the proposed work, the Contractor will submit to the Engineer for approval, detailed plans showing types of materials and methods of fabrication for the protective fencing. There will be no separate measurement or payment for furnishing, installing, or maintaining protective fencing. The cost will be considered incidental to the cost of the pipe and/or structures.

3.9 FINAL SIGNING AND STRIPING OF THE 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 the desired level of completion of final roadway signing and lane striping. This will allow adequate time for the City crews to schedule and complete the task on time. The Contractor shall coordinate with the City of Phoenix to replace signing and striping within the City of Phoenix right-of-way. Contractor shall coordinate and complete all signing and roadway marking work within Maricopa County Right-of-Way limits in full compliance with Maricopa County Department of Transportation requirements.

4.0 ALLOWANCE FOR UNIFORMED, OFF-DUTY LAW ENFORCEMENT OFFICER

This project includes a lump sum “ALLOWANCE FOR UNIFORMED, OFF-DUTY LAW ENFORCEMENT OFFICER. The amount of this allowance is determined by the Engineer, and is not subject to individual bid pricing. All bidders will incorporate the amount pre-entered in the bid proposal and will reflect the same in the total amount bid for this project.

Payment for uniformed, off-duty law enforcement officers will be made from this allowance based on approved invoiced cost plus taxes, and a maximum 10 percent markup for overhead and profit.
Payment for uniformed, off-duty law enforcement officers will be made from this allowance based on approved invoiced cost plus taxes, and a maximum 10 percent markup for overhead and profit.

4.1 TRAFFIC CONTROL PAYMENT

Payment for traffic control will be on a lump sum basis for Traffic Control Devices.

4.2 TRENCH PLATING

In Paved areas where vehicles will be driving over trench plating, the plates shall be set to match flush with existing pavement on all sides. Setting plates on top of the pavement surface and installing temporary asphalt ramps around them will not be allowed.

4.3 TRENCHING IN THE RIGHT OF WAY

The Contractor shall not be allowed to stockpile trench material or store any other than the mainline track hoe within the right-of-way. The Contractor shall secure temporary 6’ chain link fence around the track hoe during non-working hours.

4.4 MAXIMUM OPEN TRENCH

No more than 300 linear feet of open trench shall be allowed. Trenches across driveways shall be plated to maintain access. The cost of these plates shall be considered incidental to the project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION +
SECTION 01561

SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Safely guard all Work, materials, equipment and property from loss, theft, damage and vandalism. CONTRACTOR’S duty to safely guard property shall include the OWNER’S property and other private property from injury or loss in connection with the performance of the Work.

B. Employ watchmen as required to provide the required security and prevent unauthorized entry and/or theft.

C. Make no claim against the OWNER for damage or injury resulting from trespass.

D. Responsible for security and shall make good all damage to property of OWNER and others arising from failure to provide adequate security. The standard for security shall be, at a minimum, equivalent to the OWNER’S standards.

E. If the existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the ENGINEER and OWNER. Provide additional security staff, if required, to maintain the security of the facility.

F. Security measures taken shall be at least equal to those usually provided by OWNER to protect his existing facilities during normal operation.

G. Maintain security program throughout the Work until OWNER’S acceptance and occupancy precludes need for CONTRACTOR’S security program.

H. Comply with all aspects of OWNER’S site specific Security Guard Protocol. This shall include background checks equivalent to those conducted by the OWNER.

I. All costs for security as specified in this Section shall be borne by CONTRACTOR.

1.2 CONTRACTOR’S ACCESS TO THE SITE

A. Access to the site for CONTRACTOR’S employees, material, tools and equipment shall be from the designated construction entrance.
B. Ensure that each of his employees, representatives, delivery persons, suppliers and others acting for CONTRACTOR, shall be subject to the following regulations:
1. CONTRACTOR’S subcontractor’s, suppliers and manufacturer’s employee’s shall not park anywhere other than CONTRACTOR Employee’s Parking Area. The Area shall be designated by the ENGINEER. Prepare and maintain this area, as required.
2. Personal vehicles shall not be allowed outside CONTRACTOR’S Employee Parking Area.
3. Delivery vehicles shall access the site from the designated construction entrance road.
4. Access to the site from any other entrance is strictly prohibited, unless prior approval is obtained from the OWNER. Violators shall be banned from the site.
5. Firearms are not allowed on City property.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01570

TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and adjacent areas. Remove physical evidence of temporary facilities at completion of Work.

B. Obtain all City, County and State permits required for the construction of all Work, including Hazardous Material Management, Earth Moving/Dust Control and Stormwater/Stormwater Pollution Prevention Permits.

1.2 NOISE CONTROL

A. CONTRACTOR’S vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and in no case will noise levels be permitted which interfere with the Work of the OWNER or others.

1.3 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.
   1. Employ methods and use materials that will not adversely affect conditions at the site or on adjoining properties.

1.4 WATER CONTROL

A. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
   1. Control fill, grading and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.

1.5 EROSION CONTROL

A. Plan and execute construction and earth work by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
1. Hold the areas of bare soil exposed at one time to a minimum.
2. Provide temporary control measures such as berms, dikes and drains.

B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.

C. Periodically inspect earthwork to detect any evidence of the start of erosion; apply corrective measures as required to control erosion.

D. Coordinate erosion control requirements with the requirements of Article 1.4, above.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +
PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish, install and maintain temporary project identification and informational signs.

B. The following signs shall be provided:
   1. Provide 3 project signs. See attached sketch.

C. No signs, except those specified, shall be displayed, unless approved by OWNER.

1.2 SUBMITTALS

A. Submit for approval the following:
   1. Type of grade of materials.
   2. Layout, size, trim, framing, supports and coatings.
   4. Samples of colors.
   5. Proposed sign installation location

1.3 CONSTRUCTION

A. Use 3/4-inch exterior grade plywood, unless shown otherwise.

B. Use, trim, mitered on all edges.

C. Design signs and supports to withstand 100 mile per hour wind.

D. Paint with exterior gloss-finish enamel. Sign painter shall be a professional in the type work required.

1.4 INSTALLATION AND MAINTENANCE

A. Location of signs shall be as shown or directed by ENGINEER.

B. Maintain signs so they are clean, legible and upright. Keep grass and weeds cut away from signs.
C. Repair and repaint damaged signs. Relocate signs as required by progress of the Work.

D. Remove signs when project is completed or when directed by ENGINEER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

WEST ANTHEM GRAVITY SEWER IMPROVEMENTS - PHASE 1
COP NO. WS90500276
OWNER: COP WATER SERVICES DEPT.
ENGINEER: STANLEY CONSULTANTS
CONTRACTOR:
PROJECT HOTLINE NO.: (XXX)XXX-XXXX
EST. COMPLETION: FEBRUARY XX, XXXX

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6" FRUTIGER BOLD, VTLQ. IF TEXT DOES NOT FIT AS SHOWN, REDUCE TEXT SIZE TO FIT.

++ END OF SECTION ++

01580-3 10/12/2018
SECTION 01651

TRANSPORTATION AND HANDLING OF MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.

B. Shipments of materials to CONTRACTOR or subcontractors shall be delivered to the site only during regular working hours and shall conform to the requirements of Section 01413, CONTRACTOR’S Hazardous Materials Management Program. Shipments shall be addressed and consigned to the proper party giving name of Project, street number and city. Shipments shall not be delivered to OWNER, except where otherwise directed.

C. If necessary to move stored materials and equipment during construction, move materials and equipment without any additional compensation.

1.2 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Matchmark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with a strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or label outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, OWNER’S contract name and number, CONTRACTOR, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect products from exposure to the elements and keep thoroughly dry and dust free at all times. Protect painted surfaces against impact, abrasion, discoloration, or other damage. Grease or oil all bearings and similar items.

D. Do not have products shipped until:
   1. Related Shop Drawings have been approved by ENGINEER.
   2. Related factory test results, required in the individual Specification Sections, have been reviewed and accepted by ENGINEER.
   3. Required storage facilities have been provided.
E. Items shall be supported, packaged and stored per product manufacturers recommendations.

1.3 DELIVERY

A. Arrange, with the United States Postal Service, a special address for the Project. All deliveries shall be made to that address.

B. Arrange deliveries of products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.

C. Coordinate deliveries to avoid conflict with Work and conditions on site and to accommodate the following:
   1. Work of other contractors, or OWNER.
   2. Limitations of storage space.
   3. Availability of equipment and personnel for handling products.
   4. OWNER’S use of premises.

D. Do not have products delivered to Project site until related Shop Drawings have been approved by the ENGINEER.

E. Do not have products delivered to Project site until required storage facilities have been provided.

F. Have products delivered to site in manufacturer’s original, unopened, labeled containers. Keep ENGINEER informed of delivery of all equipment to be incorporated in the Work to facilitate stored material observations and inspections.

G. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.

H. Immediately on delivery, inspect shipment to assure:
   1. Product complies with requirements of Contract Documents and reviewed submittal.
   2. Quantities are correct.
   3. Containers and packages are intact, and labels are legible.
   4. Products are properly protected and undamaged.
   5. Verify that the accelerometer recordings were made during shipment.

I. Promptly remove damaged products from the Project site and expedite delivery of new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work. Inform ENGINEER of all damaged products prior to removal.
1.4  PRODUCT HANDLING

A. Provide equipment and personnel necessary to handle products, including those provided by OWNER, by methods to prevent soiling or damage to products or packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.

C. Handle products by methods to prevent bending or overstressing.

D. Lift heavy components only at designated lifting points.

E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+++ END OF SECTION +++
1.1 DESCRIPTION

A. Be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage as specified in the General Conditions and herein.

B. In order to prevent damage, injury or loss, CONTRACTOR’S actions shall include, but not be limited to, the following:
   1. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the work of any other contractor or utility service company.
   2. Provide suitable storage facilities for all materials which are subject to injury by exposure to weather, theft, breakage, or otherwise.
   3. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
   4. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the site of the Work shall present a safe, orderly and workmanlike appearance.
   5. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other hazardous areas.

C. Shall not, except after written consent from proper parties, enter or occupy privately-owned land with personnel, tools, materials or equipment, except on easements provided herein.

D. Assume full responsibility for the preservation of all public and private property or facility on or adjacent to the site. If any direct or indirect damage is done by or on account of any act, omission, neglect or misconduct in the execution of the Work by CONTRACTOR, it shall be restored by CONTRACTOR, at his expense, to a condition equal to that existing before the damage was done.

E. CONTRACTOR shall be responsible for any staking/roping needed to identify the contractual limits of construction activities, including easements.

1.2 BARRICADES AND WARNING SIGNALS
A. Where Work is performed on or adjacent to any roadway, right-of-way, or public place, provide barricades, fences, lights, warning signs, danger signals, watchmen, and shall take other precautionary measures for the protection of persons or property and of the Work. Barricades shall be painted to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade. Sufficient barricades shall be erected to keep vehicles from being driven on or into Work under construction. Furnish watchmen in sufficient numbers to protect the Work. CONTRACTOR’S responsibility for the maintenance of barricades, signs, lights, and for providing watchmen shall continue until the Project is accepted by OWNER.

1.3 TREE AND PLANT PROTECTION

A. Protect existing trees, shrubs and plants on or adjacent to the site that are shown or designated to remain in place against unnecessary cutting, breaking or skinning of trunk, branches, bark or roots.

B. Materials or equipment shall not be stored or parked within the drip line.

C. Temporary fences or barricades shall be installed to protect trees and plants in areas subject to traffic.

D. Fires shall not be permitted.

E. Within the limits of the Work, water trees and plants that are to remain, in order to maintain their health during construction operations.

F. Cover all exposed roots with burlap which shall be kept continuously wet. Cover all exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, run-off or noxious materials in solution.

G. If branches or trunks are damaged, prune branches immediately and protect the cut or damaged areas with emulsified asphalt compounded specifically for horticultural use in a manner approved by the ENGINEER.

H. All damaged trees and plants that die or suffer permanent injury shall be removed and disposed of off-site when ordered by the ENGINEER and replaced by a specimen of equal or better quality.

I. Coordinate Work in this Section with requirements of Section 02230, Clearing, and Section 02901, Planting.

J. Erect and maintain temporary construction fence to protect areas from construction traffic and activities.
1.4 PROTECTION OF EXISTING STRUCTURES

A. Underground Structures:
   1. Underground structures are defined to include, but are not limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical and communication conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.
   2. All underground structures known to ENGINEER, except water, gas, sewer, electric, and telephone service connections, are shown. This information is shown for the assistance of CONTRACTOR, in accordance with the best information available, but is not guaranteed to be correct or complete.
   3. CONTRACTOR shall uncover all obstructing underground structures sufficiently to determine their location and elevation, to prevent damage to them and to prevent interruption to the services which such structures provide a minimum of 14 Days in advance of trench and excavation Work. If CONTRACTOR damages an underground structure, he shall restore it to original condition at his expense.
   4. Necessary changes in the location of the Work may be made by ENGINEER to avoid unanticipated underground structures.
   5. If permanent relocation of an existing underground structure or other subsurface facility is required and is not otherwise provided for in the Contract Documents, ENGINEER will direct CONTRACTOR, in writing, to perform the Work, which shall be paid for under the provisions of the General Conditions.

B. Surface Structures:
   1. Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.

C. Protection of Underground and Surface Structures:
   1. Sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure. Before proceeding with the Work of sustaining and supporting such structure, satisfy the ENGINEER that the methods and procedures to be used have been approved by the party owning same.
   2. Assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits of the Work. Be responsible
for all damage and expense for direct or indirect injury caused by his Work to any structure. Repair immediately all damage caused by his Work, to the satisfaction of the Owner of the damaged structure.

D. All other existing surface facilities, including but not limited to, guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work, shall be replaced and restored to their original condition at CONTRACTOR’S expense.

1.5 PROTECTION OF FLOORS AND ROOFS

A. Protect floors and roofs during entire construction period.

B. Proper protective covering shall be used when moving heavy equipment, handling materials or other loads, when painting, handling mortar and grout

C. Use metal pans to collect all oil and cuttings from pipe, conduit, or rod threading machines and under all metal cutting operations.

D. Concrete floors less than 28 days old shall not be loaded without written permission of the ENGINEER. No floor, roof or slab shall be loaded in excess of its design loading.

1.6 PROTECTION OF INSTALLED PRODUCTS AND LANDSCAPING

A. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed prior to completion of Work.

B. Control traffic to prevent damage to equipment, materials and surfaces.

C. Provide coverings to protect equipment and materials from damage.
   1. Cover projections, wall corners and jambs, sills and soffits of openings, in areas used for traffic and for passage of products in subsequent work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. The ENGINEER will establish a base line for the Project and two benchmarks for use by CONTRACTOR. The ENGINEER and CONTRACTOR will coordinate the location of the benchmarks and base line to suit the Work.

B. CONTRACTOR:
   1. Provide civil, structural and other professional engineering services specified, or required to execute CONTRACTOR’S construction methods.
   2. Develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, and all other working lines, elevations and cut sheets.
   3. Provide all material required for bench marks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
   4. Be solely responsible for all locations, dimensions and levels. No data other than written orders of the ENGINEER shall justify departure from the dimensions and levels required by the Contract Documents.
   5. Safeguard all points, stakes, grade marks, monuments and bench marks made or established on the Work. Re-establish same with the exception of primary control monuments if disturbed and rectify all Work improperly installed because of not maintaining, not protecting or removing without authorization established points, stakes, marks and monuments.
   6. Provide such facilities and assistance as may be necessary for ENGINEER to check line and grade points placed by CONTRACTOR. Do not perform any excavation or embankment work until all cross-sectioning necessary for determining pay quantities has been completed and checked by ENGINEER.
   7. CONTRACTOR shall provide notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work. If CONTRACTOR observes that the Contract Documents are at variance therewith, promptly notify the ENGINEER, in writing within 24 hours.

1.2 CONTRACTOR’S FIELD ENGINEER

A. Employ and retain at the site of the Work a field engineer with the experience and capability of performing all engineering tasks required of CONTRACTOR. Tasks included are:
1. Provide daily reports of Project activity. Reports to be submitted to the ENGINEER with all pertinent information pertaining to the project as follows:
   a. Number of employees.
   b. Subcontractor employees.
   c. Breakdown of employees by trades.
   d. Major equipment and materials installed.
   e. Major construction equipment utilized.
   f. Location of all areas in which construction was done.
   g. Materials and equipment received.
   h. Work and tests performed.
   i. Weather conditions.
   j. Safety.
   k. Delays.
   l. Instructions received.
2. Submit 1 copy of CONTRACTOR’S daily report electronically in .PDF format. The daily report is due at the ENGINEER’S field office by 9:00 a.m. the next working day after the Work was performed and shall be signed by a responsible member of CONTRACTOR’S staff.
3. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment.
4. Maintain field office files and drawings, Record Drawings, and coordinate engineering services with subcontractors. Prepare layout and coordination drawings for construction operations.
5. Check and coordinate Work for conflicts and interferences and immediately advise ENGINEER of all discrepancies noted.
6. Cooperate with ENGINEER in field inspections, as required.
7. Review and coordinate Shop Drawings and other submittals.

1.3 CONTRACTOR’S SURVEYOR

A. Employ and retain, as needed, at the Work site a surveyor with the experience and capability of performing all surveyor and layout tasks required of CONTRACTOR. The surveyor shall be a land surveyor registered in the State of Arizona. Tasks included are:
   1. Provide all surveying equipment required including transit, level, stakes and required surveying accessories.
   2. Furnish all required lines and grades for construction of all facilities, structures, pipelines and site improvements.
   3. Keep professional, accurate, well organized, and legible notes of all measurements and calculations made while surveying and laying out the Work.
   4. Survey, locate, and record and redline Drawings to accurately represent all existing and newly installed utilities and buried structures prior to backfilling.
B. Any primary control survey monuments damaged or destroyed, will be re-established by the ENGINEER, at CONTRACTOR’S expense.

C. Perform such surveys and computations as are necessary to determine quantities of Work performed or placed during each progress payment period, and shall perform all surveys necessary for the ENGINEER to determine final quantities of Work in place.

D. Notify the ENGINEER at least 24 hours before performing a quantity survey and, unless waived in writing by the ENGINEER, quantity surveys shall be performed in the presence of the ENGINEER.

E. From established primary control points, establish all lines and grades, and elevations necessary to control the Work, and shall be responsible for all measurements that may be required for execution of the Work to the tolerances prescribed in the Contract Documents.

F. Establish, place, and replace as required, such additional stakes, markers, and other controls as may be necessary for control, intermediate checks, and guidance of construction operations.

1.4 SURVEYING

A. Follow the following construction surveying guidelines for this project:
   1. Alignment Staking: Each 50 feet on tangent; each 25 feet on curves.
   2. Slope Staking: Each 50 feet on tangent; each 25 feet on curves; restake every 10 feet in elevation.
   3. Structure: Stake out structures, including elevations; checkouts prior to and during construction.
   4. Pipeline: Stake out pipelines including elevations; checkout prior to and during construction.
   5. Road: Tops each 50 feet on tangent and each 25 feet on curves.
   6. Cross-Section: Original, final and intermediate as required, for the structure sites and other locations as necessary for quantity surveys.
   7. Easement Staking: Each 50 feet on tangent; each 25 feet on curves. Also wooden laths with flagging at 100 feet maximum spacing.
   8. Record Staking: Provide permanent stake where blind flanges or caps are provided for future connecting, with a material acceptable to the ENGINEER.

B. Temporary survey references set by CONTRACTOR for CONTRACTOR’S own use shall be established to at least second order accuracy (e.g., 1:10000). Construction staking used as a guide for the actual Work shall be set at least third order accuracy (e.g., 1:5000). The basis on which such orders are established shall be sufficient to provide the absolute margin for error specified below.
C. The horizontal accuracy of easement staking shall be plus or minus 0.1 feet. The accuracy of all other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.

D. Survey calculations shall include an error analysis sufficient to demonstrate the required accuracy.

E. Survey Records:
   1. Maintain a complete, accurate log of all control and survey Work as it progresses.
   2. All survey data shall be in accordance with recognized professional surveying standards. All original field notes, computations, and other surveying data shall be recorded by CONTRACTOR’S surveyor in CONTRACTOR furnished hard-bound field books, and shall be signed and sealed by CONTRACTOR’S surveyor. The completeness and accuracy of all survey Work, and the completeness and accuracy of the survey records, including the field books, shall be the responsibility of CONTRACTOR. Failure to organize and maintain survey records in a professional manner to allow reasonable and independent verification of all calculations by the ENGINEER, and to allow reasonable identification by the ENGINEER of all elevations, dimensions, and grades of the Work shall be cause for rejection of the survey records, including the field books.
   3. Illegible notes or data, or erasures on any page of the field books is not acceptable. Copied notes or data shall not be permitted. Corrections by ruling or lining out errors will be satisfactory only if initialed by the surveyor. Violation of the above may require resurveying the data in question.

F. Survey Submittal:
   1. Survey submittal shall be made as described herein. Submittal shall be signed and sealed by CONTRACTOR’S surveyor and shall include:
      a. A complete survey plan that shall be submitted ten days prior to beginning survey Work.
      b. Resumes shall be submitted of the Registered Land Surveyors conducting the Work ten days prior to beginning survey Work. During the course of the Work, a resume shall be submitted for each new Registered Land Surveyor working on the project at least ten days prior to the beginning of Work by such new Registered Land Surveyor.
      c. A sample of the proposed survey field books to be maintained by CONTRACTOR’S surveyor. The sample shall have sufficient information and detail, including example calculations and notes, to demonstrate that the field books will be organized and maintained in a professional manner, meeting the requirements of Article 1.3 and Article 1.4 of this Section.
      d. The original field books shall be submitted within two days upon completion of the Work.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION) ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes administrative and procedural requirements for the cutting and coring, and rough and finish patching of holes and openings in existing construction.

B. All cutting, coring and rough patching shall be performed by CONTRACTOR requiring the opening. Finish patching shall be the responsibility of CONTRACTOR and shall be performed by the trade associated with the application of the particular finish.

C. Provide cutting, coring, fitting and patching, including attendant excavation and backfill required to complete the Work, or to:
   1. Remove and replace defective Work or Work not conforming to requirements of the Contract Documents.
   2. Remove samples of installed Work as specified or required for testing.
   3. Remove all constructions required to provide for specified alterations or addition to existing work.
   4. Uncover Work to provide for ENGINEER'S observation of covered Work or observation by regulatory agencies having jurisdiction.
   5. Connect to completed Work that was not accomplished in the proper sequence.
   6. Remove or relocate existing utilities and pipes that obstruct the Work in locations where connections must be made.
   7. Make connections or alterations to existing or new facilities.

D. Coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes Work that is directly related to this Section.
   1. Division 2, Site Work, through 17, Instrumentation, Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 QUALITY ASSURANCE

A. Structural Work: Do not cut or patch structural elements in a manner that would change their load-carrying capacity as load-deflection ratio.
B. Operating Elements: Do not cut or patch operating elements in a manner that would result in reducing their capacity to perform as intended. Do not cut or patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

1.3 SUBMITTALS

A. Submit a written request to ENGINEER well in advance of executing any cutting or alteration which affects:
   1. Design function or intent of Project.
   2. Work of OWNER or any other contractor.
   3. Structural value or integrity of any element of the Project.
   4. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   5. Efficiency, operational life, maintenance or safety of operational elements.

B. Request shall include:
   1. Identification of Project.
   2. Description of affected Work of CONTRACTOR and work of others.
   4. Effect on work of OWNER or any other contractor, or on structural or weatherproof integrity of Project.
   5. Description of proposed Work, describing:
      a. Scope of cutting and patching.
      b. Trades who will be executing the Work.
      c. Products proposed to be used.
      d. Extent of refinishing.
      e. Schedule of operations.
   6. Alternatives to cutting and patching, if any.
   7. Designation of party responsible for cost of cutting and patching, when applicable.
   8. Written permission of any other contractor whose work will be affected.

C. Should conditions of Work, or schedule, indicate a change of materials or methods, submit written recommendation to ENGINEER, including:
   1. Conditions indicating change.
   2. Recommendations for alternative materials or methods.

D. Submit written notice to ENGINEER, designating time Work will be uncovered, to provide for observation. Do not begin cutting or patching operations until authorized by ENGINEER.
E. Conform to all applicable specifications for application and installation of materials used for patching.

1.4 WARRANTY

A. Replace, patch and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials in such a manner as to not void required or existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform all cutting and coring in such a manner as to limit the extent of patching.

B. Core drill all holes to be cut through concrete and masonry walls, slabs or arches, unless otherwise approved by the ENGINEER.

3.2 INSPECTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed before cutting.

B. Report unsatisfactory or questionable conditions to ENGINEER, in writing. Do not proceed with Work until the ENGINEER has provided further instructions.

3.3 PREPARATION

A. Provide temporary support as required to maintain structural integrity of Project, to protect adjacent Work from damage during cutting, and to support the Work to be cut.
B. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that will be exposed during cutting and patching operations.
   1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
   2. Do not cut existing pipe, conduit or ductwork serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.4 CORING

A. Perform coring with a non-impact rotary tool using diamond core drills. Size holes for pipe, cylinders, conduit, sleeves, equipment or mechanical seals, as required.

B. Protect existing equipment, utilities and adjacent areas from water and other damage covered by drilling operations.

C. Vacuum or otherwise remove slurry or tailings from the Work area following drilling.

3.5 CUTTING

A. Cut existing construction using methods least likely to damage elements retained or adjoining construction and that will provide proper surfaces to receive installation or repair.
   1. In general, use hand or small power tools designed for sawing or grinding, not hammering and chopping.
   2. Cut through concrete and masonry using a concrete wall saw with diamond saw blades.
      a. Provide for control, on both sides of walls, of slurry generated by sawing.

B. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Provide temporary covering over openings where not in use.

C. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.

D. Provide adequate bracing of area to be cut prior to start of cutting.

E. Provide equipment of adequate size to remove cut panel.
3.6 PATCHING

A. Patch construction by filling, repairing, refinishing, closing-up and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified, in other Sections of these Specifications.

B. Where feasible, test patched areas to demonstrate integrity of installation.

C. Fit Work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

D. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   1. For continuous surfaces, refinish to nearest intersection.
   2. For an assembly, refinish entire unit.

E. Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Clean areas and spaces where cutting, coring and patching are performed. Clean piping, conduit or similar constructions before applying paint or other finishing materials. Restore damaged pipe covering to original condition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01724

CONNECTIONS TO EXISTING FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform all construction necessary to complete connections and tie-ins to existing facilities.

B. Keep existing facilities in operation unless otherwise specifically permitted in these Specifications or approved by OWNER.

C. Perform all construction activities so as to avoid interference with operations of the facility and the work of others.

1.2 BYPASSING

A. Bypassing of plant flow will be permitted only for brief intermittent periods necessary to make the connections.

1.3 SEQUENCING AND OPERATIONS

A. All operations of existing valves and gates required for the Work shall be done by OWNER.

B. Insofar as possible, all equipment shall be tested and in operating condition before the final tie-ins are made to connect equipment to the existing facility.

C. Carefully coordinate all Work and schedules and shall provide OWNER written notice at least 1 week before shut-downs or by-passes are required.

D. Work Sequence: Sequence of Work and Schedule of Completion is specified under Section 01111, Schedule of Completion, and shown on the Construction Sequence Diagrams included in the Drawings.

1.5 SUBMITTALS

A. For any tie-ins/connections or required shutdowns to existing mains and systems, the CONTRACTOR shall submit a shutdown/tie-in plan to Water Distribution personnel and Engineering and shall be approved at least two 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.
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01782

RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Maintain and provide the ENGINEER with Record Documents as by Contract Documents.

B. Definitions
   1. Contract Documents: The contract documents include the drawings, specifications, and addenda developed and furnished to the CONTRACTOR at the beginning of construction.
   2. As-Built Drawings: As-built drawings are an annotated set of drawings prepared by the CONTRACTOR. They show, in red, as-constructed changes to the original Contract Documents that have been made during the construction process. The As-Built Drawings may include supplemental drawings to provide the necessary detail, comply with project standards or where annotation would otherwise be impractical.
   3. Record Drawings: Record Drawings are prepared by the ENGINEER and reflect as-constructed changes that the CONTRACTOR annotated in the As-Built Drawings.
   4. Record Documents: The Record Documents include Record Drawings, specifications, addenda, approved shop drawings, samples, photographs, change orders, other modifications to the Contract Documents, test records, survey data, field orders, Request for Information, Instruction to Contractor, Work Change Directives, submittals, Warranty certificates, and all other documents pertinent to the CONTRACTOR’S Work.

C. Maintenance of Documents:
   1. Three sets of black line sets of plans, including any Addenda, of the Drawings will be furnished to CONTRACTOR by the OWNER.
   2. Maintain in CONTRACTOR’S field office in clean, dry, legible condition complete sets of the following: Drawings, Specifications, Addenda, approved Shop Drawings, Samples, Photographs, Change Orders, other modifications to the Contract Documents, test records, survey data, field orders, Request for Information, Instruction to Contractor, Work Change Directives, submittals, Warranty certificates, and all other documents pertinent to CONTRACTOR’S Work.
   3. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI), unless otherwise approved by ENGINEER.
   4. Make documents available at all times for inspection by ENGINEER and OWNER.
5. Record Documents shall not be used for any other purpose and shall not be removed from CONTRACTOR’S office without ENGINEER’S approval.

6. Any contractually required testing provided by others shall be thoroughly documented by the CONTRACTOR and maintained with the project Record Documents. All testing results shall be maintained in their own separate log for the project; being kept current weekly and made readily available for viewing at any time.

D. Marking System: Changes, revisions, additions and deletions, to the record set of Drawings shall be marked in Red.

E. Recording:
1. Submit as-built drawings and make a record of the locations of all work completed as part of the project. The as-builds must indicate the locations of the beginning(s) and end(s) of the construction, and all valves, fire hydrants, pipe fittings, service connections and appurtenances. They must also show locations and elevations where significant elevation changes occur or changes in direction in all pipe alignments. Their locations must be shown by stationing and dimensioning from appropriate monument lines or in their absence appropriate lot lines, property lines or easement line references.

2. Global Positioning System (GPS) Recording: For construction projects located in the Right-Of-Way, certain assets locations are required to be recorded with survey-grade GPS device such as Trimble GSA-6000 GeoXH (or equivalent) currently used by CITY staff to locate assets. The contractor shall coordinate with the ENGINEER to identify assets requiring GPS coordinates (northing and easting) and elevation to the top of the buried asset. The following GPS coordinate set up shall be followed by the CONTRACTOR:
   b. Zone: Arizona Central 0202 (Grid)
   d. Elevation: NGVD 29
   e. Altitude Units: feet
   f. Coordinate Unit: International feet
   g. Coordinate order: North/East
   h. Projection: Transverse Mercator

The GPS coordinates shall be recorded on a spreadsheet provided by the ENGINEER. The ENGINEER will review the GPS coordinates provided by the CONTRACTOR and confirm their accuracy by navigating to the assets using the provided coordinates to ensure the accuracy tolerance is met. The confirmation process shall be performed before the assets are buried to ensure accuracy compliance. The coordinates will be submitted to the CITY at the project completion to be loaded into the CITY’s asset registry system. In general, GPS coordinates are required for but not limited to:
   a. Valves for Water pipes, Reclaimed Water pipes, and sewage forcemains,
b. Fire Hydrants  
c. Tap for Water Service Line, Reclaimed Water Service, and Lateral tap for sewer service  
d. Manholes  
e. Cleanouts  

3. Label the Cover Sheet, Index and each supplemental sheets of each document “PROJECT RECORD” in 2-inch high printed letters.  

4. Keep the As-Built Drawings current. CONTRACTOR’S refusal, failure or neglect to maintain current As-Built Drawings shall constitute sufficient basis for the ENGINEER to recommend the withholding of some or all of any payment due.  

5. Do not permanently conceal any Work until required information has been recorded.  

6. Drawings: Legibly mark to record actual construction including:  
   a. Depths of various elements of foundation in relation to datum.  
   b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.  
   c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.  
   d. Field changes of dimensions and details.  
   e. Changes made by Change Order or Field Order.  
   f. Details not on original Drawings.  

7. Specifications and Addenda: Legibly mark up each Section to record:  
   a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.  
   b. Changes made by Change Order or Field Order.  
   c. Other matters not originally specified.  

F. Record Drawings:  
1. As-Built Drawings shall be prepared for all the Work included in the Contract. On a weekly basis, furnish to the ENGINEER a full size annotated copy of the As-Built Drawings that include changes from the previous week’s As-Built Drawing submittal. Annotations shall include redlined “clouds” of only those changes from the previous week’s submittal. The redlined As-Built Drawings shall show the actual in-place installation of the items installed under this Contract. The redlined As-Built Drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations that will be used to develop complete Record Drawings.  

2. Develop and furnish to the ENGINEER, redlined Instrumentation and Control and Electrical Drawings showing one line diagrams with all conduit and wire sizes shown of the distribution systems and the actual in-place grounding system, lighting arrangement, motor control centers, corrected wiring diagrams, equipment and conduit and cable plans.  
   a. The Contract Drawings may be used as a starting point in developing these Instrumentation and Control and Electrical As-Built Drawings.
Subcontractor and manufacturer drawings may be included in this drawing package. The drawing package must be fully integrated and include the necessary cross references between drawings. The drawing package shall include interconnection and termination details to equipment furnished under this Contract.

b. All As-Built Drawings must be submitted on a weekly basis for approval of the ENGINEER.

3. Survey results shall be posted to the as-builts on a weekly basis.

G. Submittals:
1. Acceptance of CONTRACTOR’S monthly application for payment shall be dependent on the ENGINEER’S acceptance and agreement that CONTRACTOR’S As-Built Drawings and weekly submittals are complete, thorough and acceptable in showing all Work up through and including such work as CONTRACTOR is claiming for completion and payment on CONTRACTOR’S application for payment. Any items which do not appear on the As-Built Drawings in complete and acceptable form shall not be paid for in CONTRACTOR’S monthly payment.

2. Examination by the ENGINEER of CONTRACTOR’S As-Built Drawings will be made on a weekly basis to determine completion for consideration of monthly pay application. Also, make available all As-Built Drawings at all times to the ENGINEER for examination.

3. Prior to Completion of the Work, deliver final As-Built Drawings to ENGINEER. Substantial completion will not be made until satisfactory final As-Built Drawings are current and received by ENGINEER.

4. Accompany final and weekly submittals with transmittal letter containing:
   a. Date.
   b. Project title and number.
   c. CONTRACTOR’S name and address.
   d. Title and number of each As-Built Drawings.
   e. Certification that each document as submitted is complete and accurate.
   f. Signature of CONTRACTOR, or his authorized representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 -EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Approximately one year after issuance of final completion, ENGINEER will make arrangements with OWNER and CONTRACTOR for a Post-Final Inspection and will send a written notice to OWNER and CONTRACTOR advising of the date and time of the inspection.

B. After the inspection, ENGINEER will inform CONTRACTOR of any corrections required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ END OF SECTION +
SECTION 02145

DIVERSION OF WATER OR SEWAGE FLOW AND DEWATERING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This section describes the existing conditions for temporary bypassing and dewatering of water systems or sewers for internal television inspection (CCTV), cleaning operations and/or rehabilitation of project pipelines. Temporary bypass pumping is very important for the project, including the maintenance of service to customer connections or making alternative arrangements acceptable to customers.

B. Requirements:
   1. Provide all labor, materials and supervision to temporary bypass flow around the work in accordance with the specified needs of the rehabilitation method being utilized and dewater the pipelines in preparation for cleaning and rehabilitation.
   2. Provide the design of the bypass arrangement and describe the means and methods of accomplishing the bypassing and submit to the ENGINEER to determine conformance to project objectives.
   3. Prior to placing the bypass system into operation, successfully test the system to 1.5 times the maximum operating pressure of the system.
   4. Notify the ENGINEER 48 hours prior to shutting down or operating the bypass. Provide continuous manned monitoring of the bypass flow.
   5. Should a spill occur, immediately contact the ENGINEER and provide immediate and proper cleanup.

1.2 SUBMITTALS

1. At the Preconstruction Conference, submit drawings and complete design data showing methods and equipment proposed to be utilized in the water piping or sewer bypassing for review by the ENGINEER. Include the following information in the submittal.
   a. Drawings indicating the scheme and location of temporary water or sewer line plugs, bypass discharge lines and the method and location for discharging the bypass lines.
   b. Capacities of pumps, prime movers and standby equipment.
c. Design calculations proving adequacy of the system and selected equipment sealed by a Professional Civil Engineer, registered in the State of Arizona.
d. Standby Power Source
e. Staffing Plan
g. Spill Response Plan
h. Odor Control Plan

1.3 JOB CONDITIONS

A. Available Flow Data:
   1. Available flow data for the water systems or sewers to be rehabilitated at the projects is located in Part 3, Section 3.1 of this specification. Flow data for the service laterals is not available. Determine the flow in service laterals and submit the data to the ENGINEER.

B. Protection:
   1. Bypassing to the ground surface, receiving waters, storm drains or bypassing which results in soil or groundwater contamination or any potential health hazards is not permitted.

C. Scheduling:
   1. The bypassing system is not allowed to be shut down between shifts, on holidays, weekends or during work stoppage without written permission from the ENGINEER. Provide an attendant, around the clock, whose only duty is to maintain the bypass pumping system until the bypassing of that specific pipeline is no longer required.

D. Service Lines:
   1. Water or sanitary sewers to be bypassed may have service lines connected to adjacent users. The known service lines have been shown on the construction drawings. Verify the locations of these lines and any other service lines not shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide temporary pumps, conduits and other equipment to bypass flow around the work area. Furnish all necessary labor and supervision to set up and operate the pumping and bypass system.
   1. Provide critical grade sound attenuated pumps capable of achieving an operating noise level of 70 decibels or less measured at a distance of 50 feet from the operating pump for the bypass pumping. Conduct sound
measurement tests in accordance with the American National Standards S. 13-1971.

2. Provide pumps and bypass lines of adequate capacity and size to handle the required capacity.

3. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without said muffler.

B. Maintain on site, sufficient equipment and materials to ensure continuous and successful operation of the bypass system. Unless otherwise approved by ENGINEER, provide standby pumps on site for a minimum 50% redundancy of the bypass system flow except at least 100% redundant capacity must be provided if only one pump is being used to bypass flows. Provide, install in-place, make fully operational and be fueled at all times the standby pumps, equipment and piping. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, water line or sewer plugs, piping and other parts or system hardware to ensure immediate repair or modifications of any part of the system as necessary.

C. Unless otherwise approved by ENGINEER, provide and install fully operational redundant bypass line(s) so they can be placed in service in the event one of the bypass lines develops a leak. Provide 33% redundancy in the bypass piping for design flows, except at least one redundant bypass line must be provided when less that three bypass lines are provided by design. Provide and install independent valves on all lines for the bypass pump system so they can be quickly activated or removed from service if necessary.

D. Install all pumps, generators and other equipment with sufficient secondary containment to protect against gasoline, oil and hydraulic fluid spills. Provide a berm at the edge of the containment to prevent direct runoff of spills.

PART 3 - EXECUTION

3.1 ESTIMATED FLOWS IN THE PROJECT PIPELINE

A. The following paragraph provides estimated peak daily dry weather flow information for the project pipeline. The information was obtained from the City of Phoenix. For questions pertaining to this information contact the City of Phoenix, Water Services Department, 200 West Washington Street, Phoenix, Arizona, during normal business hours.

B. The approximate estimated dry weather low flow, average daily dry weather flow and peak dry weather flow for Project Segment West Anthem Gravity Sewer Improvements – Phase 1 (WS90500276) are listed below in Table 1.
Use of this flow data in no way relieves responsibilities for design, construction and operation of an adequate and properly functioning bypass system. Rain events may result in significantly larger flow rates. Make own determination of bypass capacity needs. The bypass design must provide sufficient capacity to handle this increase.

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<td>Dry Weather</td>
<td>Flow Estimates</td>
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<tr>
<td>Project</td>
<td>Low Flow</td>
<td>Average Flow</td>
<td>Peak Flow</td>
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<td>0.8 MGD</td>
</tr>
</tbody>
</table>

C. Monitoring Flows:
   1. Monitor flows and bypass operations during the course of the project to ensure proper operation and ensure against upstream surcharges and/or spills.

D. Service Lines:
   1. Water or sewer service to customers must be maintained during the course of the work, unless other acceptable arrangements are made with the customer.
   2. The ENGINEER shall provide a public information representative to accompany the CONTRACTOR when visiting customers to discuss bypass pumping of services or making alternate arrangements with the customer to discuss bypass pumping of services or making alternate arrangements with the customer for service outages.
      a. No matter what arrangement is made, cooperate with the ENGINEER to provide the City of Phoenix documentation that all affected customers have been contacted and arrangements made for continuous service or alternate accommodations. This document must be submitted prior to start of work on the section of line affected.

E. Notifications;
   1. Cooperate fully in providing the ENGINEER with advance notice and details pertaining to work schedule and individual service arrangements.
   2. Notify the ENGINEER and City of Phoenix of any planned service interruptions at least two weeks prior to the event.
   3. The ENGINEER or local public involvement firm retained by the ENGINEER shall perform notification of the work to the public. Notification shall be made door to door with printed handouts or door hangers. The information provided includes, at a minimum, the reason for the interruption, the time period of the interruption and a local 24 hour telephone hotline number for project information.
a. The first notification is to be five days before interruption of service. Much greater advance notice may be required if an alternate to pumping the customer’s service is proposed.

b. The second notification is to be 24 hours prior to interruption of service.

3.2 PROTECTION

A. Water or wastewater spills, overflows and backups into customer’s properties are not allowed. Bypassing to the ground surface, receiving waters, storm drains or bypassing which results in groundwater contamination or potential health hazards are not allowed.

B. Inspect the entire bypass pumping and piping system for leaks or spills on an hourly basis. Create an inspection log and enter the time of the inspections and the conditions of the piping and the name of the inspector into the log for review by the ENGINEER.

C. Provide ENGINEER a copy of an emergency spill response plan. Plan shall address notification and clean up procedures. Immediately take action to halt and clean up all spills and immediately notify ENGINEER of any/all spills.

D. Perform all work in compliance with OSHA standards and in no case will noise levels be permitted which would interfere with the work of the City or others. Noise levels shall be in accordance with City of Phoenix noise ordinance. Utilize sound attenuated bypass pumps with a maximum decibel rating of 70 db @ 50 feet.

E. Odor Control:
1. Employ methods and procedures that mitigate the generation and discharge of objectionable odors to the surface environment at all times.
2. Add ferric chloride to the wastewater flow upstream of bypass pumping operations to reduce odor. Make determination of flow characteristic for required dosing.
   a. Add the ferric chloride from a location upstream that will allow 10 to 15 minutes reaction time before the flow enters the work area. The chemical dosing shall reduce odors generated from the wastewater stream to a level acceptable to the City. If this is not accomplished by adding the ferric chloride only, an additional control may be required. Add hydrogen peroxide downstream to the flow that has been dosed with ferric chloride. The Hydrogen peroxide shall be added to allow a 5 – minute reaction time before the flow enters the work area. Any dosage combination of the two chemicals may be used to ensure continuous control of odors acceptable to the City.
3.3 DAMAGES

A. Repairs for any damage that may result from negligence, inadequate or improper installation, maintenance, insufficient and operation of bypass system, including mechanical or electrical failures are the responsibility of the CONTRACTOR.

+++ END OF SECTION +++
SECTION 02230

CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to perform all
      clearing and grubbing as shown on the Drawings and specified.
   2. Coordination with Landscape Contractor on plants to be Moved Once or
      Remain in Place per Section 02906.

B. The Work covered by this Section consists of removing and disposing of all trees,
   stumps, bush, roots, shrubs, vegetation, logs, rubbish, and other objectionable
   material from the site, as required to perform the Work.

1.2 QUALITY ASSURANCE

A. Codes and Standards: State and local laws and code requirements shall govern the
   hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris and other matter.

1.3 JOB CONDITIONS

A. Protection:
   1. Streets, roads, adjacent property and other works and structures shall be
      protected throughout the entire Project. Return to original condition, satisfactory to the ENGINEER, damaged facilities caused by CONTRACTOR’S operations.
   2. Trees, shrubs, grassed and landscaped areas, which are to remain, shall be
      protected by fences, barricades, wrapping or other methods as shown on the
      Drawings, specified or approved by the ENGINEER. Equipment, stockpiles,
      etc. shall not be permitted within tree branch spread. Trees shall not be
      removed without approval of the ENGINEER, unless shown or specified.

B. Salvable Improvements:
   1. Unless specified elsewhere, carefully remove items to be salvaged and store on
      premises in approved location, all in accordance with recommendations of
      specialists recognized in the Work involved.
1.4 GUARANTEE

A. Guarantee that Work performed under this Section will not permanently damage trees, shrubs, or plants designated to remain, or other adjacent work or facilities. If damage resulting from CONTRACTOR’S operations appears during the period up to 18 months after completion of the Project, replace damaged items, at no additional cost to OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Limits of clearing shall be all areas within the Contract limit lines, except as otherwise shown on the Drawings. Damage outside these limits caused by CONTRACTOR’S operations shall be corrected at CONTRACTOR’S expense.

B. Remove from the site and satisfactorily dispose of all trees, shrubs, stumps, roots, brush, masonry, rubbish, scrap, debris, pavement, curbs, fences and miscellaneous other structures not covered under other Sections as shown on the Drawings, specified or otherwise required to permit construction of the Work.

C. No cleared or grubbed material may be used in backfills or structural embankments. Comply with requirements of Section 02315, Structural Excavation and Backfill.

D. Burning on the site will not be allowed.

E. In order to avoid additional removal or damage, existing trees and shrubs shall be trimmed as required. Trimmed or damaged trees shall be treated and repaired by persons with experience in this specialty who are approved by ENGINEER. Trees and shrubs intended to remain in place, which are damaged beyond repair or removed, shall be replaced by CONTRACTOR at no additional cost to OWNER at like caliper size and species as found on Salvage List.

F. Control air pollution caused by dust and dirt and comply with governing regulations.

++ END OF SECTION ++
SECTION 02306

GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general information, products, and execution for geotechnical instrumentation and monitoring for the I-17 crossing.

B. Contractor is responsible for:
   1. Installing all instruments and establishing baseline readings.
   2. Monitoring the following instruments:
      a. Surface Settlement Points,
      b. Settlement Monitoring Points,
      c. Reflective Targets,
      d. Utility Monitoring Points, and
      e. Extensometers or Deep Settlement Point.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 INFORMATIONAL SUBMITTALS

A. Submit to the Engineer the following a minimum of 4 weeks before the scheduled start of the applicable activity:
   1. Qualifications: Submit instrumentation specialist and instrumentation surveyor qualifications per Paragraph 1.6-D.
   2. Description of methods and materials for installing and protecting the instruments.
   3. Product Data and Samples: Submit all applicable Manufacturer's literature describing operation and maintenance procedures for the instrumentation, including probes. Provide Manufacturer's brochures on each product. Provide product description and Drawings, along with samples where applicable.
   4. Certificates: For each instrument to be installed, submit, as applicable, a certificate issued by the instrument’s Manufacturer stating that the Manufacturer has inspected and tested each instrument before it leaves the factory to see that the instrument is working correctly and has no defects or missing parts.
   5. Permits: List permits, third party approvals, and approval Contract Submittals required to perform the Work.
6. Prior to starting shaft or tunnel excavation, submit:
   a. Initial readings for the surface settlement points, settlement monitoring points, utility monitoring points, extensometers, inclinometers, and piezometers within the timeframe specified herein.
   b. Results of the preconstruction survey in accordance with Section 01323 – Construction Photographs.

1.4 ACTION SUBMITTALS

A. Submit the following to the Engineer during construction within the specified time restrictions:
   1. Installation records. Within 5 days of installation of each instrument, submit drawings showing the installed location, the instrument identification number, the instrument type, the installation date and time, established elevations, initial elevations, offset and stationing, initial coordinates, boring logs, and the anchor to tip elevation and instrument length, when applicable. Also furnish details of installed instruments showing all dimensions and materials used, a separate statement describing installation procedures for each instrument, and As-Built Drawings of each instrument including depths, lengths, elevations and dimensions of key elements.
   2. Reporting: Provide data from readings of all surface settlement points, settlement monitoring points, and utility monitoring point instruments to the Engineer within one day of obtaining the information. The data will include, but are not limited to, the following:
      a. A copy of the data sheets containing a cumulative history of readings and proximity of the excavation to the instrument location itself at the time of each reading.
      b. A copy of the plot of measured values versus time, including a time history of construction activity likely to influence such readings.
   3. Interpretation: Provide interpretations of monitoring data and submit them to the Engineer along with the data. Data or interpretations will not be published or disclosed to other parties without advance written permission of the Engineer. The Engineer may make his/her interpretations of the data available to the Contractor.

1.5 QUALITY ASSURANCE

A. Perform Work in the presence of the Engineer, unless the Engineer has granted prior approval in writing to perform such Work in Engineer’s absence.

B. Installation:
   1. A written notice will be provided to the Engineer not less than 24 hours before installing geotechnical instrumentation.
   2. Install all instruments within 3 feet of the horizontal location shown on the Drawings or as approved or directed by the Engineer.
3. Should actual field conditions prevent installation of instruments at the location and elevations shown on the Drawings or specified herein, obtain prior acceptance from the Engineer for new instrument location and elevation.

C. Requirements:
1. Provide the Engineer a minimum of 10 days advance notice of the start of Work.
2. Designate an instrumentation specialist to be in charge of instrumentation installation. The instrumentation specialist will develop the instrumentation plan then supervise and be responsible for the instrument installation. The instrumentation specialist will be in charge of procurement and installation.
3. Surveys associated with the geotechnical instrumentation will be under the direction of and reviewed by the instrumentation surveyor.
4. Minimum instrumentation and monitoring requirements are presented herein. Conduct additional instrumentation and monitoring as necessary to control the work and ensure the safety of the Work.
5. Obtain applicable encroachment permits and traffic control permits to perform the Work.
6. Remove or abandon in place instrumentation in accordance with applicable laws, regulations and guidelines and restore the ground at the completion of the project. As a minimum, instrumentation will be demolished within 5 feet of the ground surface and a record made of the type and location of any materials left in the ground on the as-built drawings.
7. See Final Disposition Requirements per Paragraph 3.6.

D. Qualifications:
1. Instrumentation Specialist Qualifications: A minimum of 3 years of documented experience in the Work of this Section.
2. Instrumentation Surveyor Qualifications: Will have previous similar experience surveying for the detection of structural or surface deformations. The surveyor will be a licensed Professional Surveyor in the State of Arizona.

PART 2 - PRODUCTS

2.1 GENERAL

A. Surface protection will be flush with the ground surface in areas where the instrument may be damaged or be an impediment to other activities. Roadway or lock boxes will be provided for inclinometers, extensometers, and utility monitoring points.

2.2 PRODUCTS

A. Surface Settlement Points: Surface settlement points will be in accordance with the Contract Drawings. Surface settlement points installed in pavement will be PK nails that are driven or drilled and grouted into the pavement. Surface settlement
points shall consist of a ¼-inch diameter, 1-inch long stainless steel bolt with an identification tag. It shall also have an indent in the center of its rounded head to receive a surveyor’s plumb bob. The identification tag shall be 1-1/2-inch diameter by 3/32 inch thick with a punched number for identification. The bolt shall be placed through the central hole in the identification tag and driven into a surface on the facility such that the identification tag lies directly between the instrumented surface and the head of the bolt with the identification number facing up so it can be read. Bonded survey targets are an acceptable alternative, provided that they are capable of delivering the required accuracy of measurement. Each surface survey point will have a tag or marking indicating the identification number, tunnel station and offset from centerline. Unless otherwise specified on the Drawings, surface settlement points will be spaced on 10 foot centers.

1. Settlement Monitoring Points: Settlement monitoring points installed in soil will be rebar placed in a shallow pre excavated hole and encased in cement. Each settlement monitoring point will have a tag or marking indicating the identification number, tunnel station and offset from centerline. Unless otherwise specified on the Drawings, surface settlement points will be spaced on 10 foot centers.

2. Utility Monitoring Points: Utility monitoring points will be in accordance with the Drawings. Each utility monitoring point will consist of a pipe casing that exposes the utility and retains the ground to allow for multiple readings throughout the Work. Provide a protective cover (road box) as necessary to protect the monitoring point from disturbance.

3. Extensometers: Extensometers shall be vertical multiple position borehole extensometers (MPBX) as shown on the Contract Drawings. Extensometers shall have multiple point rods with either hydraulic or groutable anchors as recommended by the manufacturer for the ground conditions present. Anchor depths shall be as shown on the Instrumentation Schedule in the Contract Drawings.

   a. Provide extensometers manufactured by:
      i. Geo-Slope Indicator
      ii. Geokon
      iii. Or approved equal

   b. Requirements for extensometers include the following:
      i. Outputs suitable for reading both with a mechanical readout and with transducers for remote readout, and shall include the following components:
         (a) Anchors
         (b) Rods
         (c) Protective sleeving
         (d) Reference head with displacement transducers
         (e) Electric cable
         (f) Mechanical readout unit
      ii. Portable readout unit as recommended by the manufacturer.
      iii. Extensometer drill holes shall be of a diameter recommended by the manufacturer to accommodate the number of anchors and
reference head scheduled for each instrument. Reduction in hole
diameter with increasing depth may be considered. Anchors shall
be suitable for grouting in place.
iv. Rods shall be ¼-inch diameter stainless steel.
v. Reference heads shall conform to the following requirements:
   (a) The reference head shall accommodate the number of anchors
       identified for each extensometer.
   (b) The reference head shall be fully waterproof.

c. Displacement transducers shall be vibrating wire Low-Definition
   Television (LDTV) type. They shall be fully waterproof with a range of
   not less than plus or minus 4 inches. Range adjusters shall be used to
   increase the range, if necessary. Accuracy shall be plus or minus 0.1
   percent of the range. The transducers shall be attached to the rods in a
   way that permit easy installation and adjustment of the transducers.
   Provisions shall be made for temperature measurements in each
   extensometer head for use in making corrections to the transducer
   readings. A facility to check the instruments shall be included using a
   mechanical readout unit consisting of a depth micrometer or an analog
dial gauge. Each mechanical readout unit shall be provided with a
   calibration standard.
d. The transducers shall be wired so that they can be read by a portable
   readout unit.
e. It shall be possible to establish baseline readings and take periodic
   readings with a mechanical readout device, such as a depth probe
   micrometer without having to disconnect, change, or disrupt the
   electrical readings.
f. Provide a protective cover (road box) as necessary to protect the
   extensometer from disturbance.
g. Electrical cable shall be as recommended by the manufacturer of the
   extensometers and shall be a shielded twisted pair with a waterproof
   jacket.

PART 3 – EXECUTION

3.1 GENERAL

A. Instrumentation Installation: Instrumentation will be installed at the locations
   shown on the Drawings, or as directed or approved by the Engineer.

B. Ensure that instrumentation is installed, fully functional, calibrated, consistent
   baseline readings are collected, and that the instrumentation is ready for monitoring
   at least 7 days prior to start of excavation.

C. Initial reading of all instrumentation will be taken a minimum of 7 days prior to
   start of excavation.
D. Provide specified readout units for the extensometers and inclinometers, together with associated calibration devices and software to the Engineer a minimum of 7 days prior to start of excavation.

E. Access: Provide and facilitate safe access to the instrumentation to the Engineer including keys for lock boxes.

F. Existing Conditions: Locate conduits and underground utilities in all areas where subsurface geotechnical instrumentation is to be drilled and installed. Subsurface geotechnical instrumentation locations will be modified, as approved by the Engineer, to avoid interference with existing conduits, utilities, and foundation elements.

G. Identification: Instruments will be clearly marked, labeled, and protected to avoid being obstructed or otherwise damaged by construction operations or the general public. Both protective housing and box or vault covers will be marked.

H. Instrument Designation: A unique instrument identification number will be assigned to each instrument and each point. The instrument identification number will be clearly marked on each instrument in a nondestructive manner. Both protective housing and box or vault covers will be marked.

I. Instrument Protection: Instruments and markings will be protected to avoid being obstructed or otherwise damaged by construction operations or the general public.

J. Surveying: Immediately following installation, the location of the top of all instruments will be surveyed to provide horizontal and vertical coordinates. Data will be provided to the Engineer. Re-surveying from control points will be required monthly or more frequently to address potential disturbance or resolve conflicting data.

K. Drilling from the Ground Surface: Instrumentation holes drilled from the ground surface will be subject to the same permitting and drilling requirements as those for geotechnical exploration boreholes. Obtain necessary permits for each such instrument and conform to the permit requirements during drilling, installation, monitoring, and abandonment.

3.2 INSTALLATION

A. Project survey datum will be as noted on the Drawings.

B. Surface Settlement Points: Surface settlement points will be located as shown on the Drawings and the Instrumentation Schedule. After completion of installation, the As-Built location in horizontal position will be determined to an accuracy of ±1 foot and the elevation to an accuracy of ±0.01 foot.

C. Settlement Monitoring Points:
1. Settlement monitoring points shall typically be installed into vertical surfaces of building/structure. Drilled holes shall be located to avoid historically and architecturally significant design features of the structure. Holes for anchor sleeves shall be drilled into horizontal mortar joints where possible.

2. The carriage bolt in column/building movement points shall be kept permanently fixed in anchor with thread-locking compound.

3. Settlement monitoring points shall be installed 3 to 5 feet above grade when affixed to buildings or structures.

D. Utility Monitoring Points:
1. Utility monitoring points will be installed on utilities as shown on the Drawings and the Instrumentation Schedule.

2. The location of the top, center of the utility in the field will be determined using nondestructive methods such as vacuum excavation. Be responsible for any damage to the utility during installation of the utility monitoring point. Drill casing may be used during the installation.

3. After completion of installation, the as-built location in horizontal position will be determined to an accuracy of ±0.1 foot and the elevation of the top of the utility to an accuracy of ±0.01 foot.

4. Install protective housing consisting of flush-mounted roadway box or vault so as not to obstruct vehicle or foot traffic with locking cap and padlock, and provide Engineer with a key.

E. Extensometers:
1. Extensometers shall be installed at as close as practical to the locations and with anchor point locations as shown on the Instrumentation Schedule in the Contract Drawings.

2. Conduct drilling operations using appropriate methods that are consistent with subsurface conditions presented. Provide drill casing if required to hold drill hole open. Drill hole or inside of casing, if applicable, shall provide a clear opening as recommended by the manufacturer. A log of the soils encountered during drilling shall be accurately documented, and a copy shall be provided to the Engineer.

3. Boreholes for the extensometers shall penetrate to a depth that will not encroach into the tunnel horizon. Demonstrate that no part of the completed drill hole has deviated from vertical by more than 4 percent of the depth to that part.

4. The initial settings of the vibrating wire transducers shall be as determined by the Contractor.

5. Install extensometers and anchors in accordance with the manufacturer’s recommendations and per the Contract Drawings. Backfill the annulus between extensometer rod sheaths and the ground in accordance with the manufacturer’s recommendations.

6. Grouting and filling shall be done with a grout tube inside the casing beginning at the bottom and working up to assure complete backfilling.
7. After completion of installation, but before the grout has set, verify that there is no grout or other material on the head that would obstruct the smooth movement of the rods within their protective sleeving and perform a post-installation acceptance test by taking an initial reading on each rod, and a vibrating wire transducer reading on each rod, to ensure correct functioning.

8. Protection: Install protective housing consisting of flush-mounted roadway box or vault so as not to obstruct vehicle or foot traffic with locking cap and padlock, and provide Engineer with a key.

9. After completion of installation, perform post-installation acceptance test by reading the extensometer to ensure correct functioning.

10. After completion of installation, the as-built location in the horizontal position shall be determined to an accuracy of ±0.3 foot and the elevation of the top of the reference head to an accuracy of ±0.1 foot.

3.3 MONITORING

A. Initial Readings: Take initial readings of all instruments to establish a baseline and provide the Engineer with this data.
   1. A minimum of 10 baseline readings showing consistent elevations. Consecutive baseline readings to be taken a minimum of 6 hours apart.

B. Frequency:
   1. Read required instrumentation and provide the Engineer with these data.
   2. As a minimum, follow the following schedule:

<table>
<thead>
<tr>
<th>Instrument Type</th>
<th>Responsible Party</th>
<th>Active Zone/Period&lt;sup&gt;(a,b)&lt;/sup&gt;</th>
<th>Outside Active Zone&lt;sup&gt;(c)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Settlement Points</td>
<td>Contractor</td>
<td>Daily</td>
<td>Weekly/Monthly</td>
</tr>
<tr>
<td>Settlement Monitoring Points</td>
<td>Contractor</td>
<td>Daily</td>
<td>Weekly/Monthly</td>
</tr>
<tr>
<td>Utility Monitoring Points</td>
<td>Contractor</td>
<td>Daily</td>
<td>Weekly/Monthly</td>
</tr>
<tr>
<td>Extensometers/MPBX</td>
<td>Contractor</td>
<td>Daily</td>
<td>Weekly/Monthly</td>
</tr>
</tbody>
</table>

   a. Active zone/period for tunnels is within 100 feet horizontally of active excavation or tunnel face either direction.
   b. Active zone/period for shafts is for the instruments within 100 feet of the shaft and spans the time period between the beginning of shaft excavation and 2 weeks following the end of shaft excavation.
   c. Weekly until any movement above the background baseline measurements stops and monthly thereafter.

3. Perform additional monitoring as necessary to control construction and to ensure the safety of the Work.
C. Reporting: Provide final data from readings of instruments Contractor is responsible for monitoring to the Engineer within one working day of obtaining the information. Copies of field instrumentation data will be provided to the Engineer immediately after the data are collected in the field. The data will include, but are not limited to, the following:
   1. A copy of the data sheets containing a cumulative history of readings and proximity of the excavation to the instrument location itself at the time of each reading.
   2. A copy of the plot of measured values versus time, including a time history of construction activity likely to influence such readings.

D. Interpretation: Provide interpretations of monitoring data and submit them to the Engineer along with the data. Data or interpretations will not be published or disclosed to other parties without advance written permission of the Engineer. The Engineer may make his/her interpretations of the data available to the Contractor.

3.4 RESPONSIVE VALUES

A. Abide by the following response values:

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Threshold Value</th>
<th>Shutdown Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface survey points – Pavement/Soil (not part of monitoring array)</td>
<td>0.5 inch vertical</td>
<td>1 inch vertical</td>
</tr>
<tr>
<td>Surface survey points – Pavement/Soil (part of monitoring array)²</td>
<td>Settlement: 0.5 inch vertical Angular Distortion: L/750</td>
<td>Settlement: 1 inch vertical Angular Distortion: L/375</td>
</tr>
<tr>
<td>Extensometers/ Sondex Settlement System</td>
<td>1 inch</td>
<td>2 inches</td>
</tr>
</tbody>
</table>

Note:
1. Threshold and shutdown values may vary based on requirements of individual property/structure Owners. Values provided herein will govern in the absence of a more restrictive requirement from the utility Owner.
2. L is the distance between surface survey points, or major structure elements in inches.

B. Notification:

1. If the Threshold Value is reached, the party responsible for monitoring the instrument will notify the other party within 12 hours of the discovery.
2. If the Shutdown Value is reached, the party responsible for monitoring the instrument will notify the other party immediately.
C. When a given response value is reached, it is the Contractor’s responsibility to respond in accordance with the following:
   I. Threshold value:
      a. Meet with the Engineer and any affected parties including the property Owner(s) to:
         i. Review interpretation of the data and results
         ii. Review the construction means and methods
         iii. Determine what changes, if any, will be made to better control movement.
      b. Install additional surface survey points and extensometers/Sondex settlement systems at 250 ft intervals until measured values are above threshold values.
         i. Install three surface survey points perpendicular to the tunnel alignment at tunnel centerline and 30 ft to the north and south of tunnel centerline.
         ii. Install extensometers or Sondex settlement systems on tunnel centerline at same location as each row of surface survey points.
         iii. Submit proposed instrumentation plan to the Engineer prior to installation.
   D. Shutdown Value: Stop all Work potentially causing settlement immediately and meet with the Engineer and any affected parties including the property Owner(s) to develop a plan of action and mitigation as necessary before work can be resumed.

3.5 MAINTENANCE

A. Keep the site clean and tidy at all times. Site improvements will be protected from damage or becoming soiled through suitable temporary covering.

B. Upon completion of the Work, waste will be removed from the site and the site restored to as near its original condition as possible. Any remnants of drilling fluid or grout that may have splattered on improvements will be completely removed.

C. Damaged Installations: Protect the instruments from damage. Damaged installations will be replaced or repaired prior to continuing excavation.

D. Maintenance: Maintain the instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed.

3.6 FINAL DISPOSITION

A. All portable readout units used during installation, during pre- and post- installation acceptance testing, and for collecting data shall become the property of the Contractor.
B. Surface Survey Points in Pavement: Points in pavement may remain or be removed and the pavement patched, at the option of the Governing Agency.

C. Surface Survey Point on Building/Structure: Where instruments have to be removed from buildings/structures, restore the surface to its original condition to the satisfaction of the property owner and the Engineer by use of solvents, infilling, spackling, polish, paint, or replacement.

D. For all underground instrumentation and instrumentation installed in bore holes:
   1. Remove protective housings and caps.
   2. Restore surface to the conditions existing prior to installation of the instruments.
   3. Drill out and grout, or backfill grout in accordance with permits, and environmental laws and regulations.

++ END OF SECTION ++
SECTION 02310

TUNNEL CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work under this Section includes furnishing all labor, tools, equipment and materials to construct the tunnel for the I-17 crossing. Tunneling activities shall include, but not be limited to: excavation; handling, removal and disposal of materials encountered in the tunnel; installation of initial support; groundwater control and disposal; ventilation, lighting and electrical; safety facilities; and all other appurtenant work.

B. Determine the excavated size of the tunnel based on tunneling methods, the specified line and grade tolerances, requirements for installing pipeline or other linings, and other limitations as shown on the PLANS.

C. The tunnel shall be excavated using a Tunnel Boring Machine in conformance with specifications.

D. Anticipated ground conditions are as described in “Geotechnical Baseline Report”.

1.2 RELATED REQUIREMENTS

A. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATION Sections.

1.3 REFERENCES

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

A. American Society for Testing and Materials (ASTM)
   1. ASTM A569 - Tunnel Liner Plates
   2. ASTM A307 - Bolts and Nuts
   3. ASTM A123 - Galvanized Liner Plates
   4. ASTM A153 - Galvanized Bolts and Nuts

B. Occupational Safety and Health Administration (OSHA)
   1. 29 CFR Part 1926 - Subpart S - OSHA Regulations and Standards for Underground Construction
1.6 SUBMITTALS

A. Furnish the following in accordance with Specification Section 01300, “Submittals”.

1. In addition to the items specified in Section 01300 “Submittals”, furnish the following information.

a. Qualifications. Submit within 60 days of the Notice to Proceed, qualifications and experience of individuals to be involved in tunnel construction including the proposed Tunnel Project Manager, Tunnel Engineer, Superintendents Shield Operators and TBM Operators that meet the requirements as specified herein. Owner’s representative will approve or reject the Contractor’s qualifications and staff within 15 working days after receipt of the submission. Work shall not be started on any ground support method nor materials ordered until approval of the qualifications is given. Owner may suspend the work if unqualified personnel are substituted for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

b. Working Drawings. Submit within 30 days of the Notice to Proceed, detailed description, data, or calculation of proposed facilities, equipment to be utilized, and method of construction, including, but not limited to, the following:

i. Ground water control measures during tunneling, including grouting in advance of excavation.

ii. Sequence of excavation and support installation including number, location, direction, and timing of all tunnel headings, including details of size, length and support system design for starter tunnels for shield operations.

iii. Tunnel ventilation, lighting, communications and draining systems.

iv. Methods of controlling line and grade, and survey protocols.

v. Method of protecting tunnel invert during construction of the tunnel.

vi. Detailed list and description of all equipment to be used for tunnel excavation and installation of support.

c. Documentation.

i. Permits for the disposal of excavated material. The Contractor shall obtain and submit written permits from the owners of property where excavated material (muck) will be deposited off-site if different than the approved disposal areas. Permits shall absolve the Owner from responsibility in connection with disposal of such material.
ii. Temporary ventilation plan. The Contractor shall submit details of the ventilation fans and ducting and computations showing ventilation volumes that meet the ventilation requirements specified herein.

iii. A schedule of the estimated delivery time, assembly time, and start-up time for shield excavation.

iv. Estimated overall average daily advance rate for tunnel excavation, in feet/day, from start of shield excavation to finish of shield excavation. Estimated average excavation rate in feet/hour for tunnel excavation should be included.

d. Tunnel excavation equipment. No more than ten working days after Notice to Proceed, submit schedule of design, manufacture, and delivery of equipment for proposed tunnel excavation. Contractor shall submit all documentation and drawings needed to clearly demonstrate that the all tunnel excavation augment be anticipated to be utilized and supporting equipment is adequate to excavate the ground types and conditions indicated in the Geotechnical Baseline Reports (GBR). Include description of all mechanical and electrical systems, system for installing ground support, back-up systems, dust suppression and ventilation systems, environmental control systems, air monitoring, and documentation of complete muck handling system including types and capacities of equipment to be used for muck loading and transport underground and above ground.

e. Maintain and submit on a daily basis shift records, including:
   i. Starting and ending stations for each shift.
   ii. Crew size and allocations for each shift.
   iii. Type, quantity, and location of support installed.
   iv. For Each Excavation and Support Cycle:
      • Time of beginning and end of cycle; and
      • Horizontal and vertical alignment from theoretical centerline at the end of each cycle.
   v. Air quality reports of tests for dust, toxic and hazardous gases, and other atmospheric impurities in the working environment including the time, location and gas levels.
   vi. Record of water inflow, and corrective/preventative measures implemented if required.

f. Submit all down-time, to account for 24 hours of each day from the first day of tunnel excavation. Reasons for and activities during down-times must be described in detail. Submit on a weekly basis.

g. Submit on a daily basis records of any unusual occurrences, including rock falls, unstable ground, ground water problems, equipment malfunction, power outages, damage to tunnel ground support systems and the location and time of each such occurrence.

h. Maintain and submit weekly a progress chart showing tunnel advance on a time scale, annotated with significant events and activities.
2. The CONTRACTOR shall design the initial support and additional support required for working safety. Design submittals sealed and signed by a Professional Engineer registered in the State of Arizona, will be required for initial support and any additional support required for working as safety. Submit shop drawings and information showing initial support systems for tunnel construction that conforms to plans and specified in the Contract Documents. Show detailed method of construction; detailed installation procedures; method of expansion, shim, connection, or mechanical connection, gasket, compression packing, non-shrink grout, and necessary design calculations.

3. The Owner’s Representative review of the submitted material shall, in no way, relieve the CONTRACTOR of the responsibility for making a satisfactory installation meeting the requirements of these Documents.

1.7 QUALITY ASSURANCE

A. Tolerances to line and grade shall be as follows:
   1. Horizontal Alignment. Maximum departure of 4 inches at any point along the theoretical tunnel centerline.
   2. Elevation. Maximum departure of 4 inches at any point along the theoretical tunnel grade line.

B. Tunnel Project Manager. The Contractor’s Tunnel Project Manager must have at least 10 years of experience in rock tunnel construction with the methods specified herein, and have successfully managed a similar tunnel project to completion within the last 6 years.

C. Tunnel Engineer. The Contractor’s staff shall include an engineer meeting the following requirements:
   1. Education. Graduate civil, mining or geological engineer.
   2. Registration. Licensed Professional Engineer in the State of Arizona.
   3. Experience. Both office and field experience in tunnel engineering of closely controlled and monitored tunnel excavations utilizing similar excavation equipment, pre-grouting techniques, and steel sets and lagging as ground support.
   4. Duties shall include the following:
      a. Plan and supervise tunnel excavation and ground support installation procedures.
      b. Plan and supervise ground water control measures, including grouting in advance of the heading, and implementation of corrective measures if initial pre-grouting measures are not sufficient to adequately control ground water infiltration rates into the heading.
      c. Assess ground conditions and corresponding tunnel ground support as the tunnel is advanced and documented on a daily basis.
      d. Interpret instrumentation readings and correlate them with observed ground conditions and excavation methods.
e. Hold discussions with the Owner’s Representative regarding ground and ground water conditions, ground support requirements, instrumentation readings, and excavation and ground support procedures.

f. Participate in all pertinent coordination meetings with the Owner and Owner’s Representative.

D. The Contractor’s proposed Tunnel Supervisor, and TBM/Shield Operator on each shift shall each have a minimum of five years’ experience in tunnel excavation with the methods specified herein.

E. During the tunnel construction, the CONTRACTOR’s project manager shall be assigned to the job and shall be on-site as needed during the week while work is in progress, and the CONTRACTOR’s field superintendent shall be present full-time at the job site whenever work is in progress.

F. The operator(s) of the tunneling equipment shall have technical training in the operation of the proposed equipment and shall have completed at least one tunnel project with similar equipment in the last five years.

1.8 DELIVERY, STORAGE AND HANDLING

A. Handle, ship and store material in a manner that will prevent distortion or other damage. Store material in a clean, properly drained location out of contact with the ground. Replace all damaged material with new material or repair the damaged material in a manner approved by the ENGINEER.

1.9 PROJECT CONDITIONS

A. There shall be no classification for payment of the various materials encountered in shaft or tunnel construction, except as otherwise indicated in the Contract Documents.

B. The Geotechnical Baseline Report contains geotechnical data and predictions of geologic conditions and ground behavior during the construction of the Work.

C. The CONTRACTOR shall use the predicted conditions of the Geotechnical Baseline Report to plan and bid the Work.

D. The ENGINEER will use the Geotechnical Baseline Report to identify and quantify Differing Site Conditions that may be encountered during the Work.

E. Coordinate tunneling activities with other work being performed so as not to cause any interruption in construction operations under this or other Contracts.
F. The requirement for probing and pressure grouting in front of the tunnel excavation face is defined on construction plans. This requirement is defined as the minimum amount of probing and pressure grouting to be performed. Contractor shall perform additional probing and pressure grouting, as required, for encountered conditions.

G. The Contractor shall remove the tunnel excavation equipment at the end of the tunnel drive.

1.10 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS (NOT USED)

2.2 MATERIALS AND/OR EQUIPMENT

A. Tunnel Shoring:
   1. Construction drawings providing details to stabilize the excavated tunnel.
   2. Metal liner plates shall be non-coated steel in accordance with ASTM A569. The plates shall consist of two or four flanges. The thickness of the plates and the sizes of bolts and nuts shall be as determined by the CONTRACTOR. The CONTRACTOR shall submit a structural analysis that indicates the required thickness of the plates as prepared by a Professional Engineer registered in the State of Arizona.
   3. Ribs and laggings shall consist of radial steel ribs and longitudinal steel or wood supports. The steel ribs shall be H-shaped, non-coated structural steel members. The wood lagging shall be at least 4” × 4” oak timbers, no more than 3 feet long, designed to span between steel ribs. The size of the structural steel members and wood lagging shall be determined by the CONTRACTOR. Steel laggings shall be designed to span between the ribs and to support soil loads. The CONTRACTOR shall submit a structural analysis that indicates the required thickness of the ribs and lagging prepared by a Professional Engineer registered in the State of Arizona.

B. Carrier Pipe
   1. When shown on plans the carrier pipe installed in the initial support shall conform to contract specifications.

C. Tunnel Boring Machine
   1. In accordance with Specification Section 02312.

2.3 – 2.4 (NOT USED)
PART 3 – EXECUTION

3.01 GENERAL

A. OWNER shall establish survey controls for construction. CONTRACTOR shall check these controls and report any errors or discrepancies to ENGINEER prior to the start of the work. CONTRACTOR shall use these controls to furnish and maintain all grades. CONTRACTOR shall submit to ENGINEER copies of field notes used to establish line and grade.

3.02 PREPARATION

A. Ground Classification and Typical Ground Support

1. Generally, the determination of tunnel type shall be made by the Contractor through his Tunnel Engineer, in association with the Owner’s Representative.
2. Evaluation of the ground conditions and of the appropriate ground support shall be made immediately following the completion of one excavation cycle and under consideration of the anticipated subsurface conditions immediately ahead of the face.
3. The approval of the proposed tunnel type by the Owner’s Representative or his failure to call attention to improper ground support or to require a respective change will not relieve the Contractor of his responsibility for the integrity of the tunnel excavation, the ground support system and the proper execution of the work.

3.3 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. General

1. CONTRACTOR shall select method(s) most appropriate for excavation of tunnel and installation of initial support of the tunnel, subject to any restrictions or constraints set forth in the Contract Documents. CONTRACTOR shall be fully responsible for the success of construction methods in complying with all requirements of the PLANS and Specifications.
2. The methods and equipment shall be such that loss of ground from outside the periphery of the initial support is positively prevented. Stability of the working face shall be maintained at all times. Ground shall be positively prevented from running or flowing into the tunnel, through any element of the initial support, or through joints between such elements, except for material excavated from the face during normal operation. Soil particles shall be positively excluded from any water entering the tunnel from surrounding ground.
3. The CONTRACTOR shall control and report immediately to the Owner’s Representative any water from any source entering the tunnel.
4. Where necessary to control ground during removal of obstructions or to cope with other conditions, CONTRACTOR shall within 24 hours apply other
measures of ground control.

5. No gasoline-powered equipment shall be permitted in the tunneling operations. Diesel, electrical, or air-powered equipment will be acceptable, subject to applicable Federal and State regulations. Any diesel engines used shall be equipped with scrubbers.

B. Ventilation System

1. The ventilation system should be designed in accordance with Federal State and local regulations provide a minimum of 10,000 cfm of fresh air at the face.

2. Provide, operate and maintain for duration of the project a temporary ventilation system which conforms to specified safety requirements and those of jurisdictional authorities and the requirements of contract specifications.

3. Review by the Owner’s Representative of the Contractor’s proposed ventilation scheme shall not relieve the Contractor of his responsibility to provide an adequate ventilation system in accordance with this specification.

4. Written Records of Readings. The Contractor shall provide air testing devices for flammable, toxic, and carbon dioxide gases. Written records of all readings shall be kept by the Contractor. Testing frequency and location shall be determined according to 29 CFR 1926.

C. Ground Water Control

1. Groundwater control for tunnel construction may include sump dewatering, well dewatering, fissure and cavity grouting, or a combination of these control measures. It is the CONTRACTOR’s responsibility to design and operate, as applicable, his selected groundwater control measures. The CONTRACTOR is responsible for maintaining a dewatered condition during tunnel construction. The design of the dewatering system shall consider the potential for damage to adjacent facilities due to settlement by lowering of the groundwater table. CONTRACTOR shall submit the proposed dewatering plan(s) prior to construction.

2. All groundwater seepage and other water removed from the work site shall be filtered/treated and approved by the OWNER prior to discharge. Discharge method and location shall be approved by the OWNER. Dewatering system shall be designed and constructed so as to prevent washing of native or in situ materials. Dispose of groundwater in accordance with all applicable local, State and Federal regulations, and the requirements specified in other Contract Documents. CONTRACTOR shall note the expected components of the sediment in the muck and water, as indicated in the Geotechnical Baseline Report. The OWNER has strict requirements for treatment/filtration of this water prior to disposal.

3. Discharge of groundwater from the construction area must be treated to achieve a water quality with particles no larger than 30 microns in diameter. Vendors with equipment available to achieve this degree of treatment include the following: Deltank Filter Press, Rain for Rent, Baker Corporation, or equal. Contractor to submit shop drawings of selected equipment for
review and approval in accordance with the contract documents.

4. Construction water that is discharged off-site shall meet local, state and federal water quality requirements and shall be discharged in the location shown on plans.

5. Equipment used to achieve water quality shall be operated and maintained to meet the specified effluent requirements. Filter bags, filter media, backwash fluid, removed debris, etc. shall be contained on-site until removal from the site and disposal at a location approved by the Owner.

D. Lighting

1. All work areas, including all shafts and tunnel sections under construction, shall be lighted with a sufficient number of electric lights to ensure proper safety, work and inspection, and shall comply with all OSHA requirements. Lighting of the surface work areas during “after dark” operations (when allowed by the OWNER) is also required. All lighting shall be thoroughly insulated and shall be kept separate from power circuits.

E. Ground movement

1. The CONTRACTOR shall be responsible for monitoring ground movement associated with the work in accordance with Specification 02306 Instrumentation and Monitoring and making suitable changes in construction methods to control ground movements and prevent damage to the work, the overlying highway and adjacent structures. Areas where movements exceed these requirements shall be repaired to the satisfaction of the owning agency and as directed by the Owner’s Representative.

2. Perform tunnel excavation in a manner that will minimize the movement of the ground in front of, above, and surrounding the tunneling excavation. Support the ground in a manner to prevent loss of ground and keep the perimeter and face of the tunnel stable at all times, including shutdown periods. CONTRACTOR shall, at his expense, repair any damage caused by ground movement.

F. Geological Mapping

1. The Owner’s Representative will conduct geological mapping and visual inspection of the excavated surface of the tunnel. The Contractor shall provide the tunnel station reference and access for geologic mapping, including ventilation, lighting, pumping or any other support requirements.

2. Prior to mapping, the Contractor shall clean the excavated surface of all debris and dust.

3. Where steel ribs and full perimeter lagging are to be applied, the excavated surface shall be mapped and inspected prior to installation of the initial ground support.
G. Geotechnical Instrumentation
   1. Install geotechnical instrumentation at locations in accordance with plans and Specification 02306 Instrumentation and Monitoring to monitor ground deformation following excavation.
   2. Instrumentation shall be installed as shown on the Contract Drawings and in accordance with contract requirements.

H. Face control
   1. Upon shut-down of tunnel excavation for more than 2 hour, or immediately if site conditions warrant, the CONTRACTOR shall provide complete face control. Face control shall be defined as positive measures to prevent movement or loss of soil or water at the excavated face.
   2. If face control is not maintained and face movement occurs or voids are created, the CONTRACTOR shall stabilize the ground and fill any holes or voids created prior to continuing normal tunnel excavation. The CONTRACTOR shall have on hand at all times, equipment, labor and materials necessary to immediately address and stabilize these occurrences.

I. Enlargements
   1. Enlargements of the tunnel opening for the CONTRACTOR’s convenience may be performed when approved in writing by the Owner’s Representative prior to the start of excavation. Provide shop drawings completely describing the proposed work, including dimensions of the enlargement, excavation, support and concrete backfilling methods.

J. Emergency Measures
   1. Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, the CONTRACTOR shall operate with a full crew for 24 hours a day, including weekends and holidays, without intermission, until those conditions no longer jeopardize the stability of the Work.

K. Tunnel Access
   1. Provide access for the Owner’s Representative and/or his designees to observe the work, to perform independent line and grade surveys, for geologic mapping, and for monitoring of geotechnical instrumentation, as deemed necessary by Owner’s Representative.

L. Safety Requirements
   1. Methods of construction for tunneling shall be such to ensure the safety of the work, project participants, the public, third parties, and adjacent property, whether public or private. As a minimum, all work shall conform to the requirements of OSHA. The CONTRACTOR is solely and completely responsible for maintaining safe-working conditions at the site at all times.
2. Provide lighting and ventilation to ensure proper performance and inspection of work. Provide ventilation equipment and ductwork as close to the excavated face as practicable.

3. Control noise and dust in accordance with applicable Federal, State and local laws, safety codes, regulations and ordinances.

4. Equip muck trains with acceptable braking systems and safety chains to prevent runaway trains. Provide safety equipment necessary to prevent trains from rolling out of the work area and for conducting safe muck transporting operations.

5. Maintain clean working conditions within the tunnel at all times. All muck, slush, grout spills, ponded water, and other material not required for tunneling shall be removed from the tunnel in a timely manner.

M. Carrier Pipe Installation

1. When shown on plans, install the carrier pipe in such a way as to provide full and complete support of carrier pipe, to prevent flotation until completion of the annulus grouting operation, and to achieve final alignment and grade of carrier pipe as required on the PLANS.

2. Grout the annulus between the initial support and the carrier pipe with a procedure that ensures complete filling of the annulus, the carrier pipe is undamaged by grouting, and the carrier pipe is on design line and grade.

N. Electrical System

1. Temporary power systems and electrical equipment installation shall be in conformance with applicable portions of the National Electric Code (NEC) and all OSHA requirements. All system and equipment shall be suitable for installation in wet locations. All metallic parts shall be properly grounded. Power circuits shall be separate from lighting and ventilating circuits. The construction site shall have standby generators of sufficient capacity to operate at least the lighting and ventilating systems. The standby generators shall be operated at not less than weekly intervals to ensure their performance and reliability. The standby power shall automatically and immediately provide power to the lighting and ventilating system. In lieu of standby generators for lights, the CONTRACTOR may use emergency battery lights in the tunnel.

O. Communications

1. A three-way voice communications system and an independent electric bell or buzzer system between any manned location within the tunnel, the shaft bottom, and the ground surface shall be installed and kept in operation at all times.

3.4 REPAIR/RESTORATION (NOT USED)
3.5 FIELD QUALITY CONTROL

A. Perform work so as to minimize safety hazards and exposure of workers and equipment to hazardous and potentially hazardous conditions in accordance with specified safety requirements.

B. In the event methane or other flammable, toxic gases are encountered during tunnel construction, the Contractor shall notify the Engineer and immediately take steps to control gas concentrations as described in 29 CFR 1926.

C. In case of emergency likely to endanger excavation or adjacent structures, continuously maintain full work force 24 hours per day including weekends and holidays until emergency or hazardous conditions no longer jeopardize stability and safety of the work.

3.6 ADJUSTING (NOT USED)

3.7 CLEANING AND INSPECTION

A. Dispose of tunnel muck in accordance with the contract requirements.

3.8 – 3.11 (NOT USED)

++ END OF SECTION ++
PART 1 GENERAL

1.01 SUMMARY

A. The work includes design, procurement, installation, and execution of tunnel excavation by Tunnel Boring Machine for the West Anthem Gravity Sewer improvements - Phase 1 in Phoenix, Arizona, for the I-17 crossing only.

B. All work specified is the responsibility of the Contractor, subject to the approval of the Engineer. Perform work in accordance with all current applicable regulations and codes of Federal, State, and local agencies. In the event of conflict, comply with the strictest requirements. No part of this specification shall be construed as a relaxation of any of these rules, laws, and regulations.

C. The tunnel has been classified as potentially gassy in accordance with the Code of Federal Regulations, 29 CFR 1926 Safety and Health Regulations for Construction (OSHA). All operations including, but not limited to, excavation, support installation, and ventilation shall be performed following OSHA and all other local, State, and Federal laws and regulations for work in a potentially gassy underground environment.

D. Furnish all labor, materials, and equipment required to excavate the tunnel to the minimum dimensions and grades as shown on the Drawings and as required to perform the work by use of a Tunnel Boring Machine (TBM).

E. Construction methods shall satisfy the requirements of the section while utilizing and preserving the inherent strength of the rock mass surrounding the tunnel. The strength of the rock mass forms the foundation of the permanent support for this tunnel.

F. Excavated dimensions and arrangements shown on the Drawings for the tunnel are approximate dimensions. Subject to the approval of the Engineer, the Contractor may select such dimensions as he may require to conduct the work, based on space requirements for the equipment used, installation of components, handling of excavated material, methods of construction, and ancillary services.

G. Furnish all labor, materials and equipment to install tunnel ground support, as shown on the Drawings, for the tunnel ground support type determined during construction. The Contractor’s methods of excavation shall be compatible with the requirements for the initial tunnel support, as indicated in the referenced specification items or on the Drawings. If the selected tunnel ground support type fails to provide satisfactory performance within the encountered ground conditions, the Contractor shall provide another support type with no additional cost to the Owner.

H. Furnish all material and labor to install and maintain pumps, piping, drains, and other facilities for the control, collection, and disposal of groundwater from inside the tunnel excavation. Water collected in the tunnel shall be disposed of per requirements in Section 01412 Stormwater Pollution Prevention Plan and Permit.

I. The Contractor shall be responsible for furnishing and installing all electrical equipment required to complete the tunnel construction activities both on the surface and underground at the construction sites. The Contractor shall also furnish the electrical equipment for all of the auxiliary systems which shall include but not be limited to transformers, panel boards, security lighting, grounding, power for vent fans, sump pumps, disconnect switches, voice communication equipment, office trailer, etc. The work shall include the following:

1. Electric lines shall be sized for the loads and rated properly for the delivery voltage.
2. Lighting along the length of the tunnel, in the shaft areas, and in the vicinity of all operating equipment.

3. The Contractor as required will provide communication equipment.

1.02 RELATED REQUIREMENTS

A. The Contractor shall have the sole responsibility for maintenance and protection of existing utilities, structures, and facilities within the zone impacted by the shafts. The zone of impact shall include the zone of ground movement in the vicinity of this work.

B. The Contractor shall have the sole responsibility for sizing shafts within the limits specified and shown on the Drawings. The size of the excavations shall be adequate to construct all structures required and to gain access to tunneling operations for all materials, equipment, and personnel.

C. The Contractor shall allow the Engineer and Owner’s representatives access to the shafts, and to use the shafts to assess tunnel operations.

D. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATION Sections.

1.03 – (NOT USED)

1.04 DESIGN CRITERIA

A. Definitions

1. Full-Faced Shielded TBM: A machine that excavates a full-face tunnel utilizing a rotating cutterhead. The cutterhead generally is equipped with disc cutters, picks or other excavation tools. The machine is fitted out with equipment for installing the initial support system and connected to a backup trailing gear equipped with a system of conveyors and related devices for muck removal.

2. Open-Faced Shield Machine: A machine consisting of a full shield with an open face. Excavation is carried out with a roadheader arm. The shield is fitted out with equipment for installing the initial support system and connected to a backup trailing gear equipped with a system of conveyors and related devices for muck removal.

3. Clast: A rock fragment resulting from the breakdown of larger rocks.

B. Performance Requirements

1. Excavated dimensions and arrangements shown on the Plans for the tunnel and shafts are minimum dimensions. Subject to review by the Engineer and within the constraints of any maximum dimensions shown on the drawings.

2. The methods of excavation shall be compatible with the requirements for the initial tunnel support, as indicated in Section 02310 or on the Plans.

3. For an Open-Faced Shield Machine blasting will not be allowed for tunnel construction. Therefore the equipment will need to be equipped with an excavation tool suited for excavating the ground and/or use rock splitting techniques to excavate higher strength ground.
1.05 DESIGN AND PERFORMANCE CRITERIA

A. The geological formation along the alignment of the Tunnel is shown in the Geotechnical Baseline Report (GBR).

B. Control water infiltration into the tunnel in accordance with the requirements of Contract Specifications.

C. All excavated material from the tunnel must be removed from the starting point of the tunnel.

D. Maintain an adequate supply of all ground support elements on site to prevent delays to the work.

1.06 SUBMITTALS

A. Furnish the following in accordance with Specification Section 01300, “Submittals”.

1. Submit to the Engineer the following a minimum of eight weeks before the scheduled start
   of the applicable activity.

   a. Name and qualifications of person responsible for initial support and any additional tunnel support system design. This work shall be prepared and sealed by a Professional Engineer registered in the State of Arizona.

   b. Shop drawings and design calculations indicating arrangement of supports and construction sequence for proposed Tunnel support system(s). Calculations shall include estimates of likely deflections or deformations of the supports and maximum tolerable values.

   c. Breakout plans indicating type of support installed to transfer loads and maintain excavation support and stability of the excavation during tunneling.

   d. Provisions for protecting adjacent facilities and utilities.

2. Submit to the Engineer the following:

   a. Qualification of TBM staff: Submit within 60 days of the Notice to Proceed, qualifications and experience of individuals to be involved in tunnel construction including the proposed Tunnel Project Manager, Tunnel Engineer, and TBM Operators that meet the requirements as specified.

   b. Tunnel Boring Machine: No more than ten working days after Notice to Proceed, submit schedule of design, manufacture, and delivery of TBM. Contractor shall submit all documentation and drawings needed to clearly demonstrate that the TBM and supporting equipment is adequate to excavate the excavated material types and conditions indicated in the GDR and GBR. Include description of thrust and steering system, cutter-head design, drive system, system for installing ground support, back-up systems, dust suppression and ventilation systems, environmental control systems, air monitoring, and documentation of complete much handling system including types and capacities of equipment to be used for much loading and transport underground and above ground.

   c. Maintain and submit on a daily basis shift records, including:

      i. Starting and ending stations for each shift.
ii. Crew size and allocations for each shift.

iii. Starting and ending TBM clock reading for each shift.

iv. Type, quantity, and location of support installed.

v. Horizontal and vertical alignment from theoretical centerline at the end of each push.

vi. Air quality reports of tests for dust, toxic and hazardous gases, and other atmospheric impurities in the working environment including the time, location, and gas levels.

vii. Record water inflow.

d. Submit all down time to account for 24 hours of each day from the first day of tunnel excavation. Reasons for and activities during down times must be described in detail. Submit on a weekly basis.

e. Submit on a daily basis records of any unusual occurrences, including excavated material falls, unstable ground, groundwater problems, equipment malfunction, power outages, damage to tunnel ground support systems and the location and time of each such occurrence.

f. Maintain and submit weekly a progress chart showing tunnel advance on a time scale, annotated with significant events and activities.

1.07 QUALITY ASSURANCE

In accordance with Specification Section 02310 – Tunnel Construction.

1.08 – 1.10 (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Tunnel Boring Machine (TBM)

1. The TBM shall be full-face shielded or open face shield designed and built or rebuilt for the ground conditions on this project by a recognized TBM manufacturer with at least 10 years experience in the design and manufacture of TBMs of this type. All of the various components and systems, which make up the TBM shall be new or reconditioned so that the machine is ready to operate upon installation at the site. It shall be able, with excess capacity, to handle the range of ground and groundwater conditions and ground support requirements indicated in the Contract Documents and GBR.

2. Design TBM with cutting tools, thrust and torque that will enable it to excavated the tunnel on alignment and grade to minimum diameter excavation lines in the formations indicated by the GBR. Design TBM to handle ground conditions described in GBR. The TBM shall have adequate thrust, torque, and cutter-head rotational speed to maintain advance rates that will permit completion of the work within the allowed schedule, with appropriate excess capacity as recommended by the TBM manufacturer. Select gauge-cutting diameter so as to permit ground support to be placed within tolerances, considering also the wear on the gauge cutters.

3. Provide a propulsion system capable of moving the TBM in a forward direction while maintaining the construction tolerances with respect to line, grade, and direction.
4. Design TBM and supporting equipment with capacity to steer as necessary to maintain specified tolerances without delays.

5. Provisions shall be included in the design of the TBM for installation of ground support as shown on the Drawings and as described in Specifications. The trailing gear shall be able to advance through all ground types without delay and without damaging the ground support.

6. Provisions shall be included in the design of the TBM for grouting ahead of the tunnel face, in compliance with the requirements of Construction Plans and Specifications.

7. Provide a dust suppression and environmental control system, which when combined with the ventilation system, is capable of meeting OSHA or Project requirements, whichever is more rigorous.

8. For guidance and control during operation, the TBM shall include an automatic system capable of maintaining the excavation to the tolerances specified herein.

B. Accessories

1. Rock Bolts: In accordance with Construction Plans and Specifications.

2.03 – 2.04 (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Prior to commencement of TBM excavation, the Contractor shall furnish all labor, materials, and equipment to excavate and support the excavation. If Contractor elects to construct a TBM starter tunnel to initiate TBM operations, Contractor must be aware of the requirement to completely fill and seal starter upon completion of the work.

B. The Contractor shall determine the size, length, and appropriate support system for any required starter tunnel.

C. Perform tunnel excavation as shown on the Contract Drawings and as specified herein.

D. Following determination of the required tunnel ground support type, install the necessary rock bolts, wire mesh, chain link, steel sets, in accordance with Construction Plans and Specifications.

3.02 PREPARATION (NOT USED)

3.03 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. Ground Classification and Ground Support

1. Generally, the determination of tunnel type shall be made by the Contractor through his Tunnel Engineer, in association with the Engineer.

2. Evaluation of the ground conditions and of the any additional ground support shall be made immediately following the completion of a thrust cycle and under consideration of the anticipated subsurface conditions immediately ahead of the face.

3. The approval of the proposed tunnel support type by the Engineer or his failure to call attention to improper ground support or to require a respective change will not relieve the Contractor of his responsibility for the integrity of the tunnel excavation, the ground support system and the proper execution of the work.

B. Ventilation System:
1. The ventilation system should be designed to provide a minimum fresh air at the face of all TBM excavated tunnels with accordance to Construction Plans and Specifications.

2. Provide, operate, and maintain for duration of the project a temporary ventilation system, which conforms to specified safety requirements and hose of jurisdictional authorities, and the requirements shown in Contract Documents. Review by the Engineer of the Contractor’s proposed ventilation scheme shall not relieve the Contractor of his responsibility to provide an adequate ventilation system in accordance with this specification.

3. Written Records of Readings: The Contractor shall provide air-testing devices for flammable, toxic, and carbon dioxide gases. The Contractor shall keep written records of all readings. Testing frequency and location shall be determined according to 29 CFR 1926.

C. Groundwater Control:

D. Illumination

1. In accordance with 02310 – Tunnel Construction.

E. Geological Mapping

1. The Engineer will conduct geological mapping and visual inspection of the excavated surface of the tunnel and take photographs at appropriate locations. The Contractor shall provide the tunnel station reference and access for geological mapping, including ventilation, washing of the sidewalls, lighting, pumping, or any other support requirements.

2. Prior to mapping, the Contractor shall clean the excavated surface of all debris and dust and take photographs at appropriate locations.

F. Geotechnical Instrumentation.

1. Install geotechnical instrumentation at locations directed by the Engineer to monitor ground deformation following excavation.

2. Instrumentation shall be installed as shown on the Contract Drawings and as specified in Contract specifications.

3.04 – 3.06 (NOT USED)

3.07 CLEANING AND PROTECTION

A. Dispose of tunnel muck in accordance with the requirements of Construction.

3.08 TESTING AND INSPECTION (NOT USED)

3.09 PROTECTION

A. Perform work such as to minimize safety hazards and exposure of workers and equipment to hazardous and potentially hazardous conditions in accordance with specified safety requirements.

B. In the event methane or other flammable or toxic gases are encountered during tunnel construction, the Contractor shall notify the Engineer and immediately take steps to control gas concentrations as described in 29 CFR 1926.

C. In case of emergency likely to endanger excavation or adjacent structures, continuously maintain full work force 24 hours per day including weekends and holidays until emergency or hazardous conditions no longer jeopardize stability and safety of the work.

3.10 SCHEDULES (NOT USED)

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3.11 MEASUREMENT AND PAYMENT

Unless otherwise indicated, no separate measurement or payment for work performed under this Section. Include cost of same in Contract price bid for work of which this is a component part.

++END OF SECTION++
SECTION 02315

STRUCTURAL EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to perform all excavating, backfilling, filling and grading, and disposing of earth materials as shown on the Drawings, specified, and required for construction of retaining walls, manholes, vaults, structure foundations, underground ductbanks, electrical manholes and handholes, and other structures and facilities required to complete the Work in every respect.
   2. All necessary preparation of subgrade for slabs, foundations and pavements is included.
   3. All temporary means required to prevent discharge of sediment to water courses from dewatering systems or erosion are included.
   4. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof, except rock.
   5. On-site excavated material will be classified for use as backfill material. Excavation materials include all materials regardless of type, character, composition, moisture, or condition thereof.
   6. Perform all earthwork as specified in this Section.

1.2 QUALITY ASSURANCE

A. Testing Services:
   1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory as designated in Section 01451, Testing Laboratory Services Furnished by OWNER.
   2. OWNER’S Testing Agency Scope:
      a. Test CONTRACTOR’S proposed materials in the laboratory and/or field for compliance with the Specifications.
      b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.
      c. Report all test results to the ENGINEER and CONTRACTOR.
   3. Authority and Duties of OWNER’S Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests and shall report their findings to the ENGINEER and CONTRACTOR. When the materials furnished or Work performed fails to fulfill Specification
requirements, the technician will direct the attention of the ENGINEER and CONTRACTOR to such failure.

a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the ENGINEER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of CONTRACTOR:

a. The use of testing services shall in no way relieve CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

2) Furnish such casual labor as is necessary to obtain and handle samples at the Work site or at other sources of material.

3) Advise the OWNER’S testing agency at least two days in advance of any backfill operations to allow for completion of quality tests and for the assignment of personnel.

b. Responsibility belongs to CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork, and to control his operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

c. The frequency of CONTRACTOR’S confirmation tests shall be per City of Phoenix Street Transportation Department, Design and Construction Management Materials Laboratory (EXHIBIT A – ACCEPTANCE SAMPLING/TESTING REQUIREMENTS)

d. Copies of the test reports shall be submitted promptly to the ENGINEER.

e. Demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:

1) 200 linear feet of trench backfill.

2) 10 cubic yards of structural backfill.

3) 100 cubic yards of embankment work.

4) 50 cubic yards of base material.

data. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.

g. Periodic compliance tests will be made by the ENGINEER to verify that compaction is conforming to the requirements previously specified, at no cost to CONTRACTOR. Remove the overburden above the level at which the ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete.

h. If compaction fails to conform to the specified requirements, remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the ENGINEER.
B. Permits and Regulations:
   1. Obtain all necessary permits for Work in roads, rights-of-way, railroads, etc. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations.
   2. Perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM A 36, Specification for Structural Steel.
   2. ASTM A 328, Specification for Steel Sheet Piling.
   3. ASTM D 422, Method for Particle-Size Analysis of Soils.
   5. ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil.
   6. ASTM D 1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   8. ASTM D 2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  13. Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix, Section 206, Structure Excavation and Backfill, Section 604, Placement of Controlled Low Strength Material, Section 702, Base Materials, Section 725, Portland Cement Concrete, Section 728, Controlled Low Strength Material. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and this Specification, provisions of this Specification shall govern.
  14. City of Phoenix Street Transportation Department ACCEPTANCE SAMPLING/TESTING REQUIREMENTS (EXHIBIT A)

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Excavation and Backfill Submittals:
      a. Excavation Plan: Prior to start of excavation operations, a written plan shall be submitted to demonstrate compliance with OSHA Standard 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of competent person.
2) Excavation method(s) or protective system(s) to be used.
3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.

b. Excavation and backfill requirements detailing sheeting and bracing, or other protective system(s), dewatering systems, cofferdams, and underpinning.

c. Shop Drawings shall be prepared by a Registered Professional Engineer, licensed in the State of Arizona, recognized as an expert in the specialty involved. Drawings shall be submitted to ENGINEER for record purposes only. Calculations shall not be submitted. Drawing submittals will not be checked and will not imply approval by ENGINEER of the Work involved. Sole responsibility for designing, installing, operating and maintaining whatever system is necessary to satisfactorily accomplish all necessary sheeting, bracing, protection, underpinning and dewatering belongs to CONTRACTOR.

d. Shop Drawings shall be submitted to Engineer for all materials, including select backfill, general backfill, crushed stone and sand.

1.4 JOB CONDITIONS

A. Subsurface Information: Refer to Section 00700, General Conditions, and Section 00800, Supplementary Conditions, for available data on subsurface conditions. The data is not intended as a representation or warranty of continuity of conditions between soil borings nor of groundwater levels at dates and times other than date and time when measured. OWNER will not be responsible for interpretations or conclusions by CONTRACTOR. Data is solely made available for the convenience of CONTRACTOR.

1. Additional test borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER.

B. Existing Structures: The Drawings show certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown on the Drawings for the convenience of CONTRACTOR. Explore ahead of the required excavation to determine the exact location of all existing structures. Structures shall be supported and protected from damage by CONTRACTOR. If they are broken or damaged, restore them immediately, at no additional cost to the OWNER.

C. Existing Utilities: Locate existing underground utilities in the areas of the Work. If utilities are to remain in place, provide adequate means of protection during all operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult piping or utility owner and ENGINEER immediately for directions as to procedure. Cooperate with OWNER and utility owner in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
2. In general, service lines to individual houses and businesses are not shown on the Drawings, however, assume that a service exists for each utility to each house or business.

3. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided.

4. Completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

D. Use of Explosives:
   1. The use of explosives will not be permitted.
   2. Do not bring explosives onto site or use in the Work without prior written permission from authorities having jurisdiction. Provide copy of authorization to ENGINEER. Sole responsibility for handling, storage, and use of explosive materials when their use is permitted belongs to CONTRACTOR.

E. Protection of Persons and Property: Barricade open excavations occurring as part of the Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

F. Dust Control: Conduct all operations meeting the requirements specified in Section 01414, Earthmoving and Dust Control.

G. Roadways and Walks: Unless otherwise approved by ENGINEER, excavated material and materials of construction shall be so deposited, and the Work shall be so conducted, as to leave open and free for pedestrian traffic all crosswalks, and for vehicular traffic a roadway not less than ten feet in width. All hydrants, valves, fire alarm boxes, letter boxes, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, maintain such crosswalks, sidewalks, and roadways in satisfactory condition and the Work shall at all times be so conducted as to cause a minimum of inconvenience to public travel, and to permit safe and convenient access to private and public property along the line of the Work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Backfill and Fill Materials:
   1. Materials acceptable for use as backfill against walls, foundations, underground ductbanks, and other structures shall be stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain
no organic matter, nor contain rocks or fragments greater than 4-inches in size, nor have greater than 40 percent passing the 200 sieve. The maximum expansion of on-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at two percent below optimum moisture content under a 100 psf surcharge pressure.

2. Backfill and fill materials from off-site sources shall consist of silty or clayey sand soils which are uniformly mixed, contain no organic matter and which have a Plasticity Index less than ten. The maximum particle size of imported soils shall be 4-inches or less, if required to satisfy trenching, landscaping, or other requirements. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at two percent below optimum moisture content under a 100 psf surcharge pressure.

3. All materials for use as backfill and fill material shall be tested by the laboratory and approved by the ENGINEER.

4. If on-site material is unsuitable as determined by the ENGINEER, select backfill or approved off-site fill shall be used.

5. Fill adjacent to structures is classified as backfill to a distance measured horizontally from the structure that is equal to the depth from the finished grade. Outside these limits the fill is classified as embankments, unless otherwise specified.

B. Select Backfill: Select Backfill (Aggregate Base Course (ABC)) for use beneath concrete slabs and asphaltic pavements shall be crushed aggregate conforming to the requirements below:

<table>
<thead>
<tr>
<th>Sieve Sizes (Square Openings)</th>
<th>Percentage by Weight Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4-inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>38 to 65</td>
</tr>
<tr>
<td>No. 8</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 to 40</td>
</tr>
<tr>
<td>No. 200</td>
<td>3 to 12</td>
</tr>
</tbody>
</table>

C. Fill Material for Embankments:

1. Fill materials for use as embankments, and as miscellaneous landscaping materials exterior to plant facilities, shall consist of soils obtained from on-site excavations or off-site sources that are uniformly mixed, contain no organic material, rocks or fragments greater than 3-inches in size.

2. All materials for use as described above shall be tested by the laboratory and approved by the ENGINEER.

D. Drainage Fill: Washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than five percent passing a No. 4 sieve. Crushed stone or gravel shall be crushed rock or gravel conforming to the requirements of Section 02318, Crushed Stone and Gravel.
E. General Backfill and Fill Materials: Provide approved soil materials for backfill and fill, free of clay, rock or gravel larger than 6-inches in any dimension, debris, waste, frozen materials, vegetable and other organic matter and other deleterious materials. Previously excavated materials meeting these requirements may be used for backfill.

PART 3 -EXECUTION

3.1 INSPECTION

A. Provide ENGINEER with sufficient notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed. The CONTRACTOR to call for a final inspection by the ENGINEER of all components to be buried and comply with the inspection recommendations. ENGINEER will notify CONTRACTOR if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 SITE PREPARATION

A. Clear all areas to be occupied by permanent construction or embankments of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip subgrades for fills and embankments of vegetation, sod, topsoil and organic matter. All waste materials shall be removed from site and properly disposed of by CONTRACTOR. Burning is not be permitted. Refer to and comply with the requirements of Section 02230, Clearing.

3.3 TEST PITS

A. Payment for test pits ordered by ENGINEER will be paid for under the unit price bid.

B. No separate payment will be made for test pits made by CONTRACTOR for his own use.

3.4 EXCAVATION

A. Perform all excavation required to complete the Work as shown on the Drawings, specified and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders not requiring drilling and blasting for removal, decomposed rock, pavements, rubbish and all other materials within the excavation limits, except rock.

B. Excavations for structures and underground ductbanks shall be open excavations. Provide excavation protection system(s) required by ordinances, codes, law and regulations to prevent injury to workmen and to prevent damage to new and existing structures or pipelines. Unless shown on the Drawings or specified otherwise, protection system(s) shall be utilized under the following conditions.
1. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.

2. Excavations More Than Five Feet Deep: Excavations in stable rock where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded or shored and braced.

3. Excavation protection system(s) shall be installed and maintained in accordance with drawings submitted under Article 1.3, above.

C. Where the structure or ductbank is to be placed below the ground water table, well points, cofferdams or other acceptable methods shall be used to permit construction of said structure under dry conditions. Dry conditions shall prevail until concrete has reached sufficient strength to withstand earth and hydrostatic loads. In addition, protect excavation from flooding until all walls and floor framing up to and including grade level floors are in place and backfilling has begun. Water level shall be maintained below top of backfill at all times.

D. Pumping of water from excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete materials, and to prevent damage to the existing subgrade.

E. The elevation of the bottom of footings shown on the Drawings shall be considered as approximate only and ENGINEER may order such changes in dimensions and elevations as may be required to secure a satisfactory footing. All structure excavations shall be hand-trimmed to permit the placing of full widths, and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.

F. When excavations are made below the required grades, without the written order of ENGINEER, they shall be backfilled with select backfill material, as directed by ENGINEER, at the expense of CONTRACTOR.

G. Excavations shall be extended sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of shoring or bracing or the safe sloping of banks.

H. Subgrades for roadways and structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with select backfill material. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown on the Drawings. Proof roll all subgrades prior to placing of select fill and general fill material.
I. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations.
   2. Dispose of excess soil material and waste materials as specified hereinafter.
   3. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy clay soils. Use and placement of fill shall be performed as specified for each class.
   4. Excess soil from excavations shall be disposed of off-site. Disposal shall be in accordance with state and local regulatory requirements.

J. Where ENGINEER considers the existing material beneath the bedding material unsuitable, CONTRACTOR remove same and replace it with select backfill.

3.5 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown on the Drawings, and which is not approved by ENGINEER, together with the removal and disposal of the associated material shall be at CONTRACTOR’S expense. Unauthorized excavations shall be filled and compacted with select backfill by CONTRACTOR at his expense.

3.6 DRAINAGE, EROSION CONTROL AND DEWATERING

A. Erosion Control:
   1. In general, the construction procedures outlined herein shall be implemented to assure minimum damage to the environment during construction. Take any and all additional measures required to conform to the requirements of applicable codes and regulations, and the requirements specified in Section 01412, Stormwater Pollution Prevention Plan and Permit.
   2. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion and minimize damage to vegetation.
   3. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the ENGINEER’S approval.
   4. Temporary measures shall be applied to control erosion and to minimize the silting of the existing waterways, and natural ponding areas. Such measures shall include, but are not limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of this Work.
      a. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
      b. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other Work to the extent practicable to assure economical, effective, and continuous erosion and silt control.
      c. Provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability.

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5. Remove only those shrubs and grasses that must be removed for construction. Protect the remainder to preserve their erosion-control value.

6. Install erosion and sediment control practices where shown on the Drawings and according to applicable standards, codes and specifications. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.

7. Mulching to be used for temporary stabilization.
   a. Suitable Materials for Mulching:
      1) Unrotted straw or salt hay: 1-1/2 to 2 tons/acre.
      2) Asphalt emulsion or cutback asphalt: 600 to 1200 gal. /acre.
      3) Wood-fiber or paper-fiber (hydroseeding): 1500 lbs./ acre.
      4) Mulch netting (paper, jute, excelsior, cotton or plastic).
   b. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.

8. After stabilization, remove all straw bale dikes, debris, etc., from the site.

9. In the event of any temporary Work stoppage, take steps any temporary or environmental damage to the area undergoing construction.

10. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, the OWNER reserves the right to employ outside assistance or to use its own forces to provide the corrective measures indicated. The cost of such work, plus engineering costs, will be deducted from monies due CONTRACTOR.

11. Prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on and off-site damage and health hazards. Control may be achieved by irrigation in which the site shall be sprinkled with water until the surface is moist. The process shall be repeated as needed.

B. Drainage and Dewatering:
   1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, therein is inspected by the ENGINEER and backfill operations have been completed and approved.
      a. The different working areas on the site shall be kept free of surface water at all times. Install drainage ditches and dikes and shall perform all pumping and other Work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations and fill areas. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.
      b. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the point of discharge, shall not be directly discharged. Such waters shall be diverted through a settling basin or filter before being discharged.
c. Responsibility belongs to CONTRACTOR for the condition of any pipe, conduit or channel used for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.

d. Remove water from excavations as fast as it collects.

2. Provide, install and operate sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, etc., necessary to depress and maintain the ground water level below the base of the excavations during all stages of construction operations. The ground water table shall be lowered in advance of excavation, for a sufficient period of time so as to permit dewatering of fine grain soils, and maintained two feet below the lowest subgrade excavation made until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural ground water. The system shall be operated on a 24-hour basis and standby pumping facilities and personnel shall be provided to maintain the continued effectiveness of the system. If, in the opinion of the ENGINEER, the water levels are not being lowered or maintained as required by these Specifications, install additional or alternate dewatering devices as necessary, at no additional cost to the OWNER.

a. Elements of the system shall be located so as to allow a continuous dewatering operation without interfering with the construction of the permanent Work. Where portions of the dewatering system are located in the area of permanent construction, submit details of the methods he proposes to construct the permanent Work in this location for the approval of the ENGINEER. Controls of ground water shall continue until the permanent construction provides sufficient dead load to withstand the hydrostatic uplift of the normal ground water, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until all waterproofing Work has been completed. Dispose of all water removed from the excavation in such a manner so as not to endanger any portion of the Work under construction or completed. Convey water from the excavations in a closed conduit. Before discontinuing dewatering operations or permanently permitting the rise of the ground water level, computations shall be made to show that any structure affected by the water level rise is protected by backfill or other means to sustain uplift. Use a safety factor of 1.25 when making these computations.

b. Dewatering operations shall not be discontinued without the prior authorization of the ENGINEER.

c. Design of dewatering system, including both drawings and calculations, shall be performed by a Registered Professional Engineer in the State of Arizona and shall be employed by CONTRACTOR. Dewatering system shall be designed so as to avoid settlement or damage to existing structures and utilities.

3. SRP may release water from upstream dams into the Salt and Gila Rivers which may affect ground water levels on the project site.

C. Disposal of Water Removed by Dewatering System:

1. CONTRACTOR’S Dewatering System will discharge to a location in accordance with State and Federal regulations.
2. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.
3. Dispose of water in such a manner as to cause no inconvenience to OWNER, ENGINEER, or others involved in Work about the site.
4. Convey water from the construction site in a closed conduit. Do not use trench excavations as temporary drainage ditches.
5. Meter the quantity of water discharged in a manner acceptable to the Arizona Department of Water Resources.
6. The discharged water from the Dewatering System shall be purchased from the Arizona Department of Water Resources at the prevailing rate.

3.7 SHEETING, SHORING AND BRACING FOR STRUCTURE EXCAVATIONS

A. General:
   1. Used material shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary work.
   2. All timber used for breast boards (lagging) shall be new or used, meeting the requirements for Douglas Fir Dense Construction grade with a bending strength not less than 1500 psi or Southern Pine No. 2 Dense.
   3. All steel work for sheeting, shoring, bracing, cofferdams etc., shall be designed in accordance with the provisions of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", of the AISC except that field welding will be permitted.
   4. Steel sheet piling shall be manufactured from steel conforming to ASTM A 328. Steel for soldier piles, wales and braces shall be new or used and shall conform to ASTM A 36.
   5. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
   6. Unless otherwise shown on the Drawings, specified, or ordered, all materials used for temporary construction shall be removed when Work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
   7. Provide permanent steel sheet piling or pressure creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required, but at least three feet below grade, and leave permanently in place.
   8. The clearances and types of the temporary structures, insofar as they affect the character of the finished Work, and the design of sheeting to be left in place, will be subject to the approval of ENGINEER; but responsibility for the adequacy of all sheeting, shoring, bracing, coffer-damming, etc., belongs to CONTRACTOR.
   9. Safe and satisfactory sheeting, shoring and bracing shall be the entire responsibility of CONTRACTOR.
10. All municipal, County, State and Federal ordinances, codes, regulations and laws shall be observed.

B. Removal of Sheeting and Bracing:
   1. Remove sheeting and bracing from excavations, unless otherwise directed in writing by ENGINEER. Removal shall be done so as to not cause injury to the Work. Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure.
   2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
      a. Concrete has cured a minimum of seven days.
      b. Wall and floor framing up to and including grade level floors are in place.

3.8 TRENCH SHIELDS

A. Excavation of earth material below the bottom of a shield shall not exceed the limits established by ordinances, codes, laws and regulations.

B. When using a shield for the installation of structures, the bottom of the shield shall not extend below the top of the bedding for the structures.

C. When a shield is removed extreme care shall be taken to prevent damage to the structures or the disturbance of the bedding for structures. Structures that are disturbed shall be removed and reinstalled as specified.

3.9 PLACEMENT OF FILL AND BACKFILL

A. General:
   1. All select backfill and backfill required for structures, embankments, and ductbanks and required to provide the finished grades shown on the Drawings and as described herein shall be furnished, placed and compacted by CONTRACTOR. Refer to and comply with the requirements of Section 02318, Crushed Stone and Gravel.
   2. Backfill excavations as promptly as Work permits, but not until completion of the following:
      a. Acceptance by the ENGINEER of construction below finish grade, including dampproofing, waterproofing and perimeter insulation.
      b. Inspection, testing, approval, and recording of locations of underground ductbanks.
      d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
      e. Removal of trash and debris.
   3. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material as specified.

B. Placement of Select Backfill, Backfill and Fill:

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1. Select backfill shall be placed to the grades shown on the Drawings. The lift thickness and compaction moisture content range given herein are approximate. These values shall be finally determined from the laboratory test results on the fill materials. Testing requirements shall be as specified in Paragraph 3.9.E., below.

2. All select backfill shall be placed in horizontal loose lifts, not exceeding 8-inches in thickness, and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by not less than two complete coverages of the specified compactor. Select backfill shall be placed to the underside of all concrete slabs. The fill material shall extend a minimum of two feet outside the face of each structure and be 12-inches below finished grade on all structures. The maximum slope of select backfill to the subgrade shall be one vertical to one horizontal.

3. Backfill and fill around and outside of structures and over select backfill shall be deposited in layers not to exceed 8-inches in uncompacted thickness and mechanically compacted, using platform type tampers. Compaction of structures backfilled by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of select backfill and/or backfill by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the Drawings.

4. The material shall be placed at a moisture content and density as specified under Paragraph 3.9.E., below. Provide equipment capable of adding measured amounts of water to the backfill and/or select backfill material to bring it to a condition within the range of the required moisture content. Provide equipment capable of discing, aerating, and mixing the soil to ensure reasonable uniformity of moisture content throughout the fill material and to reduce the moisture content of the borrow material by air drying, if necessary. If the subgrade or lift of earth material must be moisture conditioned before compaction, the fill material shall be sufficiently mixed or worked on the subgrade to ensure a uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.

5. No backfill or fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted. No fill shall be placed or compacted in a frozen condition or on top of frozen material. Any fill containing organic materials or other unacceptable material previously described shall be removed and replaced with approved fill material prior to compaction.

6. Compaction shall be performed with equipment suitable for the type of fill material being placed. Select equipment that is capable of providing the minimum density required by these Specifications. Hand operated compacting equipment shall be used within a distance of ten feet from the wall of any completed below grade structure. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected shall be tested at the commencement of
compacted fill Work by construction of a small section of fill within the area where fill is to be placed. If tests on this section of fill show that the specified compaction is not obtained, increase the amount of coverages, decrease the lift thicknesses and/or obtain a different type of compactor.

7. Levels of backfill against concrete walls shall not differ by more than two feet on either side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs. Particular care shall be taken to compact structure backfill, which will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure backfill, the structure backfill shall be placed and compacted to an elevation 12-inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

8. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and/or compressive strength tests shall be performed on the samples of materials submitted by CONTRACTOR. From the results of the laboratory tests, the final values of the required percent compaction, the acceptable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.

9. Control the water content of fill material during placement within the range necessary to obtain the compaction specified. In general, the moisture content of the fill shall be within three percent of the optimum moisture content for compaction as determined by laboratory tests. Perform all necessary work to adjust the water content of the material to within the range necessary to permit the compaction specified. Do not place fill material when free water is standing on the surface of the area where the fill is to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted.

10. Compact fill shall be compacted by at least two coverages of all portions of the surface of each lift by compaction equipment. One coverage is defined as the condition obtained when all portions of the surface of the fill material have been subjected to the direct contact of the compactor.

11. If the specified densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment, perform whatever Work is required to provide the required densities. This Work shall include complete removal of unacceptable fill areas, and replacement and recompaction until acceptable fill is provided.

12. If any settlement occurs, repairs will be at CONTRACTOR’S expense. Make all repairs and replacements necessary within 30 days after notice from ENGINEER or OWNER.

13. Special attention is required to assure compaction under all piping to spring line, if the compaction process is not satisfactory to the ENGINEER. The CONTRACTOR shall use half-sack slurry for backfill to spring line.
C. Backfill in Electrical Ductbank Trenches:
   1. Compacted backfill shall be required for the full depth of the trench, below and above the electrical ductbank. Where the trench for one ductbank passes beneath the trench for another pipe or ductbank select backfill shall be placed to the level of the bottom of the upper trench.
   2. Placement and compaction of backfill in electrical ductbank trenches shall conform to the requirements of Paragraph 3.9.B., above.

D. Crushed Stone Placement:
   1. Crushed stone shall be placed where shown on the Drawings to the limits shown.
   2. Crushed stone shall be place in hand tamped lifts, not to exceed 6-inches.

E. Compaction Density Requirements:
   1. The degree of compaction required for all types of fills shall be as listed below. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.

<table>
<thead>
<tr>
<th>Material</th>
<th>Required Minimum Density-Percent Compaction (ASTM D 698)</th>
<th>*Maximum Uncompacted Lift (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade and Subbase Fill:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below concrete slabs on grade</td>
<td>95</td>
<td>8</td>
</tr>
<tr>
<td>Below base of footings or mats,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>structural slabs and tank floors</td>
<td>95</td>
<td>8</td>
</tr>
<tr>
<td>Below asphalt concrete paving</td>
<td>95</td>
<td>12</td>
</tr>
<tr>
<td><strong>Structural Backfill:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 5 feet below final grade</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Less than 5 feet below grade</td>
<td>95</td>
<td>8</td>
</tr>
<tr>
<td>Aggregate Base Course:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below concrete slabs or mats</td>
<td>95</td>
<td>8</td>
</tr>
<tr>
<td>Below asphalt paving</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Trench Backfill, below and above ductbanks</td>
<td>95</td>
<td>12</td>
</tr>
</tbody>
</table>

* Where applicable.
** Structural backfill shall not be used for support of facilities which are susceptible to damage from differential settlement of the fill section relative to walls.

All fill must be wetted and thoroughly mixed to achieve optimum moisture content, ±three percent, with the following exceptions: On site clayey soils optimum to plus three percent.
Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.

2. If the tests indicate unsatisfactory compaction, provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction Work shall be performed by CONTRACTOR, at no additional cost to the OWNER, until the specified compaction is obtained. This Work shall include complete removal of unacceptable (as determined by the ENGINEER) fill areas and replacement and recompaction until acceptable fill is provided.

F. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with select backfill material and thoroughly compacted as specified in Paragraph 3.9.E., above. Sides of the excavation shall be sloped in accordance to the maximum inclinations specified for each structure location.

3.10 GRADING

A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:
   1. Turfed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than 1-inch above or below the required subgrade elevations.
   2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1-inch above or below the required subgrade elevation.
   3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten foot straightedge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.
3.11 PAVEMENT SUBBASE COURSE

A. General: Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
   1. Refer to Section 02742, Bituminous Paving, for paving Specifications.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each base course layer. Compact and roll at least a 12-inch width of shoulder simultaneously with compacting and rolling of each layer of base course.

D. Placing: Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
   1. When a compacted base course is shown on the Drawings to be 6-inches thick or less, place material in a single layer. When shown on the Drawings to be more than 6-inches thick, place material in equal layers, except no single layer more than 6-inches or less than 3-inches in thickness when compacted.

3.12 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations which does not conform to the requirements for fill or is in excess of that required for backfill shall be hauled away from the project site by CONTRACTOR and disposed of in compliance with ordinances, codes, laws and regulations at no additional cost to the OWNER. Refer to and comply with the requirements of Section 02230, Clearing.

3.13 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

A. Place 1-1/2 inches of temporary bituminous pavement immediately after backfilling trenches in paved roadways which are to be retained for permanent use. Maintain the surface of the paved area over the trench in good and safe condition during progress of the entire Work, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfilling. The permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise specified.

B. Pavement, gutters, curbs, sidewalks or roadways disturbed or damaged by the CONTRACTOR’S operations, except areas designated "New Pavement" or "Proposed Pavement", shall be restored by CONTRACTOR at his own expense to as good condition as they were previous to the commencement of the Work and in accordance with applicable local and state highway specifications.
3.14 TEMPORARY FENCING

A. Furnish and install a temporary fence surrounding his excavations and Work area, including the stockpile and storage areas. Fence shall have openings only at vehicular, equipment and worker access points.

B. Furnish and install a temporary screening fence as shown on the Drawings.

3.15 ENVIRONMENTAL PROTECTION AND RESTORATION

A. Refer to and comply with the requirements of Section 01412, Stormwater Pollution Prevention Plan and Permits.

++ END OF SECTION ++
SECTION 02318

CRUSHED STONE, GRAVEL AND DECOMPOSED GRANITE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to furnish and install crushed stone, gravel and decomposed granite of the types specified at locations shown on the Drawings and as directed by the ENGINEER.

1.2 QUALITY ASSURANCE

A. Conform to all applicable requirements of Section 701 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Government (MAG) as supplemented by the City of Phoenix. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and these Specifications, the provisions of these Specifications shall govern.

B. Sampling and sieve analysis shall be performed in accordance with ASTM D 75 and ASTM C 136.

1.3 SUBMITTALS

A. Submit for approval the following:
   1. Furnish representative samples of the crushed stone and gravel to the ENGINEER and advise of the source location.
   2. Test reports, including sieve analyses, showing material compliance with specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Furnish and place crushed stone or screened gravel fill under pipe or structures where shown on the Drawings in addition to that required under other Sections. Comply with requirements of Section 15051, Buried Piping Installation.
   2. Crushed stone and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
3. The loss by abrasion in the Los Angeles abrasion machine, determine as prescribed in ASTM C 131, Grading A, shall not exceed ten percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

B. Crushed Stone:
   1. Crushed stone shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50 percent by weight of aggregate retained on the No. 4 sieve for 3/4-inch or larger maximum sizes, and 50 percent retained on the No. 8 sieve for maximum sizes less than 3/4-inch shall consist of particles which have at least one rough, angular surface produced by crushing.
   2. The gradation of crushed stone shall comply with ASTM D 448.

C. Gravel:
   1. Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn.
   2. Crushed rock obtained by crushing rock which exceeds ASTM D 448 maximum gradation sizes may be combined provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this specification.

D. Decomposed Granite:
   1. Decomposed granite shall be ¾-inch minus, supplied from a single supply source, for a uniform appearance throughout the Project. It shall be free from lumps or balls of clay and shall not contain any calcareous coatings, caliches, organic matter of foreign substances.

PART 3 - EXECUTION

3.1 PLACING

A. Gravel shall be spread in layers of uniform thickness not exceeding 8-inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment. The placing of crushed stone or gravel shall conform to applicable requirements of Section 02315, Structural Excavation and Backfill, except as noted above.

B. Prior to placing decomposed granite, all areas to receive it shall be sprayed with a pre-emergent herbicide according to the manufacturer’s recommendations within Maricopa Association of Governments (civil) requirements. Do not spray herbicide on any areas designated to receive seeding. Decomposed granite shall be rolled uniformly for depth and compacted to all areas designated on the DRAWINGS to a minimum depth of 2 – inches.
SECTION 02530

POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 DESCRIPTIONS

A. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish high-density polyethylene (HDPE) pipe, fittings, and joints.

1.02 DEFINITIONS

A. Ring deflection: Ratio of vertical change in diameter to pipe original diameter. Deflection is often expressed as percentage.

B. Bent strap test: A field performance destructive test of fusion welded joints to confirm joint integrity on wall thickness less than 1-inch.

C. Guided side bend test: A field performance destructive test of fusion welded joints to confirm joint integrity on wall thickness greater than 1-inch.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Submit detailed drawings and data on pipe, alignment of pipes layouts and schedule, location of fittings and joints, connections to ductile iron pipe, and appurtenances as required. Refer to and comply with the requirements of Section 15051, Buried Piping Installation.
   2. Within 14 days of the Date of Agreement, submit the name of the pipe manufacturer and a list of materials to be furnished by said manufacturer. Also, include information on local representative for manufacturer, if product is sold through a distributor.
   3. Submit manufacturer's catalog data and descriptive literature for all material items listed below.
   4. Detectable Warning Tape.
   5. Fusion technician training certifications.
   6. Fusion equipment.
   7. Weld bead removal equipment and process.
   8. Pipe Repair Components: Contractor shall furnish City of Phoenix for storage the following listed items including three (3) repair clamps for each diameter of HDPE pipe furnished on this project. Full circumferential stainless steel single band repair clamps, complete with gaskets, nuts, and bolts; JCM 131 or equal; and one (1) ten feet length of pipe for each diameter of HDPE pipe furnished on this project. The ends (plain) shall be prepared for thermal-butt fusion.

B. Certificates: Submit certificates of compliance with referenced standards.
1.04 QUALITY ASSURANCE

A. Welder’s qualifications:
   1. Personnel involved with fusion welding shall have received proper training in accordance with Manufacturer’s recommended procedure. All personnel performing fusion welding to receive training and certification by factory qualified and experienced HDPE fusion joining technician as designated by pipe manufacturer. Training to include 8 hours of training and certification on performance of heat fusion joints and operation of heat fusion machine and datalogger. All training and certifications to take place in presence of Engineer. Contractor to submit employee welding certifications to Engineer for record. All personnel performing fusion welding to maintain certified fusion welding status throughout duration of all fusion welding operations. All labor, equipment, and material costs associated with this training and certification is incidental to furnishing and installation of HDPE materials.
   2. Maintain records of training. Training dates shall not exceed 12 months from date of construction, and training and certification records shall be submitted to Engineer.

B. Material and Equipment Furnished:
   1. All materials and equipment furnished under this Section shall be of a manufacturer who has been fully engaged in design and manufacturer of materials and equipment for at least five years. Manufacturer to also demonstrate to Engineer that quality of materials and equipment produced by manufacturers specifically named herein is equal, if an alternate product manufacturer is proposed.

1.05 DELIVERY, STORAGE AND HANDLING

A. Pipes shall be packaged in manner designed to deliver pipe to project neatly, intact, and without physical damage.

B. Store pipe in manner to prevent undue scratching or gouging of pipe. If pipe must be stacked for storage, stack in accordance with pipe manufacturer’s recommendations. Handling of pipe shall be done in such manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

C. Sections of pipe having been discovered with cuts or gouges in excess of 10% of wall thickness of pipe shall be cut out and removed at no additional cost to the Owner. Undamaged portions of pipe shall be rejoined using approved methods specified herein.

D. Handle fused segments of pipe to avoid damage to pipe. When lifting fused sections of pipe, chains or cable chokers are not allowed. Nylon slings or other nonabrasive material shall be used. Exercise care to avoid cutting or gouging pipe.

1.06 REFERENCE STANDARDS: Comply with applicable provisions and recommendations of the following, except as otherwise shown or

A. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400 ft-lbf/ft³(600 kN-m/m³).


E. ASTM D2774, Standard Practice for Underground Installation of Thermoplastic Pressure Piping.


I. AASHTO T 99, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in).

J. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 63 in (100mm Through 1,600 mm), for Water Distribution and Transmission.

PART 2 - PRODUCTS

2.01 PIPE TRENCH DESIGN REQUIREMENTS

A. Bedding: Applies from bottom of pipe to 4” (150 mm) below pipe, fine graded, and compacted and tested to 95% of AASTO T-99 Bedding materials shall be deposited as specified in Section 15051, Buried Piping Installation, and as shown on the Drawings.

B. Pipe zone: Applies to full trench width from bottom of trench to 1’ (300 mm) above top of pipe. Pipe zone shall be compacted to 95% of AASHTO T-99.

C. Remaining backfill: Applies to backfill above pipe zone. Remaining backfill shall be mechanically compacted in accordance Section 15051, Buried Piping Installation.

D. Plastic Tracer Tape and Magnetic Tracer Tape Marking shall conform to the requirements specified in Section 15051, Buried Piping Installation.

2.02 PIPE AND FITTINGS

A. Pipe and fittings with standard thermoplastic material designation code of PE4710 in accordance with ASTM D3350; W.L. Plastics, JM Eagle, ISCO Industries, or equal:
   1. Cell Classification: PE445574C/E, Type III, Grade,
   2. Standard Dimension Ratio (SDR): 11 maximum,
   3. Minimum pressure rating of 200 psi at 73.4°F,
4. Nominal inside diameter of 8.68 inches and 10 inches OD, and
5. Nominal inside diameter of 20.99 inches and 26 inches OD.
6. Submit manufacture certification that pipe complies with Specifications.

B. Materials shall be listed under manufacturer’s name in Plastic Pipe Institute (PPI) TR-4. Manufacturer shall supply product with standard grade hydrostatic design basis (HDB) rating of 1,600 psi (minimum) at 73°F (23°C) and 1,000 psi (minimum) for 140°F (60°C). Upon request, manufacturer shall supply certification that materials used to manufacture pipe and fittings meet above requirements.

C. Homogenous throughout; free of visible cracks, holes, foreign inclusions, blisters, dents or other injurious defects.

D. Uniform as commercially practicable in color, capacity, density and other physical properties. HDPE pipe and fittings to be manufactured with coextruded light color interior surface.

E. Pipe and tubing shall be manufactured using compounds complying with dimensional requirements. Dimensional and performance characteristics shall conform to requirements of ASTM F714.

2.03 MARKING

A. Permanently mark pipe in accordance with AWWA C906.

B. Indent marking may be used provided:
   1. Marking does not reduce wall thickness to less than minimum value for pipe.
   2. Demonstrate that marks have no effect on long-term strength of pipe or tubing.
   3. Marks do not provide leakage channels when elastomeric gasket compression fittings are used to make joints.

C. Marking shall remain legible under normal handling and installation practices.

D. Mark fittings on body or hub. Marking shall be in accordance with applicable standard depending upon fitting type. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer’s name or trademark.

2.04 JOINTS

A. Ductile iron pipe to HDPE pipe joints: Flanged joints.
   1. HDPE flanged adaptor/stub end, fusion welded to HDPE pipe.
   3. Gaskets: As specified by product manufacturer at specified pressure rating.

B. Pipe and fittings shall be joined by the following type of thermal fusion in accordance with manufacturer’s recommended procedures:
   1. Butt fusion.
      a. Melt beads produced during butt fusion process shall be removed from inside of pipe.
C. Contractor shall assume responsibility for restrained joint thrust restraint system design.

2.05 FITTINGS

A. Fabricate from HDPE pipe sections butt fusion welded together. Fabricated fittings shall be of the same material and pressure rating as the pipe. Fabricated fitting SDR to be no greater than pipe, unless specified otherwise. Fittings shall be butt fusion welded to the pipe unless called for otherwise on the drawings. Internal dimensions of all fused fittings to match HDPE pipe section internal diameters to facilitate future cleaning and pigging operations.

B. Working pressure: Equal to or greater than adjacent pipe.

C. Joint type: Same as associated piping.

2.06 DATALOGGER

A. Butt fusion welds shall be logged and recorded. Datalogger shall record approximate pipeline station, date, time, heat fusion properties, and parameters of each butt fusion joint.

B. Manufacturer: McElroy Manufacturing or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with ASTM D2774 and PPI procedures and guidelines. All pipe is to be laid to the lines and slopes depicted in the Drawings. Allowable variation from the specified values include the following: Vertical Position – plus or minus 3.0 inches, Horizontal Position – plus or minus 4.0 inches.

B. Take necessary precautions and design considerations necessary to effectively mitigate effects of thermal expansion and contraction. Measures shall include allowing pipe to cool to approximately ground temperature before backfilling and before making final connection to rigid members (fittings or structures).

C. Trenches and backfill:
   1. Trench requirements and limitations: As specified in Section, 15051, Buried Pipe Installation.
   2. Backfill material shall be in accordance with specification Section 02315 Structural Excavation and Backfill and Section 15051 Buried Pipe Installation.
   3. Compaction shall be in accordance with this specification. Water consolidation not allowed for HDPE pipe.

D. Joints:
   1. Contractor shall be responsible for field set-up and performance of fusion equipment and fusion procedure used by operator. Upon request, verify fusion quality by making and
testing joints in accordance with manufacturer’s recommended qualification procedure and bent test strap method specified herein.

2. Adjust set-up, equipment, operation, and fusion procedure. Joints that fail qualification procedure or tests shall be cut out of pipe section and new joint shall be constructed at no cost to Owner.

3. Construct joints in accordance with PPI Handbook of Polyethylene Pipe.

3.02 FIELD QUALITY CONTRL

A. Butt fusion joint quality:
   1. Joints shall be visually inspected to ensure proper bonding for all sizes of conventionally extruded polyethylene pipe.
   2. Visual inspection criteria for butt fusion joints shall be obtained from pipe manufacturer.

B. Butt fusion joint destructive testing: Fusion joining may be destructively tested to confirm joint integrity, operator procedure, and fusion machine set-up. Field-performed destructive test used on Project shall be bent strap test-and guided side bend test. Contractor to perform bent strap tests on HDPE pipe with wall thickness of 1-inch or less. Perform guided side bend tests on HDPE pipe with wall thicknesses greater than 1-inch. These applicable tests shall be completed on the first weld of each new pipe diameter or standard dimension ratio or at Engineer’s direction.
   1. Bent strap test specimen shall be prepared by making trial butt fusion weld and allowing it to cool to ambient temperature.
   2. Test strap that is at least 6" (150 mm) or 15 pipe wall thicknesses long, whichever is greater, on each side of fusion weld, and about 1" (25 mm) or 1-1/2 wall thicknesses wide, whichever is greater, shall be cut out of trial fusion pipe. Strap shall be bent so that ends of strap touch. Dis-bonding at fusion weld shall be unacceptable, and shall indicate poor fusion quality.
   3. If failure occurs, fusion procedures or machine set-up shall be changed, and new trial fusion and bent strap test specimen shall be prepared and tested.
   4. Field fusion shall not proceed until test joint has passed both bent strap and guided side bend tests.

C. Allowable ring deflection:

<table>
<thead>
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<th>DR</th>
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<tr>
<td>Allowable Ring Deflection</td>
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</table>

D. Hydrostatic testing:
   1. Submit detailed plan indicating procedure and schedule for pipe testing. Plan shall:
      a. Indicate pump(s) utilized.
      b. Means to measure make-up water.
      c. Pressure gages utilized.
      d. Drawing showing pipe sections to be tested.
   2. HDPE piping system shall be hydrostatically pressure tested before being put into service. Provide necessary equipment and manpower to perform required tests.
3. Pretest inspection:
   a. Test equipment and pipeline shall be examined before pressure is applied to ensure that connections are tight, necessary restraints are in place and secure, and components that should be isolated or disconnected are isolated or disconnected.
   b. Low-pressure pipes and other items not subject to test pressure shall be disconnected or isolated.

4. Test procedure consists of initial pressurization and expansion phase and test phase. Total test time including initial pressurization and expansion, and time at test pressure, shall not exceed 8 hours. If pressure test is not completed within 8-hours test section shall be depressurized, and allowed to “relax” for at least 8 hours before bringing test section up to test pressure again.

5. Initial pressurization and expansion phase:
   a. Free air shall be removed from test section prior to raising pressure in section above static head.
   b. Raise pressure at steady rate to required test pressure of 46-psi, plus or minus 2-psi. This pressure shall be measured as close as possible to lowest point of test section. Sufficient make-up water shall be added each hour for 3 hours to maintain test pressure.

6. Test phase:
   a. Begin only after completion of pretest inspection and initial pressurization and expansion phase.
   b. Duration: 2 hours, after which Contractor shall add measured amount of make-up water to pipe system to return test section to pressure of 46 psi.
      1) If amount of make-up water added does not exceed values shown on table below, test section passes hydrostatic test.
      2) If amount of make-up water added exceeds values shown on table below, test section fails hydrostatic test.

7. RemEDIATE and retest pipe sections that fail hydrostatic testing.

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Allowable Make-Up Water (gallons per 100’ of pipe @ 73.4°F)</th>
<th>2-Hour Test</th>
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E. Deflection Test: The inside diameter of an installed section of flexible pipe shall not be allowed to deflect more than five (5%) percent. The pipe deflection shall be checked by means of the deflection gauge in the presence of the Engineer after the placement of all trench backfill. Pipe deflection gauge shall be fabricated to permit passage through installed sections of pipelines within the specified tolerances applicable for flexible pipe. Any section or sections of flexible pipe that does not permit deflection gauge passage will not be accepted and said section or sections shall be replaced and rechecked as directed by the Engineer. Rerounding a damaged section is not permitted.

F. Camera Inspection: Final testing shall be in full compliance with City of Phoenix Supplements to MAG Section 615. Closed Circuit T.V. (CCTV) inspection is required after backfilling has been completed. Prior to testing, the inside of each completed piping system shall be thoroughly cleaned of all dirt, loose scale, sand, and all foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air, as appropriate for the size and type of pipe. Contractor to notify Engineer 5 days prior to requested CCTV testing to allow scheduling of City of Phoenix CCTV inspection crews. Initial CCTV inspection to be paid by Owner. If additional CCTV inspections are required due to failure of initial inspection, CCTV inspection costs shall be paid by Contractor. All CCTV inspections will be completed by Water Services Department.
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install all precast and cast-in-place manholes.

B. General:
   1. Manholes shall conform in shape, size, dimensions, material, and other respects to the details shown on the Drawings or as directed by ENGINEER.
   2. Cast iron frames, grates and covers shall be the standard frame and grate or cover, unless otherwise shown on the Drawings, and shall be as specified in Section 05501, Miscellaneous Metal Fabrications, and Section 05561, Castings.
   3. Concrete for cast-in-place manholes and for inverts in precast manholes shall be Type “1” and shall conform to the requirements specified under Section 03305, Concrete.
   4. All concrete sanitary or process manholes including the Bid Alternate discharge structure carrying untreated wastewater shall be coated, tested and inspected in accordance with all applicable City of Phoenix Supplement to MAG Specifications 625 and 626, instructions, SSPC SP-13/NACE No. 6 “Surface Preparation of Concrete”, and manufacturer’s recommendation to meet its expected service life.
   5. All manholes shall be clean, dry, and free of sewage and debris during all inspections.

1.2 QUALITY ASSURANCE

A. Standard Specifications and Details:
   1. Conform to all applicable requirements of Section 625 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. If there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and these Specifications, the provision of these Specifications shall govern.

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.
1. ASTM C 139, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
2. ASTM C 140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
5. AWWA C 302, Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids.
6. MAG Section 625, as supplemented by the City of Phoenix.
7. City of Phoenix Supplement to MAG, Section 626.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Drawings showing design and construction details of all precast and cast-in-place manhole components, including details of joints between the manhole bases and riser sections and stubs or openings for connections.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

A. Manholes, including the concrete bid alternate discharge structure, shall conform to the details shown on the Drawings.

B. Except where otherwise specified, precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478, except as modified herein.

C. Reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.

D. Joints between manhole components shall be the tongue and groove type employing a single, continuous rubber O-ring gasket and shall conform to AWWA C302. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections and top slabs of manholes 72-inches in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than 72-inches in diameter shall be provided with steel bell and spigot rings.

E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for
Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than 5-inches. Concrete top slabs shall not be less than 8-inches thick.

F. Lifting holes, if used in manhole components, shall be tapered, and no more than two shall be cast in each section. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs driven from the outside face of the section only.

G. The point of intersection (P.I.) of the sewer pipe centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in the floor of each manhole base and protruding approximately 1-inch above the finished floor of the base.

H. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

I. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. All openings in precast cylinders are to be manufactured or cored to accommodate sewer pipe penetrations. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

J. A precast or cast-in-place slab or precast eccentric cone, as shown on the Drawings or approved by the ENGINEER, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover.

K. No ladder or steps shall be installed / casted inside of a manhole.

2.2 MISCELLANEOUS METALS

A. Metal frames, covers, and similar required items shall be provided as shown on the Drawings and in accordance with Division 5, Metals.

2.3 DROP CONNECTIONS

A. Drop connections for manholes shall be constructed where shown on the Drawings or directed by the ENGINEER and shall conform to the design and details shown on the Drawings. Pipe and fittings shall be ductile iron or reinforced concrete, as shown on the Drawings or otherwise approved by the ENGINEER. Concrete for pipe encasement shall be Type “2” as specified under Section 03305 Concrete. Concrete shall be bonded to manhole in the manner shown on the Drawings or otherwise approved by ENGINEER. Manhole drop connections shall be formed utilizing rigid forming material in conformance with MAG Section 505.
PART 3 - EXECUTION

3.1 PLASTERING

A. The outside of grading rings shall be neatly plastered with 1/2-inch of cement mortar as the Work progresses.

3.2 MANHOLE BASES

A. Cast-in-place bases shall be placed on suitable foundations after the pipes are laid. They shall be cast monolithically to an elevation at least 12-inches above the top of the highest pipe entering the manhole, except where a drop connection is to be installed. Base, walls and bottom shall be at least of the thickness shown on the Drawings and reinforced to withstand the loads to be expected. Connections for sewer pipes shall conform to the details shown on the Drawings. Manhole bases shall be formed utilizing rigid forming material in conformance with MAG Section 505.

B. Precast bases shall be set on a concrete or crushed stone foundation, as shown on the Drawings. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.3 PRECAST MANHOLE SECTIONS

A. Set sections vertical and in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

B. Install sections, joints and gaskets in accordance with manufacturer's recommendations.

C. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

3.4 MANHOLE CHANNELS

A. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown on the Drawings or as directed by the ENGINEER. Benches shall be built up to the heights shown on the Drawings or as directed by the ENGINEER and given a uniform wood float finish. Care shall be taken to slope all benches for proper drainage to the invert channel.
3.5 GRADING RINGS

A. Grading rings shall be used for all precast manholes, where required. Grade rings shall be a maximum of 12- inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the grade rings shall be such as is necessary to bring the manhole frame to the proper grade.

B. Each grading ring shall be laid in a full bed of mortar and shall be thoroughly bonded.

3.6 STUBS FOR FUTURE CONNECTIONS

A. As shown on the Drawings or required for connections, cast iron sleeves, ductile iron or reinforced concrete pipe stubs with approved watertight plugs shall be installed in manholes. Where pipe stubs, sleeves or couplings for future connections are shown on the Drawings or directed by the ENGINEER, provide all materials and labor in order to complete the Work.

3.7 GRADING AT MANHOLES

A. All manholes in unpaved areas shall be built, as shown on the Drawings or directed by the ENGINEER, to an elevation higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown on the Drawings or directed by the ENGINEER. The slope shall be covered with 4-inches of top soil, seeded and maintained until a satisfactory growth of grass is obtained.

B. Manholes in paved areas and areas receiving gravel shall be constructed to meet the final surface grade as shown on the Drawings.

C. Sole responsibility for the proper height of all manholes necessary to reach the final grade at all locations belongs to CONTRACTOR. Caution: ENGINEER'S review of Shop Drawings for manhole components will be general in nature, provide an adequate supply of random length precast manhole riser sections and adjustment rings to adjust any manhole to meet field conditions for final grading.

3.8 MANHOLE WATERTIGHTNESS

A. All manholes shall be free of visible leakage. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to ENGINEER'S approval. Manhole testing shall conform with the requirements of Section 15051, Buried Piping Installation, and City of Phoenix Supplement to MAG Section 625.
All manholes shall be vacuum tested prior to application of epoxy coating system. Epoxy coating system shall be in accordance with City of Phoenix Supplement to MAG Section 626.

3.9 FLEXIBLE PIPE JOINT AT MANHOLE BASE

A. An approved flexible joint shall be provided between each pipe entering and exiting the manhole. This may be accomplished by the installation in the manhole base of the bell end of a pipe or by other means subject to approval of ENGINEER. Joints shall be similar to the approved pipe joints. The joint into the manhole base shall be completely watertight.

+ + END OF SECTION + +
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section specifies requirements for installing welded steel pipe at the I-17 crossing. Pipe fabrication, placement of backfill around the pipe, and field pressure testing of the pipe are specified elsewhere.

1.2 SYSTEM DESCRIPTION

A. Design Criteria:
   1. Pipe support systems within the tunnel and shafts shall hold the pipes securely in position within the alignment tolerances specified herein during installation, backfilling, and operation.
   2. Pipe length: As indicated on the drawings.
   3. Refer to the Plans for additional criteria.

B. Performance Requirements:
   1. Maintain personnel for which qualifications have been specified herein assigned to the project on a full-time basis for the duration of work for which they are responsible.

C. Tolerances:
   1. Pipe Circularity: \((D_h-D_v)/D_v \leq 0.01\), where \(D_v\) is the pipe diameter measured vertically and \(D_h\) is the pipe diameter measured horizontally, immediately prior to encasement in backfill. When pipe sections are not horizontal, measure \(D_v\) and \(D_h\) in mutually perpendicular axes that yield the maximum and minimum dimensions for diameters.
   2. Pipe Alignment in Tunnel:
      a. Line: Within 0.25-inches of theoretical alignment.
      b. Grade: Within 0.25-inches of theoretical grade.
   3. Pipe Alignment in Shafts:
      a. Within 0.25-degrees of vertical.
      b. Corrections to verticality: No greater than 0.5-inches in 10 feet.

1.3 SUBMITTALS

A. General: Make submittals in accordance with Section 01300.
B. Product Data: Manufacturer’s technical information and recommendations for materials incorporated into the work that is not covered by product data submitted in connection with the fabrication of the pipe.

C. Shop Drawings: Pipe laying diagram for tunnel and each shaft showing pipe for each pipe section the length deflection, pipe identification number, joints and special fittings. Demonstrate that proper clearances for pipe installation exist and that the minimum annular space, shown on the Plans, will be provided.

D. Working Drawings and Methods Statements: Detailed means and methods for transporting, handling, storing, protecting, installing, supporting and blocking the pipe in place at its final location. Include:
1. Calculations demonstrating the pipe’s ability to handle transportation, handling, and construction loads without damage.
2. Preparations for installing pipe sections, including details of mock-up pipe section assembly.
3. Methods for cleaning areas where pipe is to be placed and maintaining such areas free of objectionable materials and standing or running water.
4. Panning details, drain pipes, and other methods for controlling groundwater inflows. Provide details to seal edges of panning to prevent backfill intrusion into drainage system.
5. Means and methods for filling voids, overbreak areas, blockouts and depressions in initial tunnel support systems and shaft excavation support systems where required.
6. Details of cradles, pipe supports, and methods for preventing flotation and buckling while placing backfill. Submit calculations demonstrating that pipe will not be damaged by proposed backfill sequences.
7. Sequence and methods for installing and securing gravity sewer pipe sections in the tunnel where the wedge blocking alternative is used. Provide details indicating the methods proposed to secure the wedge blocks and hold them in place for both the initial and final phases of the installation.
8. Sequence and methods for subsequently encasing pipe sections in backfill concrete. Show method, locations, and repair requirements used to monitor the advance of backfill.

E. Quality Control:
1. Qualifications:
   a. Contractor’s design engineer.
   b. Pipe installation superintendent.
2. Certifications: From pipe manufacturer and Contractor that pipe sections are capable of handling transportation, handling, installation, and construction loads without damage or distortion.
3. Quality Control Plans:
   a. For Pipe:
i. Methods for achieving minimum specified tolerances for line and grade, restricting pipe ovalization to specified limits, and providing the minimum annular clearance.

4. Recordkeeping: Daily records submitted no later than the beginning of the following working day:
   a. Number and classification of men and equipment.
   b. Beginning and ending stations or elevations of pipe lining, and station or elevation where joint work has been completed.
   c. Testing, including time, location, and results of tests.
   d. Notation of any downtime or interruption to production, including length of time and reason.

5. As-Built Data:
   a. As built survey of tunnel indicating the tunnel crown and invert elevations and centerline of tunnel at 50-foot intervals throughout tunnel. Superimpose design line-and-grade of pipeline on the as-built survey drawing.
   b. Prior to initiating pipe installation operations, survey data indicating that all ground movements around the tunnel and shafts have stabilized.
   c. Alignment of each pipe section taken at pipe centerline.
   d. Survey data for each joint on the pipe interior at the pipe centerline and springline.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor’s design engineer: Registered Arizona Civil or Structural Engineer with at least five years of experience in steel lining installation in tunnels and shafts.
   2. Superintendent in charge of pipe installation: In responsible charge of similar work on a minimum of two projects of equivalent size and complexity within the past ten years.

B. Preconstruction Meeting:
   1. Hold separate meetings for each location at least five calendar days but not more than 30 calendar days prior to commencing pipe installation where pipe will be installed. Provide minimum five calendar days advance notification of meeting time.
   2. Review and discuss the following items at each meeting:
      a. Construction methods and constraints overview.
      b. Equipment operating parameters.
      c. Safety procedures.
      d. Quality control procedures and quality assurance requirements.
      e. Reporting requirements.
      f. Other issues as may be raised by either party.

C. Testing: In accordance with pipe specifications.
1.5 SEQUENCING AND SCHEDULING

A. For Pipe: Install pipe in tunnel, place backfill and encasement concrete around pipe, and complete contact grouting and skin grouting.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle, transport, and store pipe sections in accordance with manufacturer’s recommendations, subject to the following:
   1. Do not use cables or chains.
   2. Support stored pipe at a minimum on the quarter points along the pipe length.
   3. Do not drag or skid pipe.
   4. Align pipe sections using jacks or other suitable devices without hammering, the use of sledges, and the use of dogs or equivalent devices attached to the pipe.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe: Refer to Sections 15050 and 15076.

B. Timber for stulls and braces:
   1. Construction Grade Douglas Fir, graded in accordance with WCLIB rules and especially selected for straightness.
   2. The Contractor may utilize used timber conforming to the above, provided however that it is sound, free from decay, torn grain, or other defects that may impair its serviceability.

C. Blocking:
   1. Precast concrete.
   2. Untreated, hardwood timber conforming to requirements for stulls and braces.
   3. Steel shapes with corrosion protection.
PART 3 – EXECUTION

3.01 PREPARATION

A. Control groundwater in the tunnel so that at no time during placement or initial hardening of the backfill concrete shall excessive water wash, mix with, or seep into the backfill concrete. Control and isolate water from the tunnel by erecting panning, and diverting with invert drain pipes, by pumping from sumps, or a combination thereof. Install sheeting, panning, and invert drains as needed to control groundwater inflows into the tunnel that shall be detrimental to backfill concrete quality. Demonstrate with survey data taken from tunnel initial support systems and shaft excavation support systems that ground movements have been stabilized.

B. Clean surfaces to receive backfill of muck, grout, debris, and other objectionable materials in each reach where pipe is to be installed.

C. All surfaces of tunnel initial support systems and shaft excavation support systems shall be inspected and approved in writing by the Engineer prior to installation of pipe.

D. The Engineer will inspect tunnel support systems and shaft excavation support systems to identify voids, openings, blockouts, and depressions which could hinder the complete infilling of backfill where required behind pipe, subject to specified criteria. Fill such voids, blockouts, and depressions determined by the Engineer to require filling using cellular concrete, concrete, or other materials approved in writing by the Engineer.

E. Temporary drain pipes no longer needed for groundwater control shall be removed or permanently backfilled with grout prior to installation of pipe.

F. Remove all rock, nonessential timber lagging or blocking, and other wood or degradable materials to provide the minimum thickness of low density cellular concrete indicated.

G. Clean-up of the tunnel and shafts shall be completed prior to pipe installation. Clean-up shall include the removal of material as follows:
   1. All loose, disturbed rock soil or rock in the tunnel or shaft inverts and along the tunnel or shaft sidewalls.
   2. Remove timber lagging, timber blocking, and timber wedges as much as practical without endangering the stability of the excavation. Immediately prior to pipe installation, all blocking and lagging shall be checked and made tight.

H. Pipe installation shall not commence until the Engineer approves in writing that tunnel preparation, clean-up, and groundwater control measures have been properly completed.
3.02 INSTALLATION

A. Immediately prior to moving a pipe section into the tunnel or shaft:
   1. Inspect sections and appurtenances. Remove or repair damage as directed by the Engineer. Replace damaged items that cannot be repaired as determined by the Engineer. Perform this work at no additional cost. Verify that sections can be transported to their required location without interference with or damage to initial tunnel support systems.
   2. Check threaded connections attached to the pipe section and equip with plugs.
   3. Remove foreign matter and contaminants from the pipe surfaces.

B. Install required supports and devices for aligning and positioning each pipe section to the required line and grade. Furnish and install necessary pipe supports, blocking, and stulling to eliminate pipe flotation and buckling and prevent other movement during backfill placement, and to securely hold the pipe in position in such manner as not to interfere with required work at the joints.

++ END OF SECTION ++
SECTION 02742

BITUMINOUS PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install hot mix hot-laid bituminous paving.
   2. The Work includes the following:
      a. Preparation of subgrade.
      b. Coarse graded base course.
      c. Fine graded surface course.
      d. Pavement marking.
      e. Microseal (Type III)
      f. Crack Seal
      g. Tack Coat
      h. Testing as specified.

1.2 QUALITY ASSURANCE

A. Standard Specifications and Details:
   1. Conform to all applicable requirements of the Uniform Standard Specifications For Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix as follows:
      a. Section 321, Placement and Construction of Asphalt Concrete Pavement.
      b. Section 332, Micro Surfacing Specification (Type III) (Microseal)
      c. Section 702, Base Materials.
      d. Section 713, Emulsified Asphalt Materials.
      e. Section 710, Asphalt Concrete.
      f. Section 714, Microsurfacing Materials (Type III) (Microseal)
      g. Section 337, Crack Sealing
      h. Section 329, Tack Coat
      i. Section 401, Temporary Traffic Control
   2. Conform to all applicable requirements of the Maricopa County Department of Transportation (MCDOT) Supplement to MAG Uniform Standard Specifications & Details for Public Works as follows:
      a. Section 461, Painted Pavement Markers.
      b. Section 462, Thermoplastic and Preformed Pavement Markings.
c. Section 463, Raised Pavement Markers.
d. Section 464, Roadside Sign Support.

3. Construction in Maricopa County shall follow the MCDOT Pavement Marking Manual.

4. If there is a conflict between the MAG Standard Specifications as supplemented by the City of Phoenix and these Specifications, the provisions of these Specifications shall govern.

   a. COP Supplement to MAG Section 401.

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.
   3. ASTM D 698, Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lbf/ft$^3$).
   4. MAG Standard Specifications, Section 321, as supplemented by the City of Phoenix.
   5. MAG Standard Specifications, Section 702, as supplemented by the City of Phoenix.
   6. MAG Standard Specifications, Section 710, as supplemented by the City of Phoenix.
   8. MAG Standard Specifications, Section 714.
   9. MAG Standard Specifications, Section 337.
   10. MAG Standard Specifications, Section 401, as supplemented by the City of Phoenix.
   11. MAG Standard Specifications, Section 713
   12. MAG Standard Specifications, Section 331.
   13. MAG Standard Specifications, Section 329, as supplemented by City of Phoenix.
   15. MCDOT 2017 Supplement to MAG Standard Specifications, Section 462.
   16. MCDOT 2017 Supplement to MAG Standard Specifications, Section 463.
   17. MCDOT 2017 Supplement to MAG Standard Specifications, Section 464.

C. Testing Services:
   1. General: Testing of materials and of compaction requirements for compliance with technical requirements of the Specifications shall be the duty of a testing laboratory provided by the OWNER, as described in Section 01451, Testing Laboratory Services Furnished by OWNER. Determination and testing of the proposed design mix for the hot-mix course shall be performed by a testing laboratory provided by CONTRACTOR, as described in Section 01452, Testing Laboratory Services Furnished by CONTRACTOR.
   2. Testing Services: The OWNER'S testing laboratory shall:
a. Test CONTRACTOR'S proposed materials in the laboratory and field for compliance with the requirements of these Specifications.
b. Perform field density tests to assure that the specified compaction of base course materials has been obtained.
c. Report all test results to the ENGINEER and CONTRACTOR.

3. Authority and Duties of OWNER'S Testing Laboratory: Technicians representing the testing laboratory shall inspect the materials in the field and perform compaction tests, and shall report their findings to the ENGINEER and CONTRACTOR. When the materials furnished or Work performed by the CONTRACTOR fails to fulfill Specifications requirements, the technician shall direct the attention of the ENGINEER and CONTRACTOR to such failure.
   a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the ENGINEER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Specifications, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of CONTRACTOR: The use of testing services shall in no way relieve CONTRACTOR of his responsibility to furnish materials and construction in full compliance with the Contract Documents. To facilitate testing services:
   a. Secure and deliver to the ENGINEER and the testing laboratory representative samples of the materials he proposes to use and which are required to be tested.
   b. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
   c. Advise the testing laboratory and ENGINEER sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
   d. Utilize Contractor’s Testing Laboratory to provide sampling and testing during paving operations.

D. Pre-Paving Meeting:
1. Prior to the placement of Bituminous Paving, arrange a meeting at the job-site with the paver and its foreman, general CONTRACTOR and its foreman, ENGINEER and other representatives directly concerned with placement. Record the discussions of the conference and the decisions and agreements (or disagreements) and furnish a copy of the record to each party attending. Review foreseeable methods and procedures relating to the paving work, including but not necessarily limited to, the following:
   a. Review Project requirements, including Contract Documents, Project Schedule, approved Shop Drawings, pending and approved Change Orders and requests for information that may have been submitted by CONTRACTOR to ENGINEER.
   b. Review required samples, submittals, and documentation procedures.
   c. Review sub grade preparation
   d. Review availability of materials, tradesman, equipment and facilities needed to make progress, avoid delays and protect the Work from damaging conditions.
e. Review required inspection, testing, certifying and quality control and quality assurance procedures.
f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. City of Phoenix mixes as depicted in Contract Drawings, giving complete data on materials, including source, location, percentages, temperatures and all other pertinent data.
   2. Base and Surface Materials
   3. Microseal Materials (Type III).
   4. Crack Seal Materials
   5. Tack Coating Materials
   6. The submittals shall be reviewed by the ENGINEER and OWNER.

B. Material Certificates:
   1. In lieu of laboratory reports required in the State Standards, CONTRACTOR may submit certificates of compliance for the following:
      a. Coarse and fine aggregates from each material source and each required grading.
      b. Asphalt for each penetration grade.
      c. Job-mix design mixtures for each material or grade.
      d. Density of uncompacted bituminous concrete.
      e. Density of compacted bituminous concrete.
      f. Density and voids analysis for each series of bituminous concrete mixture test specimens.
      g. Bituminous concrete plant inspection.
   2. Certificates that materials, mixtures and plant comply with Specification requirements.
   3. Certificates signed by CONTRACTOR.

1.4 JOB CONDITIONS

A. Weather Limitations:
   1. For base paving 2-inches thick or greater, atmospheric temperature shall be 40°F and rising. For surface paving or pavement less than 2-inches thick, the surface temperature shall be 50°F or greater.
   2. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base on which the material is to be placed contains moisture in excess of the optimum. Asphalt concrete shall be placed only when the ENGINEER determines that weather conditions are suitable.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope for each course during construction operations.
PART 2 - PRODUCTS

2.1 PAVEMENT THICKNESS

A. Provide a minimum of 3-inch compacted premixed base course and minimum of 2-inch compacted surface course for a total compacted depth of 8.0-inches or according to thickness detailed on the Drawings for pavement where shown on the Drawings.

B. All sides of the asphalt area shall be curbed flush with edge of asphalt, unless otherwise shown on the drawings, to retain the asphalt during placement and protect edges from damage by heavy equipment.

2.2 MATERIALS

A. Base Course:
   1. Base course material shall be a A-1-1/2-inch hot mix asphalt concrete, consisting of a mixture of mineral aggregate and paving asphalt conforming to Section 710 of the MAG Standard Specifications. Gradation of the aggregate shall comply with the City of Phoenix Supplements Section 710.
   2. The City of Phoenix Type A-1-1/2-inch asphalt concrete to be provided by City of Phoenix approved supplier (see FIGURE 1.0).

B. Surface Course:
   1. Surface course material shall be a D-1/2-inch hot mix asphalt concrete, consisting of mineral aggregate and paving asphalt conforming to Section 710 of the MAG Specifications. Gradation of the aggregate shall comply with the City of Phoenix Supplements Section 710.
   2. The City of Phoenix Type D-1/2-inch asphalt concrete to be provided by City of Phoenix approved supplier (see FIGURE 1.0).

C. Tack Coat: The tack coat shall be emulsified asphalt Type SS-1h according to MAG 329, unless directed otherwise by the ENGINEER.

D. Crack Seal: Crack seal materials to comply with City of Phoenix Supplements to MAG Section 337. Crack seal to be installed a minimum of 30-calander days prior to micro seal installations.

E. Microseal: Microseal (Type III) materials to comply with MAG Section 714.

F. Striping:
   1. Within the City of Phoenix, pavement marking materials to comply with City of Phoenix Supplements to MAG Section 401.
2. In Maricopa County, pavement marking materials to comply with MCDOT 2017 Supplement to MAG Standard Specifications Sections 461, 462, 463, and 464.

2.3 TRAFFIC AND PARKING MARKING MATERIALS

A. Traffic and parking marking materials within the City of Phoenix shall be a water based paint conforming to the COP Supplement to MAG Section 401. Refer to paragraph 1.2.A.3.

B. In the Maricopa County, Match existing stripping and pavement markers in accordance with MCDOT Supplement to MAG Standard Specification as noted in Paragraph 2.2.F.2.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the subgrade on which bituminous concrete will be installed. Notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. No materials shall be placed on subgrades, which are muddy or have water thereon.

3.2 CONSTRUCTION OF ROADWAYS

A. General:
   1. The roadways shall be constructed to the lines, grades, and typical sections shown on the Drawings.

B. Base and Surface Course:
   1. Base and surface course to comply with the requirements of MAG Standard Specifications Section 321, as supplemented by City of Phoenix.

C. Tack Coat:
   1. A tack coat shall be applied to all existing and to each new course of bituminous surfaces prior to the placing of a succeeding layer of bituminous mixed material. The tack coat may be deleted when a succeeding layer of asphalt concrete is being applied within 24 hours over a freshly laid course that has been subjected to very little traffic and clean when approved by the ENGINEER.

   2. The same material that is specified above for the tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.

   3. Tack coat shall be diluted in the proportion of 50 percent emulsion and applied at the rate of 0.05 to 0.10 gallons per square yard. Application shall be made in advance of subsequent construction as directed by the ENGINEER.
4. Tack coat shall be applied by pressure-type distributor trucks with insulated tanks. Hand spray by means of hose or bar through a gear pump or air tank shall be acceptable for resurface work, corners or tacking of vertical edges. Care shall be taken to provide uniform coverage. Equipment that performs unsatisfactory shall be removed from the job.

D. Construction Joints:
   1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction and bond throughout.
   2. A transverse joint extending over the full width of the strip being laid and at right angles to its centerline shall be constructed at the end of each day's work and at any other times when the operations of placing the hot mixture are suspended for a period of time which will permit the mixture to chill. The forward end of a freshly laid strip shall be thoroughly compacted by rolling before the mixture has become chilled. When Work is resumed, the end shall be cut vertically for the full depth of the layer.

E. Joining of Pavements: When pavement is to join existing or previously laid pavement, the existing or previously laid pavement shall be neatly and carefully edged to allow for overlapping and feathering of the surface course material. A tack coat of bituminous prime coat material shall be placed at the interface of pavement and existing or previously laid pavement.

F. Curing: The pavement shall not be opened to traffic until directed by the ENGINEER. Construction traffic on the pavement shall be held to a minimum as allowed by the ENGINEER. Accelerating pavement cooling by means of adding water is prohibited.

3.3 FRAME ADJUSTMENT

A. Set frames and covers to final grade in an approved manner. Include existing frames and frames furnished under other Sections of these Specifications. Comply with requirements of City of Phoenix Supplement to the Latest Edition MAG Uniform Standard Specifications Section 345.

3.4 PAVEMENT QUALITY REQUIREMENTS

A. General: In addition to other specified conditions, comply with the following minimum requirements:
   1. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
   2. Repair holes from test specimens with hot asphalt as specified for patching defective Work.

B. Density:
   1. If directed by ENGINEER, compare density of in-place material against laboratory specimen or certificates on same bituminous concrete mixture. Use nuclear devices.
   2. Pavement densities to comply with MAG and COP Supplements to MAG Section 321.10.5.
C. Thickness: In-place compacted thicknesses to comply with MAG and COP Supplements to MAG Section 321.10.4.

D. Surface Smoothness:
   1. Test finished surface of each bituminous concrete course for smoothness, using a ten foot straightedge applied parallel to and at right angles to centerline of paved areas.
   2. Check surfaced areas at intervals as directed by ENGINEER.
   3. Surfaces will not be acceptable if exceeding the following:
      a. Base Course: 3/8-inch in ten feet.
      b. Surface Course: 1/4-inch in ten feet.
      c. Crowned Surfaces:
         1) Test crowned surfaces with a crown template, centered and at right angles to the crown.
         2) Surfaces will not be acceptable if varying more than 1/4-inch from the template.

3.5 PATCHING

A. As directed by ENGINEER, remove and replace all defective areas. Cut-out such areas and fill with fresh bituminous concrete. Compact to the required density.

3.6 CLEANING AND PROTECTION

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled bituminous materials and all foreign matter. Diesel fuel is prohibited from use during paving operations to clean tools and equipment.

B. Protect newly finished pavement until it has become properly hardened by cooling. Use of water or other liquids to accelerate cooling of pavement is prohibited.

C. Cover openings of drainage structures in the area of paving until permanent coverings are placed.

3.7 MARKING PAVEMENT

A. Cleaning:
   1. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
   2. Do not begin marking bituminous concrete pavement until approved by ENGINEER.

B. Application:
   1. City of Phoenix – conform to City of Phoenix Supplement to MAG Standard Specifications Section 401.
3. Stripping and pavement marking to match existing.

### City of Phoenix
Design and Construction Management
Materials Lab
2018 Approved Conventional Asphalt Mix Designs

The following mix designs have been approved by the City of Phoenix Materials Lab for use on all City of Phoenix projects:

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<thead>
<tr>
<th>PLANTS</th>
<th>Dispatch Phone</th>
<th>A-1 1/2&quot; 4.3% Mix Design Date</th>
<th>C-3/4&quot; 5.0% HV Mix Design Date</th>
<th>C-3/4&quot; 5.5% LV Mix Design Date</th>
<th>D-1/2&quot; 5.1% HV Mix Design Date</th>
<th>D-1/2&quot; 5.6% LV Mix Design Date</th>
</tr>
</thead>
</table>

*For ALL Vulcan Materials Mix Designs, verify the oil supplier from the ticket and specify which oil supplier is being utilized in the daily report. Note the oil supplier on the City of Phoenix sample card.

FIGURE 1.0

Updated: 7/1/2018
City of Phoenix  
Design and Construction Management  
Materials Lab  
2018 Approved Polymer Modified Asphalt Rubber (PMAR) Mix Designs

The following mix designs have been approved by the City of Phoenix Materials Lab for use on all City of Phoenix projects:

<table>
<thead>
<tr>
<th>PLANTS</th>
<th>Dispatch Phone</th>
<th>TR 6.0% HV (Mix Design Date)</th>
<th>TR 6.2% LV (Mix Design Date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanson #34 Higley</td>
<td>602-685-3450</td>
<td>AZ3412TRPH (11/10/2018)</td>
<td>AZ3412TRPL (11/10/2018)</td>
</tr>
<tr>
<td>Hanson #35 51st Ave</td>
<td></td>
<td>AZ3512TRPH (2/5/2018)</td>
<td>AZ3512TRPL (2/5/2018)</td>
</tr>
<tr>
<td>Southwest Asphalt #4 El Mirage</td>
<td>602-268-9011</td>
<td>422CT (3/7/2018)</td>
<td>422DT (3/7/2018)</td>
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<tr>
<td>Southwest Asphalt #1 New River</td>
<td></td>
<td>122CT (3/7/2018)</td>
<td>122DT (3/7/2018)</td>
</tr>
<tr>
<td>*Vulcan Gomez (5223-211)</td>
<td></td>
<td>38643H (2/20/2018)</td>
<td>38644H (2/20/2018)</td>
</tr>
<tr>
<td>*Vulcan 19th Ave (5224-211)</td>
<td></td>
<td>38643D (2/20/2018)</td>
<td>38644D (2/20/2018)</td>
</tr>
<tr>
<td>*Vulcan #117 West 43rd Ave (5182-211)</td>
<td>602-254-0081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Vulcan #130 Sun City (5180-211)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Vulcan W. Broadway Plant (5184-211)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*For ALL Vulcan Materials Mix Designs, verify the oil supplier from the ticket and specify which oil supplier is being utilized in the daily report. Note the oil supplier on the City of Phoenix sample card.

Updated: 7/12/18

FIGURE 1.0 (cont.)

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install concrete curbs, gutters and sidewalks.
   2. Types of Work covered by this Section are as follows:
      a. Conventionally formed or machine formed curb.
      b. Conventionally formed or machine formed curb and gutter.
      c. Conventionally formed or machine formed curb and sidewalk.
      d. Conventionally formed or machine formed curb, gutter and sidewalk.
   3. The thickness and extent of curb, gutter and sidewalk as shown on the Drawings.

1.2 QUALITY ASSURANCE

A. Standard Specifications and Details:
   1. Conform to all applicable requirements of Section 340 of the Uniform Standard Specifications to Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. If there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and these Specifications, the Provisions of these Specifications shall govern.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D 1190, Specification for Concrete Joint Sealer, Hot Poured Elastic Type.

C. Applicator Qualifications: Minimum of two years installing curbs, gutters and sidewalks.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:
   1. Samples, manufacturer's product data, test reports and material certifications as required in referenced Sections for concrete Work.
B. Certificates: Manufacturer’s certification that sealer meets Specification requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars and Welded Wire Fabric: Deformed steel bars and smooth wire fabric shall comply with requirements of Section 03200, Concrete Reinforcement.
   1. Furnish wire fabric in flat sheets, not rolls.

B. Concrete Materials: Comply with requirements of applicable Sections of Division 3, Concrete, for formwork, concrete materials, admixtures, bonding materials, curing materials and others as required.

C. Expansion Joint Material: Comply with requirements of Section 03251, Concrete Joints, for preformed expansion joint fillers.

2.2 CONCRETE MIX, DESIGN AND TESTING

A. Comply with requirements of applicable provisions of Section 03305, Concrete, for concrete mix design, sampling and testing, and quality control.

B. Design the mix to produce concrete having properties of compressive strength, slump range and air content as specified in Section 03305, Concrete.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Verify that earthwork is completed to correct line and grade.

C. Check that subgrade is smooth, compacted, and free of frost and excessive moisture.

D. Do not commence Work until conditions are satisfactory, and approved by ENGINEER.

3.2 POROUS FILL
A. Porous Fill Under Sidewalk: Furnish fill consisting of crushed stone, gravel, sand, or other approved material. Properly wet and compact fill to the thickness as shown on the Drawings. Comply with requirements of Section 02318, Crushed Stone and Gravel.

3.3 FORM CONSTRUCTION

A. Set forms to line and grade. Install forms over full length of curb, gutter and sidewalk.

3.4 REINFORCEMENT

A. Locate, place, and support reinforcement as specified in Section 03200, Concrete Reinforcement, unless otherwise shown on the Drawings. Size of reinforcement shall be as shown on the Drawings.

3.5 CONCRETE PLACEMENT

A. General: Comply with the requirements of Section 03305, Concrete, for mixing and placing concrete, and as specified.

B. Place concrete for curbs and gutters using methods which prevent segregation of the mix. Consolidate concrete along the face of forms with an internal vibrator.

C. For sidewalks, place concrete in one course, monolithic construction, for the full width and depth of walks.

D. Machine Formed: Automatic curb, gutter and sidewalk machine may be used for forming, at CONTRACTOR’S option. Concrete shall have properties as specified in Section 03305, Concrete, except that maximum slump shall be 2-1/2-inches and air content shall be two percent of design. Machine forming shall produce curbs, gutters and sidewalks to the required cross-section, lines, grades, finish, and jointing, as specified for conventionally formed concrete. If results do not conform to requirements remove and replace, at no additional cost to the OWNER.

3.6 JOINTS

A. General: Construct expansion, contraction, and construction joints with faces perpendicular to surface of the curb, gutter and sidewalk. Construct transverse joints at right angles to the Work centerline and as shown on the Drawings.

B. Contraction Joints: Provide these joints at ten feet on centers for curbs and gutters and five feet on centers for sidewalks.
C. Construction Joints: Place joints at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints.

D. Expansion Joints: Provide 1/2-inch expansion joint filler where Work abuts structures; at returns; and at 30 foot spacing for straight runs. If curb, gutter, and sidewalk are not poured monolithically, provide expansion joints where each abuts the other.
   1. Place top of expansion joint material not less than 1/2-inch or more than 1-inch below concrete surface. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with manufacturer's instructions.

3.7 CONCRETE FINISHING

A. Smooth the exposed surface by screeding and floating.

B. Work edges of gutter and sidewalks back top edge of curb, and transverse joints; and round to 1/4-inch radius.

C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic.

3.8 CURING

A. Protect and cure finished concrete curbs, gutters and sidewalks, complying with applicable requirements of Section 03305, Concrete.

3.9 REPAIR AND CLEANING

A. Repair or replace broken or defective curbs, gutters and sidewalk as directed by the ENGINEER.

B. Sweep Work and wash free of stains, discolorations, dirt and other foreign material.

+ + END OF SECTION + +
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all materials, equipment, labor, and incidentals required for the re-
      planting and move once of all trees, shrubs, cactus, and groundcover as shown
      on the Drawings and specified herein.
   2. All Work shall conform to the Maricopa Association of Governments Uniform
      Standard Specifications for Public Works Construction, Section 430,
      Landscaping and Planting.
   3. Types of products required include the following:
      a. Fertilizers.
      b. Mulches and weed-control barriers.
      c. Accessories.

B. Coordination:
   1. Review the procedures described under the other Sections, and shall coordinate
      all Work required for the planting operation with that of other trades.

1.2 QUALITY ASSURANCE

A. A single firm specializing in landscape installation and maintenance, with the
   appropriate State of Arizona Contractor’s license in force, and a minimum of five
   years of experience in the type of Work described in this Section.

B. Assign a least one person to serve as Project Supervisor. This person shall be
   thoroughly familiar with the materials, equipment, and techniques of the planting
   operation, and shall be on site at all times to direct the Work described in this
   Section.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Planting schedule showing scheduled start and finish dates for each type of
      planting in each area of the site.
   2. Manufacturer's specifications and installation instructions for all materials
      required.
   3. Composition and analysis of commercial fertilizers and all purchase receipts
      showing the total quantity actually purchased for this Project.
   4. Qualifications Data: Submit qualifications data for the following:
a. Landscape installer.
b. Landscape supervisor.
c. Testing agency.

B. Certificates: Submit for approval the following:
1. Certificates of inspection as may be required to accompany shipments, and manufacturer's certified analysis for soil amendments and fertilizer materials.
2. For standard products, submit other data certifying that materials comply with specified requirements.

C. Warranty: Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of exterior plants and in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualification to ENGINEER along with the following information on a minimum of three successful projects:
   a. Names and telephone numbers of owner, architects or engineers responsible for projects.
   b. Approximate contract cost of the plants.
   c. Amount and kinds of exterior plants installed.
2. Installer’s Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-site during the time of preparation for, and planting of, exterior plants. Supervisor shall have achieved landscape or horticultural certification acceptable to the OWNER and ENGINEER.
3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to 1. Certified landscape supervisor shall be on-site throughout the day-to-day performance of the Work of this Section.
4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications and in accordance with each manufacturer’s instructions provided on each product label.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
1. Deliver packaged materials in original, unopened containers, legibly showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery. Provide protective covering.
2. Immediately remove unacceptable material from site.
B. Storage of Materials:

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1. Store and cover materials to prevent deterioration. Remove packaged materials that have become wet, or show deterioration or water marks, from site.

C. Handling of Materials:
1. Do not lift or drag plants by stems or trunks. Handle plants by lifting root ball or container.
2. Water as necessary to maintain plant root systems in a moist condition.

1.6 PROJECT CONDITIONS

A. Existing Conditions:
1. Obstructions Below Ground and Utilities: Exercise extreme caution in all planting operations, as there are underground electric and telephone cables, sewer lines and water lines throughout the entire site. Study and be familiar with the location of these obstructions and underground utilities. Place plantings, where shown on the Drawings in the proximity of these obstructions and underground utilities, clear of any interference. Repair all damages to obstructions and underground utilities caused by the Work of this Section.

B. Environmental Requirements:
1. Proceed with and complete the Work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of plant shown.
2. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.
3. Do not resort to chemical control measures at the first sign of insect or disease attack. Make an attempt to determine the environmental cause of the attack and take corrective measures.
4. Apply chemical insect and disease measures locally and specifically to the area and type of planting in need of such insect and disease control, so as not to damage plantings, or endanger the environment. Select natural chemical controls specific to the type of insect or disease encountered, or provide naturally controlling insect predators and bacterial controls for release at the Site.
5. Plantings exhibiting a broad and heavy infestation of insects or diseases, or where insects or diseases have disfigured plantings such that they no longer provide their intended aesthetic effect, shall be replaced with new plantings.

C. Scheduling:
1. Do not begin planting until water, acceptable for use and adequate in supply, is available on-site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.
2. Do not proceed with installation of plants until all subgrade utility services have been installed, are operating successfully and have been approved by ENGINEER.
3. Plant only after final grades are established, unless otherwise acceptable to ENGINEER.
4. Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage to protect during digging, handling, and transportation.
   a. One week before evergreen trees and deciduous trees and shrubs in full leaf are to be dug, spray with anti-desiccant at nursery before moving and again two weeks after planting.
   b. Apply anti-desiccant to evergreens, again, immediately after the first frost.

1.7 WARRANTY

A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranty: WARRANT the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate care and maintenance, or abuse by OWNER, or incidents that are beyond CONTRACTOR’S control.
   1. Warranty Period for Trees and Shrubs: One year from date of end of extended service period.
   2. Warranty Period for Vines and Ground Cover and Plants: One year from date of end of extended service period.

1.8 EXTENDED SERVICE

A. Extended Landscape Service:
   1. Begin extended service immediately after each planted area, including Seeding and Decorative Stone Landscaping Work, is acceptably completed. Provide extended service for not less than the following periods:
      a. Trees and Cacti: Ninety days after trees and shrub plantings are acceptably completed.
   
   2. Prune, cultivate, water, weed, fertilize, shade, mist, restore planting saucers, tighten and repair stakes and guy supports, and reset plantings to proper grades or vertical position, as required to establish healthy, viable plantings.
      a. Do not allow plantings to wilt or show other signs of environmental stress. Visit the site twice a week during the extended service periods, to inspect the condition of the plantings and immediately provide required care.
      b. Provide landscape installer who shall be available on-call if notified between regular visits that plants require critical care or maintenance, throughout the time of extended service periods.
3. Check and observe plantings for signs of insect and disease attack. Take corrective measures immediately upon notice of such attack. Control damaging insects and diseases, as specified.

4. Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season.

B. Any decline in the condition of plants shall require CONTRACTOR to take immediate action to identify potential problems and undertake corrective measures. If required, engage professional arborists or horticulturists to inspect plants, identify problems and recommend corrective procedures. Advise ENGINEER of all such actions and submit inspection and recommendation reports.

PART 2 - PRODUCTS

2.2 CHEMICAL FERTILIZER

A. Agriform fertilizer tablets at the following rates:

<table>
<thead>
<tr>
<th>Plant Size</th>
<th>No. of Tablets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxed</td>
<td>6</td>
</tr>
<tr>
<td>15 Gallon</td>
<td>4</td>
</tr>
<tr>
<td>5 Gallon</td>
<td>2</td>
</tr>
<tr>
<td>1 Gallon</td>
<td>1</td>
</tr>
</tbody>
</table>

B. Additional fertilizer/amendments, as recommended by CONTRACTOR’S soils laboratory.

2.4 TREE STAKES, GUYS, AND TIES

A. Unless otherwise shown on the Drawings, the following criteria shall be used to stake, guy, tie and brace trees:

1. Stakes:

<table>
<thead>
<tr>
<th>Trunk Height</th>
<th>Stake Size</th>
<th>Stake Type</th>
<th>Min./Max. Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 feet or less</td>
<td>8 feet</td>
<td>Lodge Pole</td>
<td>6 feet/6 feet</td>
</tr>
<tr>
<td>6 feet-9 feet</td>
<td>10 feet</td>
<td>Lodge Pole, Redwood,</td>
<td>7 feet/8 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Douglas Fir</td>
<td></td>
</tr>
<tr>
<td>9 feet or more</td>
<td>12 feet</td>
<td>Lodge Pole, Redwood,</td>
<td>9 feet/10 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Douglas Fir</td>
<td></td>
</tr>
</tbody>
</table>

B. Tree ties shall consist of heavy gauge solid wire (min. 12 gauge) inserted through 3/8-inch or 3/4-inch garden hose.
C. All trees must be staked or guyed, unless written approval is given to exempt any tree.

D. The ENGINEER has the final approval of all staking, guying and tying procedures.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to all Work of this Section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may commence. In addition, CONTRACTOR shall verify the location and depth below ground level of all utilities, footing, underground piping and conduit. All existing debris shall be removed from the site.

B. Verify that planting may be completed in accordance with the original design and the referenced standards.

C. All plants shall be in containers and placed in a cool area protected from sun and drying winds while in temporary storage prior to planting.

D. Planting areas shall not be cultivated when they are so dry as to cause excessive dust or so wet as to cause the formation of large clods.

E. Finish grade for these areas shall not vary more than 1-inch from the specified grade and cross-section and shall be smooth uniform surface, free of any abrupt grade changes or depressions. Unless otherwise specified, finish grade below adjacent paving, curbs, or headers shall be 2-inches.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and cacti locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain ENGINEER’S acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by ENGINEER. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
3.3 TREE AND SHRUB EXCAVATION

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation. Dispose of subsoil removed from pits and trenches in a legal manner, off-site.
   1. Excavate approximately three times as wide as ball diameter for (--1--) stock.
   2. Excavate at least 12-inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.

B. Obstructions: Notify ENGINEER if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of ten feet, whichever is less, and backfill with free-draining material.

C. Drainage: Notify ENGINEER if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

D. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.4 TREE AND SHRUB PLANTING

A. Set plants plumb and in center of pit or trench with top of root ball set such that it will be 1-inch above adjacent finish grades, at plant stem, after planting soil mix has settled.
   1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use plant if root ball is cracked or broken before or during planting operation.
   2. Place planting soil mix around root ball in layers. Each layer shall not be more than 6-inch deep. Tamp to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
   3. Remove all soil from around the root flare of the stem of each plant and from the top of the root ball to determine the true depth of the root flare. Plant with root flare at surface of finish planting soil mix.

B. Carefully remove root ball from container without damaging root ball or plant.
   1. After removal of plant from container, or sides from box, tease out feeder roots to assure positive contact and embedment into planting soil.
C. Organic Mulching: Apply 2-inch average thickness of organic mulch extending 12-inches beyond edge of planting pit or trench. Do not place mulch within 3-inches of trunks or stems.

D. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

E. Perform complete sequence of planting steps for each plant within the same day.

F. Dish top of backfill to allow for mulching. Provide dish four feet in diameter approximately 4-inches deep around each tree, with planting soil berm around edge of excavations to form shallow saucer to collect water.

G. After watering, any settlement within basins shall be refilled to required grade with planting soil mix.

3.5 BACKFILLING

A. Prepared backfill material shall consist of the following:
   1. 100% percent on-site Soil.
   2. Agriform fertilizer tabs, as specified.

B. Sufficiently tamp backfill in 12-inch lifts to eliminate air pockets. Water in when initial backfilling is complete and add additional backfill, as required, to fill any noticeable depressions or voids.

3.6 TREE AND SHRUB PRUNING

A. Prune, thin out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by ENGINEER, do not cut tree leaders. Remove only injured or dead branches from ornamental flowering trees, if any. Prune to retain natural character and accomplish their use in the landscape design. Required tree sizes are the size after pruning.

   1. Remove all dead wood and suckers, and all broken and badly bruised branches.

B. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

C. Paint cuts over 1/2-inch in size with standard tree wound compound, covering exposed, living tissue.

D. All pruning wounds shall show vigorous bark on all edges at the time of harvest.
3.7 GUYING AND STAKING

A. Guy and stake trees immediately after planting.

B. Upright Staking and Tying: Stake trees of 2-inches through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of two stakes of length required to penetrate at least 18-inches below bottom of backfilled excavation and to extend at least 72-inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:
   1. Use two stakes for trees up to 12 feet high and 2-1/2-inches or less in caliper.
   2. Use three stakes for trees greater than 12 feet, but less than 14 feet high and up to 4-inches in caliper. Space stakes equally around trees.

C. Guying and Staking: Guy and stake trees exceeding 14 feet in height and more than 3-inches in caliper, unless otherwise indicated. Securely attach no fewer than three guys to stakes 30-inches long, driven to grade.
   1. For trees more than 6-inches in caliper, anchor guys to pressure-preservative-treated deadmen 8-inches in diameter and 48-inches long buried at least 36-inches below grade. Provide turnbuckles for each guy wire and tighten securely.
   2. Attach flags to each guy wire, 30-inches above finish grade.
   3. Paint turnbuckles with luminescent white paint.

3.9 ACCEPTANCE CRITERIA FOR PLANTS

A. Planting Work will be considered acceptable when:

   1. Broadleaf Evergreen Trees: When firmly planted, properly located and vertically upright with all mulches and saucers formed and in-place; with plant showing no signs of environmental stress, disease, insect infestations, chlorosis, sun or wind scald, disfigurement or areas of missing or dead foliage, and with expanding buds or other indications of vigorous, healthy growth.

3.10 CLEANUP AND PROTECTION

A. Protect plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and extended service periods. Treat, repair, or replace damaged exterior planting.

B. Protection includes all temporary fences, barriers and signs and other Work incidental to proper maintenance.

3.11 INSPECTION AND ACCEPTANCE

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A. Where plants do not comply with specified acceptance criteria, replace plants and continue extended service period until plants comply with criteria for acceptance.

++ END OF SECTION ++
SECTION 02906

NATIVE PLANT SALVAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials, equipment and incidentals required to protect, salvage and maintain all native plants as shown on the Drawings, and as directed by the ENGINEER. This includes plants marked as:
   1. Move Once
   2. Protect (or Remain) In Place
   3. Salvage
   4. Care and Maintenance of all plants until Final Acceptance, including protective fencing.

B. Coordination
   1. Review the procedures described under the other Sections and coordinate all Work required for the native plant salvage operation with that of the other trades.

1.2 QUALITY ASSURANCE

A. Assign one person to serve as Project Supervisor. This person shall have a minimum of five years of experience in this specific type of Work and shall be thoroughly familiar with the materials, equipment, and techniques of salvaging native plants. This person shall be on site at all times to direct the Work described in this Section.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Prior to the start of any salvage or Move Once Work, submit to the ENGINEER documentation of experience in this type of Work along with three copies of documentation of the Salvage Feasibility Survey Results.
      a. Include proposed methods and inspection procedures of watering or dewatering for each species.
      b. Include proposed methods of determining continuing viability for each species of tree and cactus. Minimum viability reporting shall be monthly. Final determination of viability of plant shall be by the ENGINEER at any time until Substantial Completion. Any plants deemed non-viable by ENGINEER will be replaced with like kind and size at no cost to OWNER. Replacement plants will be reviewed same as transplanted plants.
PART 2 - PRODUCTS

2.1 ACCEPTABLE TREE SALVAGE COMPANIES

A. Provide one of the following tree salvage companies:
   1. Company approved by City of Phoenix
   2. Arizona Best Native Plant Care, Inc.
   3. Desierto Verde, Inc.

2.2 BOXING LUMBER

A. Boxing lumber shall conform to the following:
   1. Horizontal Members:
      a. One-inch material up to 60-inch box.
      b. Two inches material over 60-inch box.
   2. Vertical Members:
      a. One-inch material up to 48-inch box.
      b. Two inches material over 48-inch box.
      c. One-inch material shall be 1-inch by 12-inches, #5 pine.
      d. Two inches material shall be 2-inches by 6-inches or 2-inches by 12-inches economy grade.

2.3 BANDING STEEL

A. Banding steel shall be 3/4-inch by 0.025-inch.

PART 3 - EXECUTION

3.1 SALVAGE FEASIBILITY SURVEY

A. Walk the project site noting all plants previously identified by the ENGINEER and Landscape Architect as plants to be salvaged, moved once, and those to remain in place. Based on their experience as well as on the results of any specific field testing, make a final determination of feasibility to salvage or move once plants shown on Drawings and specified herein.

B. Submit schedule and methods for accomplishing “Move Once” type salvage, including providing sufficient water and protection for Move Once plants.

3.2 PRUNING

A. General: The objective of pruning is to remove a certain amount of foliage which is proportionate to the amount of root system to be eliminated during the boxing
operation, and to provide an aesthetic framework of branches that preserves the size and character of the plant.

B. Procedure: Identify the major limbs to be retained and remove approximately 60 percent to 80 percent of the remaining medium and smaller sized branches.

3.3 SIDE BOXING

A. General:
1. After pruning, determine the size of box to be used based on the following guidelines:

<table>
<thead>
<tr>
<th>Trunk Diameter (inches)</th>
<th>Box Size (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 6</td>
<td>24 to 42</td>
</tr>
<tr>
<td>6 to 12</td>
<td>48 to 60</td>
</tr>
<tr>
<td>12 to 18</td>
<td>66 to 84</td>
</tr>
<tr>
<td>18 and up</td>
<td>90 and up</td>
</tr>
</tbody>
</table>

2. Write the box size on flagging tape to alert boxing crew.

B. Procedure:
1. Measure the top of the root ball to be exposed and mark the outline to facilitate digging.
2. Begin digging a trench around the plant using the outline established in the previous step as the inside dimensions.
3. Carefully cut roots flush with the side of the root ball as they are encountered.
4. As trench progresses, gradually cut the root ball inward to accommodate the taper of the box.
5. When trench reaches the depth of the box, place box sides in trench and check fit around root ball. Trim root ball as necessary.
6. Attach box sides around root ball with nails.
7. Secure box sides with banding.
8. Pack dirt tightly into any space between box sides and root ball.
9. Water thoroughly and repack dirt as needed for one to two weeks before bottoming.

3.4 PLACING SUPPORTING TOPWOOD

A. General: The objective of this procedure is to minimize movement of the plant and its root system during transportation.

B. Procedure:
1. Measure 2-inches by 4-inches or 2-inches by 6-inches wood to fit the width of box and cut.
2. Place wood on each side of trunk. Nail wood to tree trunk and box sides.
3. Place cross members and additional supporting wood as necessary based on size and orientation of tree.
4. Nail 1-inch material across top of root ball (at least two boards in each direction).

3.5 BOTTOMING

A. General: The objective of the bottoming operation is to cut the remaining roots while minimizing loss of soil from the bottom of root ball.

B. Procedure:
   1. Place stake a safe distance from trench in the direction plant is to be tipped. Attach "come along" and one end of chain. Wrap other end of chain around box and secure. Cinch chain until taut.
   2. Gradually undercut beneath the root ball. Cut tap roots cleanly as encountered.
   3. Frequently test tautness of chain. When possible begin to tip box over in direction of stake. When box begins to tip, place safety brace against bottom of box to prevent box from falling in case of stake or chain failure.
   4. As box is tipped back, nail bottom strips to box sides. When tree is fully tipped and bottom completely covered, nail boards across others. Depending on soil conditions, pre-assembled bottoms may be feasible.
   5. Place banding underneath cross members.
   6. Lower box down to its original orientation.
   7. Bring banding up along sides and other top of box. Tighten banding and secure with crimper.

3.6 REMOVAL AND TRANSPORTATION

A. General: The goal of this operation is to move boxed plant to holding area or designated move once site without damaging box or plant.

B. Procedure:
   1. Determine equipment required based on accessibility, estimated weight of plant and distance to holding or new planting area.
   2. If using backhoe or front loader, place chain around box and secure to bucket of machine. Tilt bucket back and lift out of hole.
   3. If using crane, place two cables cross-wise around box and attach to hook. Lift out of hole.
   4. Move Salvage plants to a secured temporary holding area. Location to be as shown on the Drawings or determined by ENGINEER.
   5. Move the “Move Once” Plants to new permanent Location as determined by Drawings or by ENGINEER.
3.7 TEMPORARY STORAGE AND MAINTENANCE

A. General: The objective here is to provide optimum conditions for the plants to overcome transplant shock and maintain viability throughout the storage period or until Final Acceptance in the case of Move Once plants.

B. Nursery Procedure:
   1. Attach plants to drip watering system. Soak thoroughly according to regular schedule based on weather conditions.
   2. After first few soakings, check root ball for excessive run-off caused by cavities in soil and holes in box sides. Repack soil and repair box as necessary.
   3. Apply slow-release fertilizer every 25 days throughout maintenance period.
   4. Check for insect activity at least once a week. Use foliar systematic spray for sucking insects such as thrips and mites. Use trunk spray for wood borers.

C. Move Once Plants:
   1. Place protective fencing around plant as shown on Drawings until Final Acceptance.
   2. Water plants as needed according to approved methods in the Contractor’s Salvage Feasibility Study.
   3. Review periodically the health of the plant and adjust watering accordingly and report viability monthly as approved in the Contractor’s Salvage Feasibility Report.
SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install concrete reinforcement.
   2. The extent of concrete reinforcement is shown.
   3. The Work includes fabrication and placement of reinforcement including bars, ties and supports, and welded wire fabric for concrete, encasements and fireproofing.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A184, Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
   3. ASTM A185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   4. ASTM A496, Specification for Steel Wire, Deformed, for Concrete Reinforcement.
   5. ASTM A497, Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   6. ASTM A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   7. ASTM A706, Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
   8. ASTM A775, Specification for Epoxy-Coated Reinforcing Steel Bars.
  10. ACI 318, Building Code Requirements for Structural Concrete.
B. Allowable Placing Tolerances: Comply with ACI 318, Chapter 7 - Details of Reinforcement except as specified below:
   1. Concrete surfaces which are in contact with liquids: 2-inches minimum coverage.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for all materials and reinforcement accessories. Comply with the requirements of Section 01332, Shop Drawing Procedures.
   2. Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, Parts A and B. For walls, show elevations to a minimum scale of 1/4-inch to one foot. For slabs, show top and bottom reinforcing on separate plan views. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement unless otherwise noted. Splices shall be kept to a minimum. Splices in regions of maximum tension stresses shall be avoided whenever possible.
   3. Drawings detailing the location of all construction and expansion joints as required under Section 03251, Concrete Joints, shall be submitted and approved before Shop Drawings for reinforcing steel are submitted.
   4. Description of reinforcing weld locations and weld procedures.

B. Certificates:
   1. Submit one copy of steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.
   2. Submit certification of welders and weld procedures for splices in accordance with ANSI/AWS D1.4 requirements.

1.4 DELIVERY, HANDLING AND STORAGE

A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams. Comply with the requirements of Section 01651, Transportation and Handling of Materials and Equipment.

B. Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust. Store on heavy wood blocking so that no part of it will come in contact with the ground.

PART 2 - PRODUCTS
2.1 MATERIALS

A. Reinforcing Bars: ASTM A 615, and as follows:
   1. Provide Grade 60 for all bars, unless indicated otherwise.
   2. At beams and columns forming frames and wall boundary elements, where indicated on the Drawings, provide ASTM A 706 or ASTM A 615, Grade 60, with a maximum yield stress of 78,000 psi.

B. Mechanical Couplers: Reinforcement bars may be spliced with a mechanical connection. This connection shall be a full mechanical connection which shall develop in tension or compression, as required, at least 125 percent of specified yield strength (fy) of the bar in accordance with ACI 318.

C. Steel Wire: ASTM A 82.

   1. Furnish in flat sheets, not rolls.

E. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
   1. Use wire bar type supports complying with CRSI “Manual of Standard Practice” recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, 4-inch square in plan, with embedded tie wire as specified by CRSI, “Manual of Standard Practice”. The precast concrete blocks shall have the same or higher compressive strength as specified for the concrete in which they are located.
   3. For all concrete surfaces, where legs of supports are in contact with forms, provide supports complying with CRSI "Manual of Standard Practice" as follows:
      a. At formed surfaces in contact with soil, weather, or liquid or located above liquid, supports shall be CRSI Class 1 for maximum protection. The plastic coating on the legs shall extend at least 1/2-inch upward from the form surface.
      b. At interior dry surfaces (not located above liquid), supports shall be either Class 1 or Class 2 for moderate protection.
      c. At formed surfaces with an architectural finish, use stainless steel protected legs (Type B).
   4. Over waterproof membranes, use precast concrete chairs.

F. Drilled Dowels
   1. Adhesive material for drilled dowels shall be a vinylester resin, epoxy resin, urethane methacrylate, or vinyl urethane resin. Polyester resin shall not be used.
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The resin shall be a high modulus, moisture insensitive type. The resin shall be packaged in a cartridge type dispensing system with a mixing nozzle. The resin shall be formulated to maintain its bond and integrity under continuous submergence by water. The adhesive anchoring systems shall have an ultimate capacity in excess of 125 percent of the yield strength of the reinforcing steel at an embedment of 12 bar diameters.

2. Adhesive systems shall be:
   a. HIT HY150, manufactured by Hilti Corporation.
   b. HSE 2411, manufactured by Hilti Corporation.
   c. Epcon System Ceramic 6, manufactured by ITW Ramset/Redhead.
   d. Powerfast, manufactured by Powers/Rawl Fastening System.
   e. Or equal.

2.2 FABRICATION

A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI, “Manual of Standard Practice”. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:
   1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
   2. Bends or kinks not shown on approved Shop Drawings.
   3. Bars with reduced cross-section due to excessive rusting or other cause.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which concrete reinforcement is to be placed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION


B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
   1. Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Prior to placement of concrete, demonstrate to ENGINEER that the specified cover of reinforcement has been attained, by using a surveying level or string line.
   3. Reinforcing steel shall not be secured to forms with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

E. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2-inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

F. Lap Splices:
   1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars, shall be as shown on the Drawings.

G. Mechanical Couplers:
   1. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

H. Welded Splices
   1. When permitted by the ENGINEER, in writing, all welding of reinforcing bars shall conform to ANSI/AWS D1.4. Preheating and rate of cooling requirements shall be based on bar steel chemistry and ANSI/AWS D1.4 requirements.
Welded splices shall be sized and constructed to transfer a minimum of 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Unless otherwise permitted by the Engineer, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.

2. Welding of wire to wire, and of wire or welded wire fabric to reinforcing bars or structural steels, shall conform to applicable provisions of ANSI/AWS D1.4 and any supplementary requirements by the ENGINEER for the particular application.

3. After completion of welding on coated reinforcing bars, coating damage shall be repaired as specified herein. All welds and all steel splice members when used to splice bars shall be coated with the same material used for repair of coating damage.

I. Drilled Dowels

1. Drilled dowels shall be reinforcing dowels set in a resin adhesive in a hole drilled into hardened concrete.

2. Holes shall be drilled to the adhesive anchor system manufacturer’s recommended diameter and depth to develop the required pullout resistance but shall not be greater in diameter than 1/4-inch more than the nominal bar diameter nor less than 12 times the nominal bar diameter in depth.

3. The hole shall be drilled by methods which do not interfere with the proper bonding of the resin. Only masonry type drill bits shall be used.

4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars only after approval by the ENGINEER.

5. The hole shall be brushed (non-metallic bristle brush only) and blown clean with clean, dry compressed air to remove all dust and loose particles.

6. Resin shall be injected into the hole through the injection system-mixing nozzle (and any necessary extension tubes) placed to the bottom of the hole. The discharge end shall be withdrawn as resin is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material is expelled from the hole during dowel placement.

7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with resin. The bar shall be inserted slowly enough to avoid developing air pockets.

3.3 INSPECTION OF REINFORCEMENT

A. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.
B. Formwork for walls and other vertical members will not be closed up until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

C. Testing of Drilled Dowels: Employ a testing agency to perform field quality control testing of the drilled dowel installation. After completion of the manufacturer’s recommended curing period and prior to placement of connecting reinforcing, ten percent of drilled dowels installed shall be proof tested for pullout. The drilled dowels shall be tensioned to 60 percent of the specified yield strength. Where dowels are located less than six bar diameters from the edge of concrete, the ENGINEER will determine the tensile load required for the test. If any dowels fail, all installed dowels shall be tested. Dowels that fail shall be reinstalled and retested at CONTRACTOR’S expense.

D. Inspection of Welded Splices: Employ a testing agency to perform field quality control testing of the welded splices. All welded splices shall be visually inspected. A minimum of five percent of butt splice welds shall be radiographically tested. Any weld which is deficient in any way shall be repaired to be completely sound at the CONTRACTOR’S expense.

++ END OF SECTION ++
SECTION 03251

CONCRETE JOINTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidental as shown, specified and required to furnish and install concrete joints.
   2. The types of concrete joints required include the following:
      a. Construction joints.
      b. Expansion joints.
      c. Control joints.
      d. Isolation joints.
      e. Waterstops.

B. General: All joints subject to hydrostatic pressure or in contact with soil, except non-water bearing slabs-on-grade, shall be provided with continuous waterstop.

1.2 QUALITY ASSURANCE

A. Standard Specifications Details:
   1. Conform all applicable requirements of Sections No. 505 and 729 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and this Specification, provisions of this Specification shall govern.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ACI 301, Standard Specifications for Structural Concrete.
C. All manufactured items shall be installed in accordance with manufacturer's instructions.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for all materials required.
   2. Layout of all construction and expansion joint locations prior to the submittal of steel reinforcement Shop Drawings. Comply with the requirements of Section 01332, Shop Drawing Procedures.

B. Samples: Submit for approval the following:
   1. Polyvinyl chloride waterstops for joints for each cross section type used.
   2. Foam rubber and cork expansion joint fillers.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All materials used for joints in concrete shall be stored on platforms or in enclosures and covered to prevent contact with the ground and exposure to the weather and direct sunlight. Storage and handling requirements of the manufacturer shall also be followed.

PART 2 - PRODUCTS

2.1 WATERSTOPS

A. Polyvinyl Chloride:
   1. Material Requirements:
      a. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications and the requirements of CRD-C572. No reclaimed or scrap material shall be used.
      b. Tensile strength of finished waterstop: 1400 psi, minimum.
      c. Ultimate elongation of finished waterstop: 280 percent, minimum.
      d. Minimum thickness shall be 3/8-inch.
      e. Waterstops shall be provided with a minimum of seven ribs equally spaced at each end on each side. The first rib shall be at the edge. Ribs shall be a minimum of 1/8-inch in height.
   2. Construction Joints: Waterstops shall be flatstrip ribbed type and 6-inches minimum in width, unless shown otherwise.
   3. Expansion Joints: Waterstops shall be centerbulb ribbed type and 9-inches minimum in width, unless shown otherwise. The centerbulb shall have a minimum outside diameter of 7/8-inch.
4. Product and Manufacturer: Provide one of the following:
   b. A.C. Horn, Incorporated.
   c. Greenstreak Plastic Products Company
   d. Water Seals, Inc.
   e. Paul Murphy Plastics Company.
   f. Or equal.

2.2 HYDROPHILIC WATERSTOP MATERIALS

A. General Material Properties
   1. Hydrophilic waterstop materials shall be bentonite-free and shall expand by a
      minimum of 80 percent of dry volume in the presence of water to form a
      watertight joint seal without damaging the concrete in which it is cast. Provide
      only where indicated in the Contract Documents.
   2. The material shall be composed of resins and polymers which absorb water and
      cause an increase in volume in a completely reversible and repeatable process.
      The waterstop material shall be dimensionally stable after repeated wet-dry
      cycles with no deterioration of swelling potential.
   3. Select materials which are recommended by the manufacturer for the type of
      liquid to be contained.

B. Hydrophilic Rubber Waterstop
   1. The minimum cross sectional dimensions shall be 3/16-inch by 3/4-inch.
   2. Product and Manufacturer: Provide one of the following:
      a. Duroseal Gasket, by BBZ USA, Inc.
      b. Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
      c. Or equal.

C. Hydrophilic Sealant:
   1. The hydrophilic sealant shall adhere firmly to concrete, metal, and PVC in dry or
      damp condition. When cured it shall be elastic indefinitely.
   2. Product and Manufacturer: Provide one of the following:
      a. Duroseal Paste, by BBZ USA, Inc.
      b. Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
      c. SikaSwell S, by Sika Corporation.
      d. Or equal.

D. Hydrophilic Injection Resin
   1. Hydrophilic injection resin shall be acrylate-ester based. The viscosity shall be
      less than 50 cps. The resin shall be water soluble in its uncured state, solvent
      free, and non-water reactive. In the cured state it shall form a solid hydrophilic
      flexible material which is resistant to permanent water pressure and shall not
      attack bitumen, joint sealants, or concrete.
   2. Product and Manufacturer: Provide one of the following:
2.3 PREFORMED EXPANSION JOINT FILLER

A. Provide preformed expansion joint filler complying with ASTM D 1752, Type I (sponge rubber) or Type II (cork).

2.4 CONCRETE CONSTRUCTION JOINT ROUGHENER

A. Provide a water-soluble non-flammable, surface-retardant roughener.

B. Product and Manufacturer: Provide one of the following:
   1. Rugasol-S, as manufactured by Sika Corporation for horizontal joints only.
   2. Concrete Surface Retarder-Formula S, as manufactured by Euclid Chemical Company, for horizontal joints only.
   3. Concrete Surface Retarder-Formula F, as manufactured by Euclid Chemical Company, for vertical joints only.
   4. Or equal.

2.5 EPOXY BONDING AGENT

A. Provide a two-component epoxy-resin bonding agent.

B. Product and Manufacturer: Provide one of the following:
   1. Sikadur 32 Hi-Mod LPL, as manufactured by Sika Corporation.
   2. Eucopoxy LPL, as manufactured by the Euclid Chemical Company.
   3. Or equal.

2.6 EPOXY-CEMENT BONDING AGENT

A. Provide a three component epoxy resin-cement blended formulated as a bonding agent.

B. Product and Manufacturer: Provide one of the following:
   1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
   2. Corr-Bond, as manufactured by the Euclid Chemical Company.
   3. Or equal.

2.7 RUBBER BONDING AGENT

A. Product and Manufacturer: Provide one of the following:
   1. Scotch-Grip 1300 Rubber Adhesive, as manufactured by 3M Company.
   2. Or equal.
2.8 NEOPRENE BEARING PADS

A. Product and Manufacturer: Provide one of the following:
   1. 65 Durometer, Sheet Neoprene No. 1200, as manufactured by Williams Products Company.
   2. Or equal.

2.9 JOINT SEALANT

A. Sealant used in expansion joints and other locations where it is shown and which will be subject to being submerged by water for any period of time shall be a two part polyurethane type sealant meeting the requirements of ASTM C 920, Type M, Class 25. The sealant shall be specially formulated for continuous submerged conditions. The manufacturer's recommended primer must be used with the sealant.

B. The sealant shall meet the following requirements (measured at 73 degrees F and 50 percent RH):
   4. Tear strength (ASTM D 624, die C): 75 pounds per inch of thickness, minimum.

C. Product and Manufacturer: Provide one of the following:
   1. Permapol RC-270 Reservoir Sealant, as manufactured by Products Research and Chemical Corporation.
   2. Sikaflex-2c, as manufactured by Sika Corporation.
   3. Or equal.

2.10 SEALANT ACCESSORIES

A. Backer Rod: Backer rod shall be an extruded closed-cell polyethylene foam rod. The material shall be compatible with the sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width at joints less than 3/4-inch wide and 1/4-inch larger in diameter at joints 3/4-inch and wider.

B. Bond Breaker Tape: Bond breaker shall be polyethylene or TFE-fluorocarbon self adhesive tape, as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION
A. Examine the substrate and the conditions under which Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 CONSTRUCTION JOINTS

A. Comply with the requirements of ACI 301 and as specified below.

B. Locate and install construction joints as shown on the Drawings. Additional construction joints shall be located as follows:

1. In walls locate joints at a spacing of 40 feet maximum and approximately 12 feet from corners.
2. In foundation slabs and slabs on grade locate joints at a spacing of approximately 40 feet. Place concrete in a strip pattern, unless otherwise indicated on the Drawings.
3. In mats and structural slabs and beams, at a spacing of approximately 40 feet. Locate joints in compliance with ACI 301, unless otherwise indicated on the Drawings.
4. Provide other additional construction joints as required to satisfactorily complete all Work.

C. Horizontal Joints:

1. Roughen concrete at the interface of construction joints by abrasive blasting, hydroblasting, or the use of surface retardants and water jets to expose the aggregate and remove accumulated concrete on projecting rebar immediately subsequent to form stripping, unless otherwise approved by ENGINEER. Immediately before placing fresh concrete, thoroughly clean the existing contact surface using a stiff brush or other tools and a stream of water under pressure. The surface shall be clean and wet, but free from pools of water at the moment the fresh concrete is placed.
2. Remove laitance, waste mortar or any other substance which may prevent complete adhesion. Where joint roughening was performed more than seven days prior to concrete placement or where dirt or other bond reducing contaminants are on the surface, additional light abrasive blasting or hydroblasting shall be done to remove laitance and all bond reducing materials just prior to concrete placement.
3. Place a 2-inch thick coat of mortar, one part sand and one part cement with water added to a flowable consistency or a 6-inch layer of Construction Joint Grout, as specified in Section 03305, Concrete, over the contact surface of the old concrete. Place fresh concrete before the mortar or grout has attained its initial set. If the concrete mix has the slump increased to at least 6-inches by addition of a high range water reducer, the placement of mortar or grout may be omitted.
D. Vertical Joints:
   1. Apply roughener to the form in a thin, even film by brush, spray or roller in accordance with the manufacturer's instructions. After roughener is dry, concrete may be placed.
   2. When concrete has been placed, remove joint surface forms as early as is necessary to allow for removal of the surface retarded concrete. Forms covering member surfaces shall remain in place as required by Section 03305, Concrete. Wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER. Alternately, the surface shall be roughened by abrasive blasting or hydroblasting to expose aggregate. The outer 1-inch of each side of the joint face shall be masked and protected from the blasting to avoid damage to the member surface.

3.3 EXPANSION JOINTS

A. Comply with the requirements of ACI 301 and as specified below.

B. Locate and install expansion joints as shown. Install joint filler in accordance with manufacturer's instructions. Sealants shall be installed as specified herein.

3.4 CONTROL JOINTS

A. Control joints shall be provided in non-water bearing slabs on grade only where specifically shown. A groove, with a depth of at least 25 percent of the member thickness, shall be formed or saw-cut in the concrete. This groove shall be filled with joint sealant material as specified in Section 03305, Concrete.

B. Where the control joint is formed by sawcutting, the cut shall be made immediately after the concrete has set enough to support the saw and be cut without being damaged. The concrete shall be kept continually moist until the cutting operation.

C. Control joints may be formed with a tool or by insertion of a joint forming strip. After the concrete has gained its design strength, the upper portion of the joint forming strip shall be removed and the void filled with sealant.

3.5 ISOLATION JOINTS

A. Wherever a sidewalk or other slab on grade abuts a concrete structure and is not shown doweled into that structure, an isolation joint shall be provided. Such joint shall be formed by a 1/2-inch joint filler with the upper 1/2-inch of the joint filled with sealant.

3.6 WATERSTOPS

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A. General:
   1. Comply with the requirements of ACI 301 and as specified below. All joints shall be made in accordance with manufacturer's instructions.
   2. Obtain ENGINEER'S approval for waterstop locations not shown.
   3. Provide polyvinyl chloride waterstops in all joints in concrete which are intended to retain liquid or are located below grade up to an elevation at least 12-inches above grade or to an elevation at least 12-inches above overflow liquid level in tanks, whichever is higher, except where otherwise shown or noted.

B. Polyvinyl Chloride Waterstop:
   1. Tie waterstop to reinforcement, at a maximum spacing of 18-inches, so that it is securely and rigidly supported in the proper position during concrete placement. Continuously inspect waterstops during concrete placement to ensure their proper positioning.
   2. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is required that:
      a. The material shall not be damaged by heat sealing.
      b. The splices shall have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
      c. The continuity of the waterstop ribs and of its tubular center axis shall be maintained.
   3. Only butt type joints of the ends of two identical waterstop sections shall be allowed to be made while the material is in the forms.
   4. All joints with waterstops involving more than two ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be prefabricated by CONTRACTOR or manufacturer prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
   5. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material, if required.
   6. The symmetrical halves of the waterstops shall be equally divided between the concrete placements at the joints and centered within the joint width, unless shown otherwise. Centerbulb waterstops shall be placed in expansion joints so that the centerbulb is centered on the joint filler material.
   7. When any waterstop is installed in the forms or is embedded in the first concrete placement and the waterstop remains exposed to the atmosphere for more than four days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.
8. Waterstop placed in joints intended for future concrete placement shall be protected from direct rays of the sun by temporary means until a permanent cover is installed so that the waterstop is not exposed to the direct rays of the sun for more than a total of four days.

C. Hydrophilic Rubber Waterstop and Sealant
   1. Where a hydrophilic rubber waterstop or sealant is called for in the Contract Documents, or where approved by the ENGINEER, it shall be installed with the manufacturer's instructions and recommendations; except, as modified herein.
   2. When requested by the ENGINEER, the manufacturer shall provide technical assistance in the field.
   3. The waterstop or sealant shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 3-inches.
   4. Where a hydrophilic rubber waterstop is used in combination with PVC waterstop, the hydrophilic rubber waterstop shall overlap the PVC waterstop for a minimum of 6-inches. The contact surface between the hydrophilic rubber waterstop the PVC waterstop shall be filled with hydrophilic sealant.
   5. Where wet curing methods are used, hydrophilic rubber waterstop and sealant shall be applied after curing water is removed and just prior to the closing up of the forms for the concrete placement. Hydrophilic rubber waterstop and sealant shall be protected from the direct rays of the sun and from becoming wet prior to concrete placement. If the material does become wet and expands, it shall be allowed to dry until it has returned to its original cross sectional dimensions before concrete is placed.
   6. The hydrophilic rubber waterstop shall be installed in a bed of hydrophilic sealant, before skinning and curing begins, so that any irregularities in the concrete surface are completely filled and the waterstop is bonded to the sealant. After the sealant has cured, concrete nails, with washers of a diameter equal to the waterstop width, shall be placed to secure the waterstop to the concrete at a maximum spacing of 18-inches.
   7. Prior to installation of hydrophilic sealant, the concrete surface shall be wire brushed or sand blasted to remove any laitance or other materials that may interfere with the bonding. Surfaces of metal or PVC to receive sealant shall be cleaned of paint and any material that may interfere with bond. When sealant alone is shown on the Contract Documents, it shall be placed in a built up bead which has a triangular cross section with each side of the triangle at least 3/4-inch in length, unless indicated otherwise. Concrete shall not be placed until the sealant has cured as recommended by the manufacturer.

3.7 BONDING AGENT

A. Use epoxy bonding agent for bonding of fresh concrete to concrete that has been in place for at least 60 days or to existing concrete.
B. Use epoxy-cement bonding agent for the following:
   1. Bonding toppings and concrete fill to concrete that has been in place for at least 60 days or to existing concrete.
   2. For all locations where bonding agent is required and concrete cannot be placed within the open time period of epoxy bonding agent.
   3. Bonding of horizontal construction joints where these are required by the Drawings or approved by ENGINEER for foundation mats that are five feet thick or greater.

C. Use a cement-water slurry as a bonding agent for toppings and concrete fill to new concrete. The cement-water slurry shall be worked into the surface with a stiff bristle broom and concrete shall be placed before the cement-water slurry dries.

D. Handle and store bonding agent in compliance with the manufacturer's printed instructions, including safety precautions.

E. Mix the bonding agent in complete accordance with the instructions of the manufacturer.

F. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with bonding agent not less than 1/16-inch thick. Place fresh concrete while the bonding agent is still tacky (within its open time), without removing the in-place bonding agent coat, and as directed by the manufacturer.

3.8 SEALANT INSTALLATION

A. Sealants shall be installed according to the manufacturer’s recommendations for sealant which is to be subjected to continuous submerged conditions and the following requirements. Prior to sealant installation, arrange to have a representative of the sealant manufacturer instruct the crew doing the Work as to the proper methods of surface preparation, mixing, and application of the sealant.

B. Surfaces to receive sealant shall be cleaned of all materials which could interfere with proper bonding. Concrete surfaces shall have all fins or other defects removed or repaired and shall receive a light abrasive blasting prior to priming and sealant application. All surfaces to receive sealant shall be completely dry.

C. Spaces to receive sealant shall be filled with joint filler as shown. Where not shown, the space shall be filled with joint filler or a backer rod so that the depth of sealant does not exceed the width of the space. Where the bottom of the space to receive sealant is formed by a material other than backer rod, a bond breaker tape shall be placed. The maximum sealant depth, at middle of the joint width, shall be 1/2-inch.

D. The primer and sealant used shall be supplied by the same manufacturer. No sealant shall be placed without the use of a primer.
E. Self-leveling sealants shall only be used in joints with a slope less than 0.5 percent and where maximum and minimum sealant depths can be maintained. Non-sag sealant shall be used at all other locations and may be used instead of self-leveling sealant. All non-sag sealant shall be tooled to a uniform concave surface before skinning and curing begins.

F. Sealant material shall be conditioned to be within the optimum temperature range recommended by the manufacturer for installation for a minimum of 16 hours prior to installation. Installation shall proceed only when the substrate is at a temperature recommended by the manufacturer. Sealant shall not be placed if there is a threat of imminent rainfall. Submit a letter certifying that the applied sealants were installed in accordance with the manufacturer’s recommendations, including temperature, relative humidity, etc.

G. All joints to receive sealant shall be inspected by the ENGINEER prior to sealant placement.

H. All sealant shall achieve final cure at least seven days before the structure is filled with water.

I. Any sealant which, after the manufacturer's recommended curing time for the job conditions, fails to fully and properly cure shall be completely removed. The surfaces to receive sealant shall be completely cleaned of all traces of the improperly cured sealant and primer. The specified sealant shall then be reinstalled. All costs of such removal, surface treatment, and reinstallation shall be at the expense of CONTRACTOR.

3.9 BEARING PAD INSTALLATION

A. Neoprene Bearing Pad: Install with water insensitive adhesive in accordance with manufacturer's instructions.

++ END OF SECTION ++
SECTION 03305

CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcement, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported placed, finished, and cured.
      b. Fabrication and placement of reinforcement, including ties and supports.
      d. Building into the concrete all sleeves, frames, anchors, inserts, and other items required to be embedded in the concrete.
      e. Providing openings in the concrete as required to accommodate Work under this and other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.

C. Classifications of Concrete:
   1. Type "1" concrete shall be steel reinforced and includes all concrete, unless indicated otherwise.
   2. Type "2" concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
      a. Concrete fill.
      b. Duct banks.
      c. Unreinforced encasements.
      d. Curbs and gutters.
      e. Sidewalks.
      f. Thrust blocks.

1.2 QUALITY ASSURANCE

A. Source Quality Control:
   1. Concrete Testing Service:
      a. Employ acceptable testing laboratory to perform materials evaluation, testing, and design of concrete mixes.
b. OWNER will employ a separate testing laboratory to perform field quality control sampling and testing on concrete delivered to and placed at the site. Full access shall be provided by CONTRACTOR to personnel of OWNER’S testing laboratory to Work and shall provide all assistance, including labor and equipment, necessary to facilitate testing and sampling.

2. Certificates, signed by concrete producer and CONTRACTOR, may be submitted in lieu of material testing when acceptable to ENGINEER.

3. OWNER’S testing laboratory will perform field quality control sampling and testing during concrete placement, as follows:
   b. Slump: ASTM C 143, one test for each load at point of discharge.
   c. Air Content: ASTM C 231.
   d. Compressive Strength: ASTM C 39, one set of compression strength specimens for each 50 cubic yards or fraction thereof or for each 2,500 square feet of surface area or fraction thereof for each class of concrete placed in any one day.
      1) Test one specimen at seven days and two specimens at 28 days.
      2) When the total quantity of concrete is less than 50 cubic yards, the strength tests may be waived by ENGINEER following review and acceptance of submitted field experience indicating evidence of satisfactory strength.
      3) Slump and air content testing shall be conducted on each sample from which compressive strength specimens are taken.

4. Report test results in writing to ENGINEER on same day tests are made.

B. Standard Specifications and Details:
1. Conform to all applicable requirements of Sections Nos. 505, 725 and 726 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Phoenix and this Specification, provisions of this Specification shall govern.

C. Reference Standards: Comply with applicable provisions and recommendations of the latest editions of the following, except as otherwise shown or specified.
1. ACI 224, Control of Cracking in Concrete Structures.
2. ACI 301, Specifications for Structural Concrete.
3. ACI 304, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
4. ACI 305, Hot Weather Concreting.
5. ACI 306, Cold Weather Concreting.
6. ACI 309, Guide for Consolidation of Concrete.
7. ACI 315, Details and Detailing of Concrete Reinforcement.
8. ACI 318, Building Code Requirements for Structural Concrete.
9. ACI 347, Guide to Formwork for Concrete.
11. ASTM A 82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
12. ASTM A 185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
13. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
14. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
15. ASTM C 33, Specification for Concrete Aggregates.
20. ASTM C 172, Practice for Sampling Freshly Mixed Concrete.
21. ASTM C 231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C 309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
27. ASTM D 1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
28. ASTM E 154, Test Method for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
31. ASTM C 1116, Standard Specification for Fiber-Reinforced Concrete, Paragraph 4.1.3, Type III.

1.3 SUBMITTALS

A. Samples: Submit samples of materials as specified and as otherwise may be requested by ENGINEER, including names, sources, and descriptions.

B. Submit the following Shop Drawings:
1. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
2. Concrete placement plans showing the location and type of all joints.
3. Drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 and ACI SP-66. For walls, show elevations to a minimum scale of 1/4-inch to 1 foot. Show bar schedules, stirrup spacing, splice lengths, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement.

4. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs in accordance with ACI 301, Section 4. Submit written report to ENGINEER for each proposed concrete mix at least 15 days prior to start of Work. Do not begin concrete production until mixes have been reviewed and are acceptable to ENGINEER. Mix designs may be adjusted when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by ENGINEER.

C. Laboratory Test Reports: Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests. ENGINEER’S review will be for general information only. Production of concrete to comply with specified requirements is the responsibility of CONTRACTOR.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling, and handling to ensure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

C. Store concrete reinforcement materials to prevent damage and accumulation of foreign material including dirt and excessive rust. Store on framework or blocking such that no materials come in contact with ground. Space framework or blocking supports to prevent excessive deformation of stored materials.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.
B. Aggregates: ASTM C 33.
   1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank run sand, and manufactured sand are not acceptable.
   2. Course Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.

C. Coarse Aggregate Size: ASTM C 33, Nos. 57 or 67, unless permitted otherwise by ENGINEER.

D. Water: Clean, potable.


F. Water-Reducing Admixture: ASTM C 494, Type A. Only admixtures which have been tested and accepted in mix designs shall be used.

G. Water Reducing and Set Adjusting Admixtures: ASTM C 494, Type D and E. Only admixtures which have been tested and accepted in mix designs shall be used.

H. High Range Water-Reducing Admixture: ASTM C 494, Type F/G. Only admixtures which have been tested and accepted in mix designs shall be used.

I. Calcium Chloride or admixtures containing chloride ions shall not be used.

J. Macro Fiber Reinforced Concrete shall meet the requirements Portland Cement Concrete in accordance with MAG Section 725, Class A Concrete, except as modified herein. Synthetic Macro Fiber Reinforcement shall be added to the concrete mix design indicated below:
   1. Synthetic macro fibers shall be added at a dosage rate of 5 lbs/CY.
   2. Synthetic macro fibers shall meet the requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
   3. Synthetic macro fibers shall be monofilament, non-fibrillating, made of virgin Polyelofin.
   4. Synthetic macro fibers shall have a minimum length of 1.38” (35 mm).
   5. Synthetic macro fibers shall have a maximum length of 2.00” (50 mm).
6. Synthetic macro fibers shall have an L/D aspect ratio (length divided by the equivalent diameter of the fiber) between 85 and 100.

7. Synthetic macro fibers shall have a minimum tensile strength of 90 ksi (620 Mpa).

8. Synthetic macro fibers shall have a minimum chord modulus or elastic modulus (calculated using the slope between 0% and 25% of the ultimate stress on the stress versus strain curve) of 1,378 ksi (9.5 GPa) measured according to ASTM D3822-01.

9. 7.5% of the cementitious material shall be replaced with Silica Fume.

2.2 CONCRETE MIX

A. General
   1. Normal weight: 145 pounds per cubic foot.
   2. Use air-entraining admixture in all concrete: provide not less than four percent nor more than eight percent entrained air for concrete exposed to freezing and thawing, and from three percent to five percent for other concrete.

B. Proportioning and Design of Type “1” Mix:
   1. Minimum compressive strength at 28 days: 4,000 psi.
   2. Maximum water cement ratio by weight: 0.45.
   3. Minimum cement content: 564 pounds per cubic yard.

C. Proportioning and Design of Type “2” Mix:
   1. Minimum compressive strength at 28 days: 3,000 psi.
   2. Maximum water cement ratio by weight: 0.50.
   3. Minimum cement content: 517 pounds per cubic yard.

D. Proportioning and Design of Type “3” Mix:
   1. The requirements for Type “1” concrete shall be met except that slump shall be increased by the use of a high range water-reducer.

E. Slump Limits:
   1. Proportion and design mixes to result in concrete slump at the point of placement of not less than 1-inch and not more than 4-inches.
   2. Where high range water reducers are used, slump prior to addition of admixture shall not exceed 3-inches. Slump after addition of admixture shall not exceed 8-inches at point of placement.

F. Adjustment to Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, job conditions, weather, test results, or other similar circumstances.

2. Laboratory test data for adjusted concrete mix designs, including compressive strength test results, shall be submitted to ENGINEER for review.

3. Adjusted mix designs shall be implemented only with the approval of the ENGINEER.

4. Adjustments to the concrete mix designs shall result in no additional costs to the OWNER.

2.3 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. Responsible for design of the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces as required by ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Not required at re-entrant corners, unless indicated otherwise.

E. Form Ties
   1. Provide factory-fabricated, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal. Materials used for tying forms will be subject to approval of ENGINEER.
   2. Unless otherwise shown, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5-inches from the outer concrete surface. Unless otherwise shown, provide form ties that will leave a uniform, circular hole no larger than 1-inch diameter in the concrete surface when removed.
   3. Ties for exterior walls, below grade walls, and walls subject to hydrostatic pressure shall have waterstops.
   4. Wire ties are not acceptable.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60 deformed bars.

C. Steel Wire: ASTM A 82.

D. Supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
   2. For slabs on grade, use precast concrete blocks (4-inches square minimum with compressive strength equal to or greater than the surrounding concrete) or supports with sand plates or horizontal runners where base materials will not support chair legs.
   3. For all concrete surfaces, where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic protected or stainless steel legs complying with the requirements of CRSI, “Manual of Standard Practice”.
   4. Provide precast concrete supports over waterproof membranes.

E. Drilled Dowels:
   1. Adhesive material for drilled dowels shall be a vinylester resin, epoxy resin, urethane methacrylate or vinyl urethane resin specifically formulated for the application, moisture condition, application temperature, and orientation of the hole to be filled. Polyester resins shall not be used. The resin shall be a high modulus, moisture insensitive type packaged in a cartridge dispensing system with a mixing nozzle.
   2. The adhesive system shall be certified by test to develop a pullout resistance in the specified concrete equal to 125 percent of the yield strength of the dowel bar when embedded to the manufacturer’s recommended depth. Drilled dowels shall be embedded a minimum of 12 times the nominal bar diameter into sound concrete.
   3. Products and Manufacturers: Provide one of the following:
      a. HIT HY150, by Hilti.
      b. HSE 2421 System, by Hilti.
      c. Epcon System Ceramic 6 or Acrylic 7, by ITW Ramset/Redhead.
      e. Or equal.

2.5 RELATED MATERIALS

A. Waterstops:
   1. Polyvinyl Chloride Waterstops:
      a. Waterstops shall meet the requirements of CRD-C 572. No reclaimed or scrap material shall be used.
c. Provide waterstops with a minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be a minimum 1/8-inch in height.
d. Construction Joints: Waterstops shall be 6-inch wide flatstrip type.
e. Expansion Joints: Waterstops shall be 9-inch wide centerbulb type.
f. Products and Manufacturers: Provide one of the following:
   1) W.R. Meadows, Inc.
   2) A.C. Horn, Inc.
   3) Or equal.
2. Hydrophilic Waterstops:
   a. Hydrophilic waterstop materials shall be Bentonite-free and shall expand by a minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
   b. Waterstop material shall be composed of resins and polymers which absorb water and cause a completely reversible and repeatable increase in volume.
   c. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
   d. Select material in accordance with manufacturer’s recommendations for the type of liquid to be contained.
   f. Location of the hydrophilic waterstops shall be as shown on the Drawings or where approved by the ENGINEER.
   g. Products and Manufacturers: Provide one of the following:
      1) Duroseal Gasket, by BBZ USA, Inc.
      2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
      3) Or equal.
   h. Hydrophilic Sealant shall adhere firmly to concrete, metal and PVC in dry or damp condition and be indefinitely elastic when cured.
      1) Products and Manufacturers: Provide one of the following:
         a) Duroseal Paste, by BBZ USA, Inc.
         b) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
         c) SikaSwell S, by Sika Corp.
         d) Or equal.
4. Liquid Chemical Floor Hardener: Provide a clear chemical hardener of the fluorosilicate family.
   1. Products and Manufacturers: Provide one of the following:
      a. Lapidolith, by Sonneborn ChemRex, Inc.
      b. Hornolith by A.C. Horn, Inc.
      c. Or equal.
D. Membrane-Forming Curing compound: ASTM C 309, Type I.

E. Epoxy Bonding Agent:
   1. Two-component epoxy resin bonding agent.
   2. Products and Manufacturers: Provide one of the following:
      a. Sikadur 32, Hi-Mod LPL, by Sika Corp.
      b. Eucopoxy LPL, by the Euclid Chemical Company.
      c. Or equal.

F. Epoxy-Cement Bonding Agent:
   1. Three component blended epoxy resin-cement bonding agent.
   2. Products and Manufacturers: Provide one of the following:
      a. Sika Armatec 110 EpoCem, by Sika Corp.
      c. Or equal.

G. Joint Fillers, Sealant and Backer Rod:
   2. Joint Sealant: Where expansion joints are indicated to be subject to being submerged by water, joint sealant shall be a two part polyurethane type sealant conforming to the requirements of ASTM C 920, Type M, Class 25. The sealant shall be formulated for use in continuously submerged conditions and shall be used only with the manufacturer’s recommended primer.
      a. Products and Manufacturer’s: Provide one of the following:
         1) Permapol RC-270 Reservoir Sealant by Products Research and Chemical Corp.
         2) Sikaflex-2c by the Sika Corp.
         3) Or Equal.
      3. Backer Rod: Extruded closed-cell polyethylene foam rod compatible with the sealant material. The backer rod shall be 1/8-inch larger in diameter than the joint width for joints less than 3/4-inch wide and 1/4-inch larger in diameter than the joint width for joints 3/4-inch wide and wider.

2.6 GROUT

A. Non-shrink Grout:
   1. Prepackaged, non-metallic, cementitious grout requiring only the addition of water at the job site.
   3. Products and Manufacturers: Provide one of the following:
      a. NS Grout by the Euclid Chemical Company.
      b. Set Grout by Master Builders, Inc.
      c. NBEC Grout by Five Star Products, Inc.
      d. Or equal.
B. Epoxy Grout:
   1. Prepackaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
   2. Minimum seven-day compressive strength: 14,000 psi, when tested in accordance with ASTM C 579.
   3. Products and Manufacturers: Provide one of the following:
      a. Euco High Strength Grout by the Euclid Chemical Company.
      b. Sikadur 42, Grout Pak by the Corp.
      c. Five Star Epoxy Grout by Five Star Products, Inc.
      d. Or equal.

C. Cement-Sand Grout:
   1. Grout mix shall consist of cement, fine and coarse aggregates, water and admixtures meeting the requirements previously specified for similar materials in concrete.
   2. Proportion and mix grout as follows:
      a. Minimum cement content: 564 pounds per cubic yard.
      b. Maximum water-cement ratio: 0.45.
      c. Maximum coarse aggregate size: 1/2-inch, unless indicated otherwise.
      d. Minimum 28-day compressive strength: 4,000 psi.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Provide openings in formwork to accommodate Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during and after concrete placement if required to eliminate cement paste leaks.

D. Removal of Formwork:
1. Conform to the requirements of ACI 301 and ACI 347, except as otherwise specified.
2. Formwork or shoring shall not be removed until supported concrete members have acquired a minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated herein.
3. Removal time for all formwork will be subject to approval of ENGINEER.
4. Form tie holes shall be repaired following the requirements of ACI 301.

3.3 REINFORCEMENT, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of specified codes and standards, and CRSI “Manual of Standard Practice”, for details and methods of reinforcement placement and support.

B. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials which act to reduce or destroy bond with concrete.

C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers and hangers, as required.
1. Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
2. Reinforcement shall not be secured to formwork with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcement more than 2-inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars.

F. Install welded wire fabric in as long lengths as practical, lapping adjoining sections a minimum of one mesh.
G. Concrete shall not be placed until the reinforcement is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected. Notify ENGINEER a minimum of two working days prior to proposed concrete placement.

H. Joints:
1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
2. In walls locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
3. In foundation slabs and slabs-on-grade locate joints at a spacing of approximately 40 feet.
4. In mats and structural slabs and beams, locate joints in compliance with ACI 224.
5. The location of all joints shall be as approved by the ENGINEER.
6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously placed concrete to a full amplitude of 1/4-inch.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates and instructions provided under other Sections for locating and setting. Refer also to Paragraph 1.1.B, above. Uncoated aluminum items shall not be embedded in concrete. Where aluminum items come in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Drilled Dowels
1. Drilled dowels shall consist of reinforcing dowels set in an epoxy adhesive in a hole drilled into hardened concrete.
2. Holes shall be drilled to the epoxy manufacturer’s recommended diameter and depth to develop the required pullout resistance but shall not be greater in diameter than 1/4-inch more than the nominal bar diameter nor less than 12 times the nominal bar diameter in depth.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcement in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcement. Adjusted hole locations shall be subject to ENGINEER’S approval.
5. The hole shall be cleaned using a non-metallic fiber bristle brush and blown out with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through the injection system-mixing nozzle (and any necessary extension tubes) placed to the bottom of the hole. The
discharge end shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material is expelled from the hole during dowel placement.

7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

8. Drill holes, install epoxy and dowels and cure epoxy in accordance with epoxy manufacturer’s recommendations and using epoxy manufacturers standard tools and accessories.

3.4 CONCRETE PLACEMENT

A. Job-Site Mixing: Use drum type batch machine mixer, mixing not less than 1-1/2 minutes for one cubic yard or smaller capacity. Increase mixing time a minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with the requirements of ASTM C 94.

C. Concrete Placement:
   1. Place concrete in a continuous operation within planned joints or sections complying with the requirements of ACI 304.
   2. Do not begin placement until work of other trades affecting concrete is completed.
   3. Wet concrete and subgrade surfaces to a saturated surface dry condition immediately prior to placement of concrete.
   4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
   5. Take care to avoid separation of the concrete mixture during transportation and placement. Concrete shall not be permitted to free fall for a distance greater than four feet during placement.
   6. Concrete placement shall be completed within 90 minutes of the addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309 using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around reinforcement and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or reinforcement shall not be permitted.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement, and curing.
   1. In hot weather comply with the requirements of ACI 305.
   2. In cold weather comply with the requirements of ACI 306.
3.5 QUALITY OF CONCRETE WORK

A. Make all concrete solid, compact, smooth and free of laitance, cracks and cold joints.

B. All concrete for liquid retaining structures, and all concrete in contact with earth, water or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to the extent directed by ENGINEER, or repair to the satisfaction of ENGINEER, surfaces which contain cracks or voids, are unduly rough or are in any way defective. Patches or plastering will not be acceptable.

D. Repair, removal and replacement of defective concrete as ordered by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection as required to prevent damage to exposed concrete surfaces. The total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHES

A. Slab Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Use a wood float only. Check and level the surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. All slab surfaces shall receive a float finish. Provide additional trowel finishing as required below.

2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

3. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects which would telegraph through applied floor covering system.

4. Use trowel finish for the following:
a. Interior exposed slabs, unless otherwise shown or specified.
   b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown on the Drawings.

B. Apply chemical floor hardener to exposed interior concrete floor areas when cured and dry, in accordance with manufacturer's instructions.

C. Formed Finish:
   1. Provide a smooth form concrete finish at all exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces also include all interior water bearing surfaces of tanks, whether directly visible or not. All surfaces shall be considered as exposed, unless buried or covered with a permanent structural or architectural material. After form removal, patch all form tie holes and defects in accordance with the requirements of ACI 301. Remove all fins exceeding 1/8-inch in height. Where surface is to be coated or to receive further treatment, remove all fins flush with concrete surface.
   2. Provide rough form finish at all unexposed surfaces. After form removal, patch all form tie holes and defects in accordance with the requirements of ACI 301. Remove all fins exceeding 1/2-inch in height.

3.8 GROUT PLACEMENT

A. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the specified requirements do not proceed until ENGINEER provides clarification.

B. Dry-packing will not be permitted, unless indicated otherwise.

C. Manufacturers of proprietary products shall make available upon 72 hours notification the services of qualified, full-time employee to aid in assuring proper use of the product under job conditions.

D. Placing grout shall conform to the temperature and weather limitations described in Article 3.4, above.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Temporary Openings
   1. Openings in concrete walls and/or slabs required for passage of Work or installation of equipment and not shown on the Drawings shall be provided, but only with approval of the ENGINEER.
   2. All temporary openings made in concrete shall be provided with waterstop in below grade or water retaining members. Continuity of required reinforcement shall be provided in a manner acceptable to the ENGINEER.
3. Temporary openings left in concrete structures shall be filled with concrete after the Work causing the need for the opening is in place, unless otherwise shown or directed. Mix, place and cure concrete as specified herein, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.

B. Equipment Bases:
1. Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Coordinate and construct bases to the dimensions shown, or as required to meet manufacturers; requirements and Drawing elevations. Where no specific elevations are shown, bases shall be 6-inches thick and extend 3-inches outside the metal equipment base or supports. Bases shall have smooth trowel finish, unless a special finish such as terrazzo, ceramic tile or heavy duty concrete topping is required. In those cases, provide appropriate concrete finish.
2. Include all concrete equipment base work not specifically included under other Sections.
3. In general, place bases up to 1-inch below the metal base. Properly shim equipment to grade and fill 1-inch void with non-shrink grout as specified in this section.

C. Curbs:
1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
2. Exterior curbs shall have rubbed finish for vertical surfaces and a broomed finish for top surfaces.

D. Steel Pan Stairs:
1. Provide concrete fill for steel pan stair treads and landings and associated items. Screed, tamp, and finish concrete surfaces as shown.
   a. Cast-in safety inserts and accessories as shown.

E. Slabs/Foundations:
1. All mechanical pipe and electrical conduit penetrations through concrete slabs must be sleeved.

++ END OF SECTION ++
SECTION 03310

LOW DENSITY CELLULAR CONCRETE BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies requirements for developing and preparing mix designs, testing and verifying mixes, and batching, transporting, and placing low density cellular concrete, as specified around pipe installed in the tunnel for the I-17 crossing. Requirements for furnishing and installing the pipe, and for performing contact grouting are specified elsewhere.

1.2 RELATED REQUIREMENTS

A. Other related work as called for on PLANS or specified elsewhere in this or other TECHNICAL SPECIFICATION Sections.

1.3 REFERENCES

A. American Concrete Institute
   1. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.

B. American Society for Testing and Materials (ASTM)
   1. ASTM C33 Specification for Concrete Aggregates.
   8. ASTM C567 Standard Test Method for Unit Weight of Structural Lightweight Concrete.

1.4 DESIGN CRITERIA

A. Design criteria:
1. Refusal: When the total amount of contact grout injected into a hole is less than 0.5-cubic feet measured over a continuous two-minute period at the maximum specified pressure.
2. Annulus: The space between concrete backfill or cast-in-place concrete and excavated ground.
3. Final Lining: The Cast-In Place concrete lining or steel pipe lining in the tunnel

1.5 DESIGN AND PERFORMANCE AND CRITERIA

A. Design Criteria:
1. Application:
   a. Cellular Concrete: Concrete placed around the pipe installed in the tunnel, where indicated on Plans.
2. Materials:
   a. Cellular Concrete:
      i. Cement content: Not less than 500-lb/cy.
      ii. Flyash: No greater than 15 percent of cement by weight.
      iii. Fine Aggregate: No more than 1,200-lb/cy.
      iv. Water content: No more than 55 percent.
      v. Wet Density: Not less than 50-lb/cubic ft.
      vi. Minimum compressive strength:
          (a) Seven calendar days: 150-psi.
          (b) 28 calendar days: 375-psi.

B. Tolerances: Minimum backfill thickness as shown on Plans.

1.6 SUBMITTALS

A. General: Make submittals in accordance with Section 01300.

B. Product Data: Refer to Section 03300 for submittal requirements.

C. Working Drawings and Methods Statements:
1. Means and methods for proportioning, mixing, batching, and delivering cellular concrete, including the storage of raw materials.
2. Details for transporting and placing cellular concrete. Integrate with and describe the sequencing of this work with the installation of steel pipe as
specified in Section 02656 or where required to backfill behind reinforced concrete cylinder pipe. Augment with:

a. Lift drawings showing details of delivery pipes, slicklines, injection ports, bulkheads, and other materials.
b. Calculations for preventing flotation and deformation of the final lining. Provide calculation for each lift planned to place backfill.
c. Descriptions of labor, equipment and supplies required to perform the work.
d. Cross-sections and profiles showing the arrangement of transportation, handling, and placing equipment including passing clearances.
e. Layout of surface facilities and details for transporting cellular concrete to placement areas.
f. Details of pumping pressures and rates, placement sequences and volumes, lift thicknesses, including the theoretical quantity for each placement.
g. Methods for diverting construction water and groundwater and protecting cellular concrete.

D. Mix Designs: Refer to Section 03300 for submittal requirements.

E. Quality Control:
   1. Qualifications:
      a. Proposed specialty firm for batching and pumping cellular concrete.
      b. Individual providing engineering field services on behalf of foaming agent material manufacturer.
      c. Concreting supervisor responsible for developing mix designs and overseeing placement of backfill concrete and cellular concrete.
      d. Field sampling and testing personnel, including qualifications of employer.
   2. Certifications:
      a. Certificates of compliance for materials incorporated into the Work.
      b. Calibration certificates for gauges, scales, and meters in accordance with ANSI B40.1.
      c. Written certification from the manufacturer and Contractor that the pipe is capable of handling the proposed pumping and hydrostatic pressures.
      d. Written certification from the manufacturer of the foaming agent material manufacturer that:
         i. Flyash proposed for use is compatible with the proposed foaming agent.
         ii. Proposed admixtures are compatible with the proposed foaming agent.
         iii. Proposed mix designs in conjunction with batching, transporting, and placing means and methods are compatible with the foaming agent.
         iv. Acceptability of the method whereby the foaming agent is introduced to the batching system.
3. Quality Control Plans:
   a. Procedures for producing cellular concrete, including procedures for verifying mix proportioning, mix ingredient quality, and procedures for sampling, testing, and record keeping.
   b. Methods for controlling critical mix parameters, such as cellular concrete density.
   c. Methods for assuring that the annular space between the pipe and the initial supports or unexcavated materials are completely filled.
   d. Methods for assuring that injection pressures do not damage the pipe or adjacent work.
   e. Method for determining when pipe bracing and supports may be removed from steel pipe installations.

4. Recordkeeping: Daily records submitted no later than the end of each working day:
   a. Scale weights for batched loads.
   b. Mix design tickets.
   c. Delivery tickets or print outs provided to the Engineer for each batch before placement indicating the weight of each material in each batch when a field batch is utilized.
   d. Daily reports and records of cellular concrete placement, including:
      i. Number and classification of men and equipment.
      ii. Beginning and ending stations or elevations of placements, beginning and ending time for the pour, type of mix and volume.
      iii. Test information, including time, location, and results of tests.
      iv. Notation of any downtime or interruption to production, including length of time and reason.

5. Notifications: One working day in advance of all placements.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Cellular Concrete Specialty Contractor: Minimum of 10 years of recent, successful experience in batching and placing cellular concrete for at least three tunnel projects of the general type, size, and diameter as required for this project.
   2. Concreting Supervisor: Experienced in similar tunnel conditions and knowledgeable in the formulation and adjustment of mix designs.
   3. Field Sampling and Testing Personnel: Qualified employees of an ACI-certified testing laboratory.

B. Acceptance Criteria:
   1. Cellular Concrete:
      b. Density: Within 10% percent of the design value.

C. Preconstruction Meeting: Coordinate meetings with preconstruction meeting
specified under Section 02656 to review details of the backfill operation, including mixing, placement procedures and sequencing, and testing and inspection.

D. Testing:
   1. General:
      a. Test cellular concrete compressive strength in accordance with ASTM C495, and mimicking in-situ pressures except:
         i. Cast cylinders using styrofoam moulds; do not use plastic molds.
         ii. Do not oven cure test specimens.
         iii. Cap specimens with plaster of Paris; do not use sulfur caps.
      b. Test cellular concrete wet densities in accordance with ASTM C567.
   2. Pre-Production Testing:
      a. Take one set comprising four cylinders for each proposed mix.
      b. Perform compressive strength tests on one set of samples at 28 calendars days.
   3. Production Testing:
      a. At batch plant: Refer to part 2 of this Section.
      b. At placement location: Refer to Part 3 of this Section.

1.8 – 1.22 (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURER(S) (NOT USED)

2.2 MATERIALS AND/OR EQUIPMENT

A. Cellular Concrete:
   1. Foaming Agent:
      a. Conforming to ASTM C869 when tested in accordance with ASTM C796.
      b. Capable of generating foam, which maintains stability until the cement sets to form a self-supporting matrix comprising closed cells and low water absorptive characteristics.
      c. Comprising Mearl Geofoam Liquid Concentrate (the Mearl Corporation, Roselle Park, New Jersey); Rheocell 15 (Master Builders Inc., Cleveland, Ohio); WF 304 Foam Concentrate (Cellufoam Concrete Systems, Scarborough, Ontario); MaxFlow Foaming Agent Concentrate (MaxFlow Environmental Corp., Black Mountain, North Carolina); or approved equal.
      d. Furnish equipment of sufficient size to batch and pump the required volume of low-density cellular concrete backfill over the distance
required and through injection ports at a uniform flow rate and under the required constant pressure in an underground environment.
e. Configure equipment to flush system with intake valves closed, with water supply valve open, and with pump running at full speed.
f. Provide a system capable of generating a non-foamed slurry meeting specified acceptance criteria.
g. Maintain equipment in good operating condition and provide an adequate inventory of spare parts and backup equipment on site to assure that the equipment is available at all times.
h. Batching equipment shall utilize mechanical system to ensure consistency of the mix.
i. Batching Equipment shall provide digital printout record of batch scale readings, accurate to one pound of dry mix ingredients before delivery to mixer.
j. Foam generator shall generate foam by combining controlled quantities of air, water, and foaming agent under pressure in accordance with the foaming agent manufacturer’s recommendations.
k. Foam generator shall maintain the temperature of water used in generating the foam below 80°F, or as recommended by the foaming agent manufacturer.
l. Foam generator shall provide timer controls to repetitively discharge a pre-selected quantity, or to continuously discharge at a fixed rate.
m. Foam generator shall discharge foam into the mixer and blend with the cement slurry.
n. Configure mixer to be compatible with the pump to assure continuous and uniform flow at the point of placement.
o. Provide a mixer capable of providing a super-wetted, homogenized mix.
p. Equip mixer with a water meter with an accuracy of plus or minus 1 gallon for measuring the amount of mixing water to be added to the dry mix ingredients.
q. Provide pumping equipment capable of pumping the amounts of low-density cellular concrete to be conveyed without pulsation or segregation.
r. Operate pump to uniformly convey a continuous stream of low-density cellular concrete, without air pockets.
s. Pumping Equipment shall be equip with pressure limit device to limit pumping pressure as required to prevent damage to pipe and initial support systems.
t. Convey cellular concrete to the point of placement in steel piping or rubber hoses.
u. Provide piping, injection hoses, valves and connections of no less than two-inch I.D.
v. Furnish a system of valves in the line at or near the points of injection to facilitate collecting samples.
w. Incorporate suitable stop valves at injection points for use in venting air or maintaining pressure, as required
x. Pressure gauges displaying up to 150 percent of the maximum allowable pressure, and accurate to within 0.5 percent over the full range of the gauge.
y. Certified and calibrated pressure gauges in accordance with ANSI B40.1, Grade 2A.
z. Pressure gauges shall be oil-filled type gauges attached to a saddle-type diaphragm seal.

2. Admixtures:
a. Do not use admixtures containing chlorides, that promote corrosion, or that have not been certified for use with foaming agent by foaming agent manufacturer.
b. Retarder/Water Reducer: Conforming to ASTM C494, Type D.
c. Plasticizer/Water Reducer: Conforming to ASTM C494, Type A.

3. Cement: Conforming to ASTM C150, Type II.
4. Fly Ash: Conforming to ASTM C618, Class F, except that fly ash with carbon content greater than six percent may be used when approved by the foaming agent manufacturer.
5. Fine Aggregate: Conforming to ASTM C33.

2.3 SOURCE QUALITY CONTROL

A. Provide delivery and measurement of materials from batching equipment to within the accuracies specified in ASTM C94. Test scales periodically in a manner and at intervals set forth in the approved Quality Control Plan.

B. Sample and test fine aggregate, when used, in accordance with ASTM C33 and at the frequency specified in the approved Quality Control Plan.

C. Sample and test fly ash in accordance with ASTM C311 once daily.

D. Test and calibrate equipment to generate foam for cellular concrete each day for density and volume output.

E. Sample and test wet density of cellular concrete prior to introduction of the foaming agent and noting the time and temperature:
   1. Every 30 minutes.
   2. For each batch mixed.
   3. Whenever compression test cylinders are made.

2.4 (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL
A. Establish the limits of each cellular concrete placement based on size and capacity of batching and placing equipment, and mix parameters such as initial set time.

B. Limit lift heights to prevent pipe flotation and to maintain cellular concrete parameters within specified limits.

C. Arrange and route utilities to provide ready and available services during backfill placement.

D. The non-timber elements of the track system used during tunnel construction may be abandoned in place provided that the minimum indicated clearances shown on the plans are maintained.

3.2 PREPARATION

A. Verify that locations where cellular concrete is to be placed are clean and free of standing water.

B. Verify that the pipe has been installed as specified in Section 02656.

C. Bulkheads:
   1. Erect full-height vertical bulkheads snug between tunnel initial support and pipe, no closer than 12-inches from the leading edge of the pipe.

3.3 PLACEMENT

A. Use multiple lifts as required to avoid pipe flotation and damage to the pipe, and collapsing of the cellular concrete. Complete each lift prior to beginning the next lift.

B. Inject cellular concrete on either side of the pipe simultaneously.

C. If only part of the tunnel length is being backfilled, complete all lifts for that particular section of tunnel prior to beginning the first lift of the succeeding length of tunnel.

3.4 CLEANUP (NOT USED)
3.5 FIELD QUALITY CONTROL

A. General:
   1. Collect samples of cellular concrete at the injection point or discharge point, as the case may be.
   2. Measure and record the volume of concrete placed. Compare actual volume placed for each length of tunnel being backfilled with the theoretical volume for that length of tunnel being backfilled. Use grout hole connections in the pipe to monitor the backfill placement operations.

B. Compression Tests:
   1. Take two sets of two cylinders for every 200-cy batched, but no less than two sets per day.
   2. Test two cylinders at 28 calendar days. Test the additional two cylinders taken at 28 calendar days.

C. Air Entrainment Test: In accordance with Section 03001.

D. Wet Density Test – Sample at the injection point:
   1. Every 30 minutes.
   2. After a change in the mix batched.
   3. Whenever compression test cylinders are made.

3.6 – 3.11 (NOT USED)

+ + END OF SECTION + +
SECTION 03435

ACID RESISTANT POLYMER STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Contract Drawings, specified, and required to design, furnish and install acid resistant manholes and discharge structure intended for use in sanitary sewer systems.
   2. Design, construction, testing, and commissioning of acid resistant manholes and discharge structure and related work including foundations, mechanical, and appurtenances.

B. General:
   1. Manholes and discharge structure shall conform in shape, size, dimensions, material, and other respects to the details shown on the Drawings or as directed by ENGINEER.
   2. Excavation and backfill required to install acid resistant manholes and discharge structure shall conform to the requirements of Section 02315, Structural Excavation and Backfill.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified:
   1. ASTM C 33 Standard specification for concrete aggregates.
   2. ASTM C 443 Standard specification for joints for concrete pipe and manholes using rubber gaskets.
   3. ASTM C478 Standard specification for precast reinforced concrete manhole sections.
   4. ASTM C497 Test methods for concrete pipe, manhole sections, or tile.
   5. ASTM D648 Test method for deflection temperature of plastics under flexural load in edgewise position.
   6. ASTM C857 Standard practice for minimum structural design loading for underground utility structures.
   7. ASTM C923 Standard specifications for resilient connectors between concrete manholes structures and pipe.
   8. ASTM D6783 Standard specification for polymer concrete pipe.
   9. ASTM D 2584 Test method for ignition loss of cured reinforced resins.
   10. AASHTO LRFD Bridge design specifications.
1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Drawings shall include station number, manhole number, location, rim and invert elevations, materials, dimensions, structural elements, reinforcing details, joint details, base slab and top slab, stubs or openings for connections, and component parts.
   2. Summary of criteria used in manhole and discharge structure design including as a minimum, material properties, loadings, load combinations, and dimensions. Include certification from manufacturer that acid resistant polymer manhole and discharge structure design meets or exceeds the load and strength requirements of ASTM C 478 and ASTM C 857. Include design basis, loads and load combinations and results.
   3. Manufacturer’s reports including documentation of required tests, inspections, certifications and qualifications.
   4. Frames, grates, rings, and covers.
   5. Materials used in fabricating drop connections.
   6. Materials used for pipe connections at manhole walls.
   7. Materials for stubs and stub plugs, if required.
   8. Materials for pipe penetration patch work.
   10. Submit calculations demonstrating the manhole and discharge structure meets the design criteria and established design standards. Design drawings and calculations shall be sealed by a professional engineer registered in the State of Arizona.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Armorock
B. US Composites Pipes, Inc.

2.2 ACID RESISTANT POLYMER STRUCTURES-ARMOROCK

A. Manholes and Discharge Structure:
   1. The manholes and discharge structure shall be designed to resist all soil and hydraulic pressures, including both lateral pressure and hydraulic uplift. Components shall be designed for a minimum lateral saturated soil pressure of 120 pounds per square foot per foot of depth, a minimum unbalanced live load surcharge on surrounding soil of 250 pounds per cubic foot, an H-20 wheel loading, and an impact allowance of 15 percent.
   2. Acid resistant polymer manhole and discharge sections, manhole and discharge risers, transition slabs, conical tops, grade rings, base sections and related components shall be designed by the manufacturer to meet the intent of ASTM
C 478 with allowable compositional and sizing differences required by a polymer product.
3. Provide base riser section with integral floors, unless shown otherwise.
4. Provide riser sections joined with bell and spigot / ship-lap design seamed with butyl mastic so that on assembly, manhole and discharge structure base, riser and top section make a continuous and uniform structure.
5. Construct riser sections for polymer manholes, and discharge structure from standard polymer manhole sections of the diameter indicated on Drawings.
6. Use various lengths of manhole and discharge sections in combination to provide correct height with the fewest joints.
7. Design wall sections for depth and loading conditions with wall thickness as required by polymer manufacturer.
8. Provide tops to support HL-93 vehicle loading and receiving cast iron frame covers as indicated on Drawings.
9. Where polymer transition slabs are required, provide precast base sections with flat polymer slab top sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric as shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by ENGINEER.
10. Elastomeric Gaskets: Gaskets shall be suitable for the service intended. All gaskets shall meet the requirement of ASTM C 443.
11. The dimensions of the manholes and discharge structure shall be as shown on the Drawings.

B. Design
1. Polymer Mixture - the mixture shall consist solely of thermosetting resin sand and aggregate. No cementitious materials will be allowed. Resin content shall be a minimum of 7% by weight.
2. Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C 33, where applicable.
3. Additives: Resin additives, such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the manhole or discharge structure.
4. The required wall thickness for all members shall be that stated by the polymer manufacturer based upon loading conditions and material properties. The wall thickness of risers and conical tops shall be not less than that prescribed by the manufacturer’s design by more than 5%. A wall greater than the prescribed design shall not be cause for rejection.
5. Thermosetting Resin - The resin shall have a minimum of deflection temperature of 158° F when tested at 264 psi (1.820 mPa) following Test Method D 648. The resin content shall not be less than 7% of the weight of the sample as determined by test method D 2584. Resin selection shall be suitable for applications in the corrosive conditions sanitary sewer wastewater which the structures will be exposed.
6. Each manhole and discharge structure component shall be free of all defects, including indentations, cracks, foreign inclusions and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. The internal diameter of manhole or discharge structure components shall not vary more than 1%. Variations in height of two opposite sides of risers and conical tops shall not be more than the 5/8 inch. The under run in height of a riser or conical top shall not be more than 1/4 inch per foot of height with a maximum of ½ inch in any one section.

7. Marking and Identification - Each manhole and discharge structure shall be marked on the inside and outside with the following information - Manufacturer’s name or trademark, Manufacturer’s location and Production Date.

8. Manhole or discharge structure joints shall be assembled with a bell/spigot or shiplap butyl mastic joint so that on assembly, manhole and discharge base, riser and top section make a continuous and uniform structure. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that would affect joint integrity.

9. Minimum clear distance between two wall penetrations shall be a minimum of 6 inches on 48-inch to 72-inch diameter manholes and a minimum of 8 inches on the discharge structure. A clearance of 6 inches is required between wall penetration and joint locations.

10. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Provide invert slope through manholes and discharge structure as indicated on the Drawings. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts. Polymer bench and channel shall be provided with all resin aggregate material. No alternative fill material is allowed. Provide extended cementitious concrete base footer where required for buoyancy concerns.

11. Provide resilient connectors conforming to requirements of ASTM C 923 or as required by ENGINEER. All connectors shall be water tight. Install approved resilient connectors at each pipe entering and exiting manholes or discharge structure in accordance with manufacturer’s instructions.

12. Exceptions to ASTM C 478- components shall be designed for the intended combinations of manufacturing materials. Component designs may be as non-reinforced members or reinforced members as recommended by the manufacturer. Steel reinforcement is not required for circumferential reinforcement, joint reinforcement, base slab reinforcement or hoop reinforcement, but may be placed for the purpose of product handling.

C. GROUTING

1. All materials needed for grouting and patching will be a polyester mortar compound provided by the manufacturer or an approved equal by the manufacture.
2.3 ACID RESISTANT POLYMER STRUCTURE – US COMPOSITES

A. Materials (per ASTM D 6783)
   1. Resin: The manufacturer shall use only polymer or vinyl ester resin systems
designed for use with this particular application. Resin content shall be a
minimum of 7% by weight.
   2. Filler: All aggregate, sand and quartz power shall meet the requirements shall
meet the requirements of ASTM C33, where applicable.
   3. Additives: Resin additives, such as curing agents, pigments, dyes, fillers and
thixotropic agents, when used, shall not be detrimental to the manholes.
   4. Elastomeric Gaskets: Gaskets shall be suitable for the service intended. All
gaskets shall meet the requirements of ASTM C443.

B. Manufacturing and Production Construction
   1. Manholes and Discharge Structures: Manholes and discharge structure
components shall be manufactured by the vibrator vertical casting process
resulting in a dense, non-porous, corrosion-resistant, homogeneous, composite
structure. Manholes and discharge structure shall be steel reinforced per ASTM
C478. Per ASTM C478, hoop reinforcement shall only be allowed in 48”
diameter manhole risers with no openings. Larger diameter manholes and
discharge structures shall not use hoop reinforcement. Manholes and discharge
structures shall have monolithic base slab unless otherwise approved. Manholes
and discharge structures shall be engineered and rated lifting devices that shall
not penetrate through the wall.
   2. Section Joints: Round manhole and discharge structure components shall be
connected with an elastomeric sealing gasket as the sole means to maintain
joint water-tightness and both the gasket material and the manhole and
discharge structure joint shall meet the requirements of ASTM C443. Round
manholes and discharge structures shall utilize spigot and bell type joints
incorporating either a confined O-ring or single step profile joint. Square and
rectangular structures shall utilize a ship-lap joint and be sealed with butyl rope
sealant per ASTM C990 as recommended by the manufacturer.
   3. Pipe to Manhole Connections: Pipes shall be directly connected to all structures
using resilient flexible pipe to manhole and discharge connector per ASTM
C923. Cold joint pipe stub grouting shall not be allowed unless shown on the
plans as such. In cases where cold joint pipe stubs are shown, they shall be
grouted using a corrosion resistant grout and rubber water stop grout ring.
   4. Fittings: Cones, reducer slabs and adjusting rings shall be of the same
material as adjoining riser sections.
   5. Invert Manhole Channels: Invert channels shall be factory built with polymer
concrete.

C. Design.
   1. Manholes and discharge structures shall be designed to withstand all live loads
and dead loads as described in the project plans and specifications. Dead loads
shall include overburden load, soil side pressure and hydrostatic load
conditions Manhole shop drawings shall be sealed by a licensed Professional Engineer licensed in the state of Arizona.

2. Manholes and discharge structure wall thickness shall be designed to resist hydrostatic pressures with a safety factor of 2.0 for full depth conditions from grade to invert. In no cases shall the wall thickness be less than 4-inches for 60” and larger and 3-inch for 48” diameter.

3. Manholes and discharge structure shall be design with sufficient bottom anchorage and side friction to resist buoyancy. Field cast floatation collars are acceptable.

4. The manholes and discharge structures shall be manufactured in one class of load rating. This class shall be H-20-wheel load (minimum 16,000 pounds dynamic wheel load).

D. Testing
1. Manholes and Discharge Structures: Manholes and discharge structures shall be manufactured in accordance with ASTM C478.
2. Joints: Joints shall meet the requirements of ASTM C443.
3. Compressive Strength: Polymer concrete shall have a minimum unconfined compressive strength of 9,000 psi when measured in accordance with ASTM C497.
4. Manhole and Discharge Structure Leakage: Manhole and discharge structure shall be tested in accordance with ASTM C1244 Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test.

E. Handling and Shipping:
1. Handling and shipping shall be performed in accordance with the manufacturer’s instruction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation shall be in accordance with the project plans and specifications and the manufacturer’s recommended practices.

B. Handling: Properly rated slings and spreader bar shall be used for lifting. The type of rigging used shall be as recommended by the manufacturer’s instructions:
1. Sealing surfaces and joint components shall be inspected for damage and cleaned of all debris.
2. Apply joint lubricant to elastomeric seals. Use only lubricants approved by the manufacturer.
3. Use suitable equipment handle and set structure components.
4. Placement and compaction of surrounding backfill material shall provide sufficient and equal side pressure on the manhole and discharge structure during installation.
3.2 GRADING AT MANHOLES AND DISCHARGE STRUCTURE

A. All manholes and discharge structure in unpaved areas shall be built as shown on the Drawings. This shall include a concrete collar around the manhole rim to protect from off-road vehicles. The ground surface shall be graded to drain away from the manhole and discharge structure. Fill shall be placed around manholes to the level 6 inches below the top of the concrete collar and upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown on the Drawings or directed by the ENGINEER.

B. Manholes in paved areas and areas receiving gravel shall be constructed to meet the final surface grade as shown on the Drawings.

C. Sole responsibility for the proper height of all manholes necessary to reach the final grade at all locations belongs to CONTRACTOR. Caution: ENGINEER’S review of Shop Drawings for manhole components will be general in nature, provide an adequate supply of random length precast manhole riser sections and adjustment rings to adjust any manhole to meet field conditions for final grading.

3.3 MANHOLE AND DISCHARGE STRUCTURE WATERTIGHTNESS

A. All manholes and discharge structure shall be free of visible leakage. Each manhole and structure shall be tested for leaks and inspected. All leaks shall be repaired in a manner subject to ENGINEER’S approval. Manhole structure testing shall conform with the requirements of Section 15051, Buried Piping Installation, and City of Phoenix Supplement to MAG Section 625.

++ END OF SECTION ++
SECTION 05561

CASTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install castings.
2. Castings include metal items, which are not a part of the miscellaneous metal fabrications or metal systems in other Sections of these Specifications.

B. Castings shall be for the following types of construction:
1. Manholes frames with covers.
2. Trench grate with frame.

1.2 QUALITY ASSURANCE

A. Standard Specifications and Details:
1. Conform to all applicable requirements of Part Nos. 600 and 700 of the Uniform Standard Specifications for Public Works Construction and all applicable requirements of the Uniform Standard Details for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. If there is a conflict between MAG Standards as supplemented by the City of Phoenix and these Specifications, the provisions of these Specifications shall govern.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

C. Shop Assembly:
1. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Fabrication and erection of all casting assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
a. Include setting drawings for location and installation of castings and anchorage devices.

2. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gray Iron Castings: ASTM A 48, Class 30A.

B. Aluminum Castings: ASTM B 26, Alloy 713 Temper T5.

C. Manhole Frames with Covers:
   1. Roadway standard with 24-inch opening and cast covers conforming to the MAG Uniform Standard Details for Public Works Construction, Detail No. 424, except where otherwise shown on the Drawings.
   2. Provide lettering as shown on Drawings.

D. Cast iron trench grate and frame shall be designed for H-20 truck loading. Frame and grate shall be as manufactured by:
   2. Or equal.

E. Product and Manufacturer: Provide one of the following:
   1. Neenah Foundry Company.
   2. Flockhart Foundry Company.
   3. Or equal.

2.2 DESIGN AND FABRICATION

A. Design round frames and covers to prevent rocking and rattling under traffic.

B. Fabricate castings true to pattern so that component parts fit together.

2.3 FINISH

A. Iron: Coat with asphaltic paint standard with the manufacturer.

B. Aluminum: Provide mill finish.

PART 3 - EXECUTION
3.1 INSTALLATION

A. Follow manufacturer's printed instructions and approved Shop Drawings.

B. Set castings accurately to required location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork.

C. Protection from Dissimilar Materials:
   1. Coat all aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel and other metals.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section specifies systems of process piping and general requirements for piping systems. Detailed Specifications for the components listed on the Piping System Specification Sheets are found in the applicable Sections of Division 15, Mechanical. This Section shall be used in conjunction with those Sections.

2. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish, install and test all piping, fittings and specials. The Work includes, but is not limited to, the following:
   a. All types and sizes of piping, except those specified under other Sections.
   b. Piping beneath, embedded or within structures.
   c. Supports, restraints and thrust blocks.
   d. Pipe encasements.
   e. Work on or affecting existing piping.
   f. Testing.
   g. Cleaning.
   h. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods and all other Work required to complete the piping installation.
      1) Gasket materials shall comply with National Sanitation Foundation (NSF-61) and Arizona Administration Code requirements as stated in Specification Section 01420 – References.
      i. Incorporation of valves, meters and special items shown on the Drawings or specified into the piping systems as required and as specified in the appropriate Division 15, Mechanical, Sections.
      j. Unless otherwise specifically shown on the Drawings, specified, or included under other Sections, all buried piping Work required begins at the outside face of structures or structure foundations and extending away from structure.

B. Coordination:

1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.

C. Definitions:

1. Pressure terms used in this Section and elsewhere in Division 15, Mechanical, are defined as follows:
a. Maximum: The greatest continuous pressure at which piping system operates.
b. Test: The hydrostatic pressure used to determine system acceptance.

### 1.2 QUALITY ASSURANCE

A. Conform to all applicable requirements of Parts 600 and 700 of the Uniform Standard specifications for Public Work Construction by the Maricopa Association of Governments (MAG) and COP Supplement to MAG. If there is a conflict between MAG Standard specifications and these Specifications, the Provisions of these Specifications shall govern.

B. Requirements of Regulatory Agencies:
   1. Comply with requirements of NFPA Standard No. 24 for "Outside Protection" where applicable to water pipe systems used for fire protection.
   2. Comply with applicable requirements of NFPA Standard No. 14 for "Standpipe and Hose Systems" used for fire protection.
   3. Comply with requirements of UL, FM and other jurisdictional authorities, where applicable.
   4. Refer to the General and Supplementary Conditions regarding permit requirements for this Work.
   5. Comply with requirements of Phoenix Construction Code.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. AASHTO M36/M36M, Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.
   2. ANSI A13.1, Scheme for the Identification of Piping Systems.
   3. ANSI B1.20.1, Pipe Threads, General Purpose (Inch).
   4. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
   5. ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300.
   7. ANSI B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
   8. ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
   10. ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   11. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   12. ANSI B31.1, Power Piping.
   14. ASME SECTION IX, Boiler and Pressure Vessel Code; Welding and Brazing Qualifications.
   16. ASTM A 53, Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.
23. ASTM A 312/A312M, Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
27. ASTM B 88, Specification for Seamless Copper Water Tube.
29. ASTM C 296, Specification for Asbestos-Cement Pressure Pipe.
35. ASTM D 2513, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
38. ASTM D 3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
40. ASTM D 3262, Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
42. ASTM D 4101, Specification for Propylene Plastic Injection and Extrusion Materials.
43. ASTM F 441, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
44. AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
45. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids.
47. AWWA C115, Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges.
48. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
49. AWWA C200, Steel Water Pipe 6 Inches and Larger.
51. AWWA C206, Field Welding of Steel Water Pipe.
52. AWWA C207, Steel Pipe Flanges for Waterworks Services--Sizes 4 In. through 144 In.
53. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
54. AWWA C209, Cold-Applied Tape Coating for special sections, Connections, and Fittings for Steel Water Pipelines.
55. AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe.
56. AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
57. AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
58. AWWA C303, Reinforced Concrete Pressure Pipe-Steel Cylinder Type, Pretensioned, for Water and Other Liquids.
59. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
60. AWWA C651, Disinfecting Water Mains.
61. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water.
63. CISPI 301, specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings.
64. FEDSPEC L-C-530B(1), Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy.
68. Phoenix Plumbing Code.
70. National Sanitation Foundation (NSF-61) and Arizona Administration Code requirements as stated in Specification Section 01420 – References.
D. Fitting and Coupling Compatibility:
   1. To assure uniformity and compatibility of piping components, fittings and
couplings for grooved end piping systems shall be furnished by the same
manufacturers.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Detailed drawings and data on pipe, fittings, gaskets and appurtenances.
      Submit these with Shop Drawings required under Section 15050, Piping
      Systems, and Section 15051, Buried Piping Installation.

B. Certificates: Submit certificates of compliance with Referenced Standards.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General:
   1. Deliver materials to the site to ensure uninterrupted progress of the Work.
   2. Handle all pipe, fittings, specials and accessories carefully with approved
      handling devices. Do not drop or roll material off trucks. Do not otherwise
      drop, roll or skid piping.
   3. Store pipes and fittings on heavy wood blocking or platforms so they are not in
      contact with the ground. Store all material per manufacturer recommendations.
   4. Unload pipe, fittings and specials opposite to or as close to the place where they
      are to be installed as is practical to avoid unnecessary handling. Keep pipe
      interiors completely free from dirt and foreign matter.
   5. Inspect delivered pipe for cracked, gouged, chipped, dented or other damaged
      material and immediately remove defective pipe from site.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Unless otherwise specified, piping materials, including pipe, gaskets, fittings,
connection and joint assemblies, linings and coatings, shall be selected from those
listed on the Piping System Specification Sheets. Piping materials shall conform to
detailed Specifications for each type of pipe and piping appurtenances specified in
the applicable Sections of Division 15, Mechanical.

B. Materials or products which can contact drinking water as part of a water treatment
process or water supply system including but not limited to pipe, gaskets, fittings,
linings, coatings, etc., must comply with National Sanitation Foundation (NSF-
61) and Arizona Administration Code requirements as stated in Specification
Section 01420 – References.

2.2 PIPING IDENTIFICATION
A. Marking Piping:
1. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
2. Cast or paint material, type and pressure designation on each piece of pipe or fitting 4-inches in diameter and larger.
3. Pipe and fittings smaller than 4-inches in diameter shall be clearly marked by manufacturer as to material, type and rating.
4. Markers bearing the legends on the background colors shall be provided in the following letter heights:

<table>
<thead>
<tr>
<th>Outside Pipe Diameter, a (inches)</th>
<th>Letter Height, (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1-1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>1-1/2 through 3</td>
<td>1-1/8</td>
</tr>
<tr>
<td>Greater than 3</td>
<td>2-1/4</td>
</tr>
</tbody>
</table>

a Outside pipe diameter shall include insulation and jacketing.

In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. Plastic Tracer Tape: Tracer tape shall be 6-inches wide, gray colored with black lettering and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.

Two messages shall be printed on the tape. The first message shall read "CAUTION CAUTION CAUTION _________ PIPE BURIED BELOW" with bold letters approximately 2-inches high. The blank shall be filled with the particular system fluid either FORCE MAIN OR SANITARY SEWER. The second message shall read, "CALL _______" with letters approximately 3/4-inch high. The blank shall be filled in with the plant telephone number (--1--). Both messages shall be printed at maximum intervals of two feet.

C. Magnetic Tracer Tape: Polyethylene magnetic tracer tape shall be as manufactured by Allen Systems, W.H. Brady Co., Seton Name Plate Corporation, Marking Services, Inc., or equal. Tape shall be acid and alkali-resistant, 3-inches wide, 0.005-inch thick, and have 1500-psi strength and 140 percent elongation value. The tape shall be inscribed with the word "CAUTION – PIPE BURIED BELOW" and the name of the piping system.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL
A. Location:
   1. Piping shall be provided as specified, except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. Piping Sizes:
   1. Where the size of piping is not shown on the Drawings or specified, provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1-inch in diameter) required for services not described by UPC shall be 1/2-inch.

C. Pipe Support, Anchorage and Seismic Bracing:
   1. Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/contraction and for seismic bracing, as well as anchorage details, are shown on the Drawings. Minimum spacing shall be as specified for supports and for seismic bracing. Where a specific type of support or anchorage is shown on the Drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports, components and hardware shall be Type 304L stainless steel. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
   2. Pipe shall be supported, alignment and installed in such a way so as not to impose undue stress/forces to couplings, connections, supports, valves, equipment and instruments.

D. Thrust Restraint:
   1. General: All ductile iron pipe plugs, caps, tees and bends in buried pressure piping systems shall be anchored by restrained joints as specified.
   2. Restrained Pipe Joints: Pipe joints shall be restrained by means suitable to the type of pipe being installed.
      a. Ductile-iron push on joints and mechanical joints shall be restrained utilizing a proprietary restrained joint system such as:
         1) American Loc-Ring or Flex-Ring
         2) Clow Super-Lock Joint
         3) EBBA Iron Sales Inc. Megalug
         4) U.S. Pipe TR Flex Joint
         5) Or Equal
      b. Harnessed lengths for pipe shall be determined by the pipe manufacturer in accordance with the formula in Section 15051, Buried Piping Installation, for determination of harnessed lengths.
c. Restrain ductile iron pipe connected to flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

d. Vitrified Clay Pipe joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe. Compression joints and couplings shall conform to MAG Section 743 and requirements of ASTM C425.

3. Concrete Thrust Blocks and Anchor Blocks:
   a. Thrust blocks and anchors shall be constructed of Class B concrete.
   b. Blocks shall be placed against undisturbed soil and sized as shown on the Drawings or as directed by the ENGINEER. Concrete shall be placed so that pipe joints and fitting joints will be accessible for repair.

E. Manufacturer's Installation Specialist:
   1. Provide the services of a competent installation specialist of the pipe manufacturer when pipe laying begins, if CONTRACTOR is not experienced in laying and jointing a particular type of pipe.
   2. Retain installation specialist at the site for a minimum of two days or until competency of the pipe laying crew has been satisfactorily demonstrated.

F. Bedding and Backfill:
   1. Bedding and backfill for buried piping shall conform to the requirements of Section 15051, Buried Piping Installation.

3.2 PIPING IDENTIFICATION

A. Pipe Coding:
   1. After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with painted bonding and lettering as specified in Article 2.2, above. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 25-foot centers.

B. Plastic Tracer Tape:
   1. A single line of tape as specified in Paragraph 2.2.B., above, shall be provided 2.5 feet above the centerline of buried ferrous pipe. For pipelines buried eight feet or greater below finished grade, provide a second line of tape 12-inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

C. Magnetic Tracer Tape: Polyethylene magnetic tracer tape shall be buried 12 to 18-inches below finished grade and shall be above and parallel to buried non-ferrous, plastic and reinforced thermosetting resin pipe lines. For pipelines buried eight feet or greater below finished grade, provide a second line of tape 2.5 feet above and parallel to each buried pipe.
3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown on the Drawings should be considered approximate.
   2. Determine the true locations of existing piping to which connections are to be made, and locations of other facilities which could be disturbed during earthwork operations, or which may be affected by CONTRACTOR’S Work already installed.
   3. Conform to applicable requirements of Division 1, General Requirements, pertaining to cutting and patching and connections to existing facilities.

B. Taking Existing Pipelines Out of Service:
   1. Do not take pipelines out of service, unless specifically listed below, or approved by ENGINEER.
   2. Notify ENGINEER at least 48 hours prior to taking pipeline out of service.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown on the Drawings or required, with machines specifically designed for this Work.
   2. Install temporary plugs to prevent entry of mud, dirt, water and debris.
   3. Provide all necessary adapters, fittings, pipe and appurtenances required to complete the Work.
   4. Existing pipelines which are cut and abandoned shall be adequately capped or filled with grout.

3.4 TESTING

A. General:
   1. Upon completion of piping, but prior to application of insulation on exposed piping, test the piping systems. Pressures, media and test durations shall be as specified in Article 3.7, below. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, notify the ENGINEER 24 hours prior to each test.
   2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new piping systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.
   3. Where testing existing chlorine and sulfur dioxide systems to the nearest isolation valve, provide a tee in the line adjacent to the valve. The branch outlet on the tee shall have a valve and used for cleaning, pressure testing, draining, and drying the line. Unless otherwise indicated, the existing chlorine or sulfur dioxide system shall not be shut down during testing or connecting the tee and
Prior to placing the line in service, the valve on the branch outlet shall be plugged or sealed with a blind flange or threaded plug. Responsibility belongs to CONTRACTOR for all damage to the existing system as a result of this work.

4. Potable Water Systems Additional Requirements:

a. The CONTRACTOR shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, including measuring device and all other equipment necessary for making the tests, except pressure gages.
b. The pipe shall be tested between each valve or between a valve and the closed end of the pipe.
c. Pipe test section shall be limited to 1/2 linear mile, or less, unless otherwise approved in writing by the Engineer. Testing cannot be done against an existing valve. The new pipeline must be separated from any potable system in such a way to prevent any potential for cross-contamination between the existing potable water system and the new pipeline.
d. The test shall be made after the backfilling is completed or compacted, regardless of the compaction method.
e. All connections, blow-offs, hydrants and valves shall be tested with the main, where practical.
f. 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.

B. Liquid Systems:

1. Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: Exposed piping, buried piping, and buried or exposed piping carrying liquid chemicals. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping.

3.5 CLEANING AND FLUSHING

A. General:

1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, and regulating or instrumentation equipment. At CONTRACTOR’S option, may clean and test sections of the buried or exposed piping systems. Use of this procedure; however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24-inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24-inches in diameter may be cleaned manually or with a cleaning ball or swab.
B. Temporary Screens:
   1. Upon completion of the cleaning, connect the piping systems to related process equipment. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

<table>
<thead>
<tr>
<th>Equipment Suction Or Piping Size, (Inches)</th>
<th>Maximum Screen Opening, (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1</td>
<td>1/16</td>
</tr>
<tr>
<td>1-1/4 to 3</td>
<td>1/4</td>
</tr>
<tr>
<td>3-1/2 to 6</td>
<td>1/2</td>
</tr>
<tr>
<td>Over 6</td>
<td>1</td>
</tr>
</tbody>
</table>

   2. Maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. Remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

C. Liquid Systems:
   1. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens.

3.6 PIPING SPECIFICATION SHEET

A. General:
   1. Piping and valves for groupings of similar plant processes or types of service lines are specified on individual Piping Specification Sheets. Piping systems are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of systems is identified by a piping system number. Piping systems specified on the Drawings are numerically arranged by system as shown in Table A. Table A also indicates the system number and fluid category for each service.
   a. Manual air vents shall be provided at the high points of each reach of pipeline where specified. Air vents shall consist of bronze cock and copper tubing return. Air vents shall be taken to the nearest floor with cock mounted four feet above the floor. Vents in piping systems for fluids containing solids shall be 1-inch nonlubricated eccentric plug valves fitted with quick couplers.
   b. Drains shall be piped to a sump, gutter, floor drain or other collection point with a valve mounted four feet above the floor. Drain valves shall be threaded end gate valves of the size specified or as shown on the
Drawings. When drains cannot be run to collection points, they shall be routed to a point of easy access and shall have hose gate valves of the size specified.

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Table A - Piping Systems

<table>
<thead>
<tr>
<th>Article No.</th>
<th>System No.</th>
<th>Symbol</th>
<th>Service Descriptions</th>
<th>Fluid Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.24</td>
<td>1</td>
<td>SS</td>
<td>Sanitary Sewer</td>
<td>Wastewater</td>
</tr>
<tr>
<td>3.50</td>
<td>2</td>
<td>FM</td>
<td>Force Main</td>
<td>Wastewater</td>
</tr>
</tbody>
</table>

(The remainder of this page was left blank intentionally.)
3.24 SYSTEM - 12

Piping Symbol/Service: SS Sanitary Sewer

<table>
<thead>
<tr>
<th>Test Requirements:</th>
<th>Medium:</th>
<th>Water: Refer to Paragraph 3.5.C., above.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pressure:</td>
<td>10 psig.</td>
</tr>
<tr>
<td></td>
<td>Duration:</td>
<td>Refer to MAG Section 743.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gasket Requirements:</th>
<th>Bell and Spigot:</th>
<th>Vitrified Clay Pipe: Refer to specification section 15051 and MAG Section 743.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fiberglass Reinforced Polymer Mortar Pipe: Refer to specification section 15076.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flush Type Joints</th>
<th>No Dig Vitrified Clay Pipe, Refer to ASTM C1208 Vitrified Clay Pipe and Joints for Use in Microtunneling, Sliplining, Pipe Bursting, and Tunnels. Resilient gasket forms watertight seal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Compression Coupling</td>
<td>Refer to specification section 15051 and MAG Section 743.</td>
</tr>
</tbody>
</table>

| Sleeve Coupling | Fiberglass reinforced polymer mortar pipe (FRPMP) Refer to specification Section 15076 with elastomeric sealing gaskets. For tunneling or jacking use low profile, flush sleeve couplings. |

**Buried and Encased Pipe/Valves:**

<table>
<thead>
<tr>
<th>30-inches and smaller</th>
<th>Pipe:</th>
<th>VCP: Extra strength in accordance with ASTM C700.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conn:</td>
<td>Bell and spigot.</td>
</tr>
<tr>
<td></td>
<td>Fgts:</td>
<td>Refer to MAG specification section 743, Vitrified Clay Pipe.</td>
</tr>
<tr>
<td></td>
<td>FRPM</td>
<td>Fiberglass reinforced polymer mortar pipe in accordance specification Section 15076.</td>
</tr>
<tr>
<td></td>
<td>Conn</td>
<td>Fiberglass sleeve couplings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>30-inches and smaller</th>
<th>Valves:</th>
<th>N/A.</th>
</tr>
</thead>
</table>

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Remarks:
1. Refer to Drawings for pipe size. Omit coating on encased pipe.

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3.50 SYSTEM - 24

Piping Symbol/Service: FM Force Main

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**Test Requirements:**
- **Medium:** Water: Refer to Paragraph 3.5.C., above.
- **Pressure:** FM: Test at 188 psig.
- **Duration:** 120 minutes.

**Pipe Requirements:**
Refer to Section 02530, Polyethylene Pipe

**Buried and Encased Pipe/Valves:**

10-inches and larger
- **Pipe:** HDPE: Refer to Section 02530, Polyethylene Pipe.
- **Conn:** Refer to Section 02530, Polyethylene Pipe.
- **Ftgs:** Refer to Section 02530, Polyethylene Pipe.

Remarks:
1. Refer to Drawings for pipe size and valve type. Omit coating on encased pipe.

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++ END OF SECTION ++
SECTION 15051

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform all excavating, backfilling, filling, grading and disposing of earth materials and to furnish, install and test all buried piping, fittings, and specials. The Work includes, but is not limited to, the following:
   a. Excavation and backfill.
   b. All temporary means required to prevent discharge of sediment to water courses from dewatering systems or erosion.
   c. All types and sizes of buried piping, except those specified under other Sections.
   d. Piping beneath structures.
   e. Restraints and thrust blocks.
   f. Pipe encasements.
   g. Work on or affecting existing piping.
   h. Testing.
   i. Cleaning.
   j. Installation of all joint and gasket materials and all other Work required to complete the buried piping installation.
   k. Unless otherwise specifically shown on the Drawings, specified, or included under other Sections, all buried piping Work required, beginning at the outside face of structures or structure foundations and extending away from structure.
2. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

B. Coordination:
1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.

1.2 QUALITY ASSURANCE

A. Conform to all requirements of Section 601 of the Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG), as supplemented by the City of Phoenix. If there is a conflict between MAG Standard Specifications and these Specifications, the Provisions of these Specifications shall govern.

B. Testing Services:
1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory as designated in Section 01451, Testing Laboratory Services Furnished by OWNER.

2. OWNER'S Testing Agency Scope:
   a. Test CONTRACTOR'S proposed materials in the laboratory and/or field for compliance with the Specifications.
   b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.
   c. Sample and test concrete, slurry, soils, grout, aggregate, asphalt, and micro surfacing materials for compliance with referenced standards and specifications.
   d. Report all test results to the ENGINEER and CONTRACTOR.

3. Authority and Duties of OWNER'S Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests and shall report their findings to the ENGINEER and CONTRACTOR. When the materials furnished or Work performed fails to fulfill Specification requirements, the technician will direct the attention of the ENGINEER and CONTRACTOR to such failure.
   a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is not discovered, nor shall it obligate the ENGINEER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of CONTRACTOR:
   a. The use of testing services shall in no way relieve CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
   b. To facilitate testing services:
      1) Advise the OWNER'S testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
   c. Responsibility belongs to CONTRACTOR to accomplish the specified compaction for backfill and to control the operations by confirmation tests to verify and confirm compliance, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
   d. 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. Contractor shall comply with MAG section 601 and City of Phoenix Supplement to the MAG Specifications.
   e. Demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
      1) 100 linear feet of trench backfill.
   f. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
g. Periodic compliance tests will be made by the ENGINEER to verify that compaction is conforming to the requirements previously specified, at no cost to CONTRACTOR. Remove the overburden above the level at which the ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete.

h. If compaction fails to conform to the specified requirements, remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR'S confirmation tests shall be performed in a manner acceptable to the ENGINEER. Frequency of confirmation tests for remedial Work shall be double that amount specified for initial confirmation tests.

C. Requirements of Regulatory Agencies:
1. Comply with requirements of NFPA Standard No. 24 for “Outside Protection” where applicable to water pipe systems used for fire protection.
2. Comply with requirements of UL, FM and other jurisdictional authorities, where applicable.
3. Refer to the General and Supplementary Conditions regarding permit requirements for this Project.
5. Obtain all necessary permits for Work in roads, rights-of-way, railroads, etc. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations.
6. Perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. Excavation and Backfill:
   d. ASTM D 1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   f. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   g. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
   h. ASTM D 4318, Method of Test for Liquid Limit of Soils.
   i. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.

k. AASHTO T-99, The Moisture-Density Relations of Soils Using a (2.5 kg) 5.5 lb Rammer and a (305 mm) 12 in. Drop {Proctor}

l. ASSHTO-T-191, Density of Soil in Place by the Sand Cone Method.

m. Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG), as supplemented by the City of Phoenix, Section 601.

2. Piping Materials and Installation:
   a. ASTM D 2321, Practice for Underground Installation of Flexible Thermoplastic Pipe.
   b. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
   c. AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
   d. AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. AWWA C206, Field Welding of Steel Water Pipe.
   f. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
   g. AWWA C606, Grooved and Shouldered Joints.
   h. ASCE MOP No. 37, Design and Construction of Sanitary and Storm Sewers.
   i. NFPA 24, Private Fire Service Mains and Their Appurtenances.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Excavation and Backfill Submittals:
      a. Excavation Plan: Prior to start of excavation operations, a written plan shall be submitted to demonstrate compliance with OSHA Standard 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of competent person.
         2) Excavation method(s) or protective system(s) to be used.
         3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.
      b. Excavation and backfill requirements detailing sheeting and bracing, or other protective system(s), dewatering systems, cofferdams, and under-pinning.
      c. Shop Drawings shall be prepared by a Registered Professional Engineer, licensed in the State of Arizona, recognized as an expert in the specialty involved. Drawings shall be submitted to ENGINEER for record purposes only. Calculations shall not be submitted. Drawing submittals will not be checked and will not imply approval by ENGINEER of the Work involved. Responsibility belongs to CONTRACTOR for designing, installing, operating and maintaining whatever system is necessary to satisfactorily accomplish all necessary work involved.
      d. Samples of all materials shall be sampled and tested by Owner’s testing service. Samples of the proposed material shall be submitted at least 14 days in advance of its anticipated use.
2. Piping Materials and Installation Submittals:
   a. Laying schedules for all piping
   b. Full details of piping, specials, manholes, joints, and connections to existing piping, structures, equipment and appurtenances.
   c. Certificates of compliance with referenced Standards for proposed pipe material.
   d. Descriptions of proposed pipe testing methods, procedures and apparatus. Prepare and submit a report for each test conducted.

3. Field Test Reports:
   a. Owner’s Testing laboratory shall submit copies of test reports for Field Density of Backfill directly to ENGINEER, with copy to CONTRACTOR

4. Record Drawings:
   a. During progress of the Work, keep an up-to-date set of Record Drawings showing field and Shop Drawing modifications.
   b. Submit Record Drawings prior to the time of Substantial Completion.

1.4 JOB CONDITIONS

A. Subsurface Information: Refer to Section 00700, General Conditions, and Section 00800, Supplementary Conditions, for available data on subsurface conditions. The data is not intended as a representation or warranty of continuity of conditions between soil borings nor of groundwater levels at dates and times other than date and time when measured. OWNER will not be responsible for interpretations or conclusions drawn there from by CONTRACTOR. Data is solely made available for the convenience of CONTRACTOR.

1. Additional test borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER.

B. Existing Structures: The Drawings show certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown on the Drawings for the convenience of CONTRACTOR. CONTRACTOR shall explore and verify 14 calendar days ahead of the required excavation to determine the exact location of all existing structures. Structures shall be supported and protected from damage by CONTRACTOR. If they are broken or damaged, restore them immediately at no additional cost to the OWNER.

C. Existing Utilities: Locate existing underground utilities in the areas of the Work. If utilities are to remain in place, provide adequate means of protection during all operations. The subsurface utility information depicted on the plans is for information only. The Contractor shall be fully responsible for the utility investigation and shall perform all necessary utility investigations required to determine actual utility locations prior to the Work. CONTRACTOR shall verify through potholing means all utility information depicted in the contract drawings at a minimum of 14 days in advance of excavation and installation. All potholing work completed by CONTRACTOR shall be considered incidental to the Work Item.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, notify utility owner and ENGINEER immediately. Cooperate with OWNER
and utility owner in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner. The Contractor will make whatever investigation it deems necessary to locate all known existing underground utility facilities that may impact this project. If such facilities are not depicted in the drawings, then (regardless of whether this is discovered prior to or during construction) the Contractor's remedies, if any, pursuant to Art. 6.3, Chapter 2, Title 40, A.R.S. (A.R.S. 40-360.21 through 40-360.32, "Underground Facilities"), shall be the Contractor's sole remedy for extra work, delays and disruption of the job, or any other claim based on the location of utility facilities. Locations of utility facilities shown on drawings are to be regarded as preliminary information only, subject to further investigation by the Contractor. The OWNER does not warrant the accuracy of these locations, and the Contractor, by entering into this contract, expressly waives and disclaims any claim or action against the OWNER under any theory for damages resulting from location of utility facilities.

2. In general, service lines to individual houses and businesses are not shown on the Drawings, however, assume that a service exists for each utility to each house or business.

3. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided.

4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

D. Use of Explosives:
   1. The use of explosives will not be permitted.
   2. Do not bring explosives onto site or use in the Work without prior written permission from authorities having jurisdiction. Provide copy of authorization to ENGINEER. CONTRACTOR is solely responsible for handling, storage and use of explosive materials, when their use is permitted.

E. Protection of Persons and Property: Barricade open excavations occurring as part of the Work and post with protective fencing and warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

F. Dust Control: Conduct all operations meeting the requirements specified in Section 01414, Earthmoving and Dust Control.

G. Roadways and Walks: Unless otherwise approved by ENGINEER, excavated material and materials of construction shall be so deposited, and the Work shall be so conducted, as to leave open and free for pedestrian traffic all crosswalks, and for vehicular traffic a roadway not less than ten feet in width. All hydrants, valves, fire alarm boxes, letter boxes, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, maintain such crosswalks, sidewalks, and roadways in satisfactory condition and the Work shall at all times be so conducted as to cause a minimum of
inconvenience to public travel, and to permit safe and convenient access to private and public property along the line of the Work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Do not drop or roll material off trucks. Do not otherwise drop, roll or skid piping.

C. Store all pipes, fittings, and related materials per manufacturer recommendations.

D. Unload pipe, fittings and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter at all times.

E. Inspect delivered pipe for cracked, gouged, chipped, dented or otherwise damaged material. Notify ENGINEER of any damaged materials, prior to removing damaged materials from site.

PART 2 - PRODUCTS

2.1 EMBEDMENT AND BACKFILL MATERIALS

A. Pipe Bedding/Granular Embedment:
   1. Bedding is the material placed in the area from the bottom of the trench to one foot above the top of the pipe. Pipe bedding shall be Select Material Type B or Aggregate Base Course having the following gradation. Open graded rock will not be used without the written approval of the ENGINEER.

<table>
<thead>
<tr>
<th>Sieve Sizes (Square Opening)</th>
<th>Percentage by Weight Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select Material Type B</td>
</tr>
<tr>
<td>1-1/2-inch</td>
<td>100</td>
</tr>
<tr>
<td>1-1/4-inch</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>30 – 70</td>
</tr>
<tr>
<td>No. 8</td>
<td>20 – 60</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 – 40</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 12</td>
</tr>
</tbody>
</table>

   2. Unless otherwise noted, the Plasticity Index as tested in accordance with AASHTO T-146, T-89 and T-90 shall not be more than five.

B. Sand:
1. No sand shall be placed without the approval of the ENGINEER.

C. Encasement Material:
   1. Pipe encasement material shall be Type 2 Portland cement concrete as specified in Section 03305, Concrete, unless otherwise shown on the Drawings.

D. Backfill Material:
   1. Materials acceptable for use as backfill above the pipe embedment shall be:
      a. Stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 3-inches in size, nor have greater than 40 percent passing the 200 sieve. The maximum expansion of on-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at two percent below optimum moisture content under a 100 pound per square foot (psf) surcharge pressure.
      b. Materials from off-site sources shall consist of silty or clayey sand soils which are uniformly mixed, contain no organic matter and which have a Plasticity Index less than ten. The maximum particle size of imported soils shall be 3-inches or less, if required to satisfy trenching, landscaping, or other requirements. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D 698 at two percent below optimum moisture content under a 100 psf surcharge pressure.
      c. All materials for use as backfill material shall be tested by the laboratory and approved by the ENGINEER.
      d. If on-site material is unsuitable as determined by the ENGINEER, select backfill or approved off-site fill shall be used.

2.2 PIPING MATERIALS

A. Unless otherwise specified, all piping materials shall be selected from those listed in Section 15050, Piping Systems. Piping materials shall conform to detailed Specifications as specified within Contract documents.

2.3 PIPING IDENTIFICATION

A. Plastic Tracer Tape and Magnetic Tracer Tape Marking shall conform to the requirements specified in Section 15050, Piping Systems.

PART 3 – EXECUTION

3.1 EXCAVATION
A. Provide ENGINEER with sufficient notice and with means to examine the areas and conditions under which excavation is to be performed. ENGINEER will notify CONTRACTOR if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

B. Perform all excavation required to complete the Work as shown on the Drawings, specified and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders not requiring drilling and blasting for removal, decomposed rock, pavements, rubbish and all other materials within the excavation limits.

C. Excavations for pipelines shall be open excavations. Provide excavation protection system(s) required by ordinances, codes, law and regulations to prevent injury to workmen and to prevent damage to new and existing structures or pipelines.

D. Where the pipeline is to be placed below the ground water table, well points, cofferdams or other acceptable methods shall be used to permit construction of said pipeline under dry conditions. Dry conditions shall prevail until the pipelines are properly jointed, tested and backfilled. Water level shall be maintained below top of backfill at all times.

E. Pumping of water from excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete materials, and to prevent damage to the existing subgrade.

F. Except where otherwise noted on the Drawings, or approved, in writing, by the ENGINEER, no more than 50 feet of trench may be opened in advance of pipe laying.

G. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations.
   2. Dispose of excess soil material and waste materials as specified hereinafter.
   3. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy clay soils. Use and placement of fill shall be performed as specified for each class.
   4. Excess soil from excavations shall be disposed of off-site. Disposal shall be in accordance with state and local regulatory requirements.

H. Trench width shall be minimized to greatest extent practical but shall conform to the following:
   1. Sufficient to provide room for installing, jointing and inspecting piping. Trenches for other than cast-in-place concrete pipe shall conform to the dimensions listed below, unless otherwise shown on the Drawings, and/or approved by the ENGINEER.

<table>
<thead>
<tr>
<th>Size of Pipe (I.D.) (Inches)</th>
<th>Maximum Width at Top of Pipe Greater than O.D. of Barrel</th>
<th>Minimum Width at Springline Each Side of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Size of Pipe (I.D.) (Inches)</th>
<th>Maximum Width at Top of Pipe Greater than O.D. of Barrel</th>
<th>Minimum Width at Springline Each Side of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 18</td>
<td>16-inches</td>
<td>6-inches</td>
</tr>
<tr>
<td>18 to 24 inclusive</td>
<td>19-inches</td>
<td>7-1/2”-inches</td>
</tr>
<tr>
<td>27 to 39 inclusive</td>
<td>28-inches</td>
<td>12-inches</td>
</tr>
<tr>
<td>42 to 60 inclusive</td>
<td>1/2 of Pipe O.D.</td>
<td>12-inches</td>
</tr>
<tr>
<td>Over 60</td>
<td>36-inches</td>
<td>12-inches</td>
</tr>
</tbody>
</table>

2. The width of the trench shall not be greater than the maximum indicated above, at and below the level of the top of the pipe. If the maximum width as specified above is exceeded at the top of the pipe, provide, at no additional cost to the OWNER, the necessary loading bearing capacity by means of bedding, having a higher bedding factor than specified, higher strength pipe a concrete cradle, cap or encasement, or by other means approved in writing by the ENGINEER.

3. The width of the trench above that level may be made as wide as necessary for shoring or other wall support measures necessary for a safe and proper installation. In all cases, responsibility belongs to CONTRACTOR for all costs incurred as a result of increased trench width.

4. Enlargements at pipe joints may be made if required and approved by ENGINEER.

5. Sufficient for shoring and bracing, or shielding and dewatering.

6. Sufficient to allow thorough compaction of embedment material adjacent to bottom half of pipe.

I. Depth of trench shall be as required to install the piping at the elevations shown on the Drawings. For all pipe 12-inches or greater in diameter, excavate for and provide an initial granular bedding at least 4-inches thick or 1/2 the outside diameter of the pipe whichever is greater. The bedding material shall be placed at a uniform density with a minimum compaction to provide uniform bearing and support along the bottom of pipe, except where it is necessary to excavate for bells and/or joint couplings. If required and approved by ENGINEER, depths may be revised. Remove all loose and unsuitable material from the trench bottom.

J. Subgrades for trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Where ENGINEER considers the existing subgrades unsuitable, remove same and replace it with granular embedment material. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with granular embedment material. The finished elevation of stabilized subgrades shall not be above subgrade elevations required for the piping installation as herein specified. Proof roll all subgrades prior to placing of select fill and general fill material.

K. Except at locations where excavation of rock from the bottom of the trench is required, care shall be taken not to excavate below the required depth. Unauthorized excavation below the specified grade line shall be refilled at CONTRACTOR’S expense with aggregate base material.
compacted to a uniform density of not less than 95 percent of the maximum density as determined by AASHTO T-99 and T-191 or ASTM D-2922 and D-3017. When AASHTO-T-99, Method A or B, and T-191 are used for density determination.

L. Whenever rock is encountered in the trench bottom, it shall be over excavated to a minimum depth of 6-inches below the O.D. of the pipe. This over excavation shall be filled with granular embedment material and compacted to a uniform density of not less than 95 percent of the maximum density as determined by AASHTO-T-99 and T-191 or ASTM D-2922 and D-3017.

M. Where pipe is laid in rock excavation, crushed stone as specified in Section 02318, Crushed Stone and Gravel, shall be carefully placed and tamped over the rock before the pipe is laid. Depth of crushed stone shall be at least 6-inches for pipe 16-inches and smaller and 9-inches for pipe 18-inches and larger. After laying pipe, the balance of the embedment and backfill shall be placed as described herein.

3.2 EXCAVATION DRAINAGE AND DEWATERING

A. General:
   1. Prevent surface and subsurface water from flowing into excavations and from flooding adjacent areas.
   2. Remove water from excavations as fast as it collects.
   3. Maintain the ground water level at approximately three feet below the bottom of the excavation to provide a stable surface for construction operations, a stable subgrade for permanent work and to prevent damage to Work during all stages of construction.
   4. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations. Adequate operational standby equipment shall be maintained on the site.
   5. Provide approved sediment traps when water is conveyed into water courses.
   6. Obtain ENGINEER’S approval before shutting down dewatering system for any reason.

B. Standby Requirements for Dewatering:
   1. Provide standby equipment to ensure continuity of dewatering operations.

C. Disposal of Water Removed by Dewatering System:
   1. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.
   2. Dispose of water in such a manner as to cause no inconvenience to OWNER, ENGINEER or others involved in work about the site.
   3. Convey water from the excavation in a closed conduit. Do not use trench excavations as temporary drainage ditches.

3.3 PIPE BEDDING/GRANULAR EMBEDMENT

A. Bedding/Granular Embedment shall be placed in the trench from the bottom of the trench to one foot above the top of the pipe.
B. Carefully place and thoroughly compact all pipe bedding as construction progresses.

C. Granular embedment shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle. After each pipe has been graded, aligned, placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and to maintain alignment during subsequent pipe jointing and embedment operations. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

3.4 PIPE INSTALLATION

A. General:
1. All bedding shall be inspected by ENGINEER prior to laying pipe. Notify ENGINEER in advance of excavating, bedding and pipe laying operations.
2. The ENGINEER prior to installation shall inspect all piping. ENGINEER’S inspection will not relieve CONTRACTOR or manufacturer from responsibility for damaged products.
3. All piping shall be carefully examined for cracks, damage or other defects before installation. Any piping that is defective, including but not limited to, cracked, damaged, in poor condition, or with damaged linings or improper markings shall be rejected, unless the product can be repaired in a manner acceptable to the manufacturer and ENGINEER. Any piping found to be broken or defective after it has been installed shall be removed, replaced or repaired at CONTRACTOR’S expense.
4. Take field measurements, where required, prior to installation to ensure proper fitting of the Work. Responsibility to obtain whatever information is required to complete the connections of the proposed pipelines to the existing pipelines belongs to CONTRACTOR.
5. Present all conflicts between piping systems and equipment, structures or facilities to ENGINEER for determination of corrective measures before proceeding.
6. Request instructions from ENGINEER before proceeding if there is a conflict between the manufacturer's recommendations and the Contract Documents.
7. Installation of all pipe, fittings, valves, specials and appurtenances shall be subject to the review and approval of the ENGINEER.
8. Install piping as shown on the Drawings, specified and as recommended by the manufacturer and in conformance with referenced standards and approved Shop Drawings.
9. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.
10. Minimum earth cover over the piping shall be as shown on the Drawings, specified or directed by the ENGINEER, but in no case shall the earth cover be less than 7 feet for all piping unless shown otherwise on Drawings, except drains.
11. Interior of all piping and mating surfaces shall be inspected and all dirt, gravel, sand, debris or other foreign material shall be completely removed from the interior and mating surfaces before installation. Measures shall be taken to maintain the interior of all piping clean until acceptance of the completed Work. Care shall be taken to prevent foreign matter from entering joint space. Bell and spigot mating surfaces shall be wiped clean immediately before piping is laid.

12. Install piping accurately to line and grade shown on the Drawings, specified or directed, unless otherwise approved by the ENGINEER. Accurate means of determining and checking the alignment and grade shall be used, which shall be subject to the approval of the ENGINEER. Any modifications to the Contract Documents to suit the pipe manufacturer's standard shall be approved by the ENGINEER. Remove and relay piping that is incorrectly installed, at CONTRACTOR'S expense. All pipe joint gap thicknesses are not to exceed pipe product manufacturer requirements.

13. Do not lay piping in water, unless otherwise specified in these Specifications or approved by the ENGINEER. Ensure that the water level in the trench is at least 6-inches below the bottom of piping. Maintain a dry trench until jointing and backfilling are complete, unless otherwise specified in these Specifications or approved by the ENGINEER.

14. Where unforeseen conditions will not permit the installation of piping as shown on the Drawings or specified, no piping shall be installed without approval of the ENGINEER. Do not modify structures or facilities without approval of the ENGINEER.

15. Start laying piping at lowest point and proceed toward the higher elevations, unless otherwise approved by the ENGINEER. Slope piping uniformly between elevations shown on the Drawings or as otherwise directed by the ENGINEER.

16. Place bell and spigot piping so that the bells face the direction of laying, unless otherwise approved by the ENGINEER.

17. Piping shall be installed so that the barrel of the piping, and not the joints, receives the bearing pressure from the trench bottom or other bedding condition.

18. No piping shall be brought into position until the preceding length and or fitting has been bedded and secured in place.

19. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, water and other foreign matter from entering the piping.

20. Field cutting of metallic piping, where required, shall be made with a machine specially designed for cutting piping and in accordance with the manufacturer's instructions. Cuts shall be carefully done, without damage to piping. Flame cutting shall not be permitted. Any piping damaged by CONTRACTOR due to improper or careless methods of cutting shall be replaced at his expense.

21. Blocking under piping shall not be permitted, unless specifically approved by ENGINEER for special conditions. Sandbags and other deleterious materials are not allowed within trench excavation and backfill zones.

22. Protective linings and coatings shall be touched up prior to installation, where required.

23. Except where bends are used, changes in alignment and grade of the piping shall be made by deflecting joints or with beveled pipe. Permissible joint deflection shall not exceed 75 percent of the amount allowed by the manufacturer.
24. All joints shall be made in the presence of the ENGINEER or his duly authorized representative, except as otherwise approved.
25. Special care shall be taken to ensure that each section of piping abuts against the next in such a manner that there will be not shoulder or unevenness of any kind along the piping invert.
26. Piping shall be rotated as required to place outlets in proper position.
27. Blind flanges and cleanouts shall be provided at locations shown on the Drawings, specified or required. Cleanouts on buried piping shall include all pipe, fittings and appurtenances required to bring cleanout to finished grade and terminate in a flange and blind flange or suitably capped piping as shown on the Drawings. Cleanout piping shall be same as that specified for the main run.
28. All gravity lines shall pitch uniformly at the grade shown on the Drawings or as specified or approved by the ENGINEER.
29. Short pipe stubs, maximum 4-feet-0-inch in length, shall be used at all manholes and other wall faces, except as otherwise specified.
30. Field painting shall be accomplished after joints are made.
31. All piping shall be plugged watertight with a suitable cap or plug securely fastened to the end of the piping at all contact interfaces.
32. On steep slopes, take measures acceptable to ENGINEER to prevent movement of the pipe during installation.

B. Manufacturer's Installation Specialist:
1. Provide the services of a competent installation specialist of the pipe manufacturer when pipe laying commences for the following:
   a. HDPE Pipe
   b. Vitrified Clay Pipe
2. Retain installation specialist at the site for a minimum of 2 days or until competency of the pipe laying crew has been satisfactorily demonstrated.

C. Separation of Sewers and Potable Water Pipe Lines:
1. Conform to requirements of MAG Specification Section 610

D. Plugs:
1. Temporarily plug installed pipe at the end of each day's Work or other interruption to the installation of any pipeline. Plugging shall prevent the entry of animals, liquids or persons into the pipe or the entrance or insertion of deleterious materials.
2. Install standard plugs into all bells at dead ends. Cap all spigot ends.
3. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
4. Where plugging is required for phasing of the Work or for subsequent connection of piping, install watertight, permanent type plugs.

E. Laying Pipe:
1. Conform to manufacturer's instructions and requirements of the standards listed below, where applicable:
b. Concrete Pipe: AWWA M9, Concrete Pipe Handbook.
c. Steel Pipe: AWWA M11, AWWA C206.
d. Thermoplastic Pipe: ASTM D 2774.
e. Fiberglass Reinforced Polymer Mortar Pipe: AWWA C950.
i. Fiberglass Reinforced Polymer Mortar Pipe, Contract Specification Section 15076.

F. Polyethylene Encasement:
1. Provide polyethylene encasement for ductile iron piping to prevent contact between the pipe and surrounding bedding material and backfill.
2. Polyethylene may be supplied in tubes or in sheet material.
3. Polyethylene encasement materials and installation shall be in accordance with the requirements of City of Phoenix Supplements to MAG Section 610.

G. Jointing Pipe:
1. Ductile Iron Mechanical Joint Pipe:
   a. Comply with requirements of Section 15101, Ductile Iron Pipe.
   b. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
   c. Lubricate the plain ends and gasket with soapy water or an approved pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
   d. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
   e. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
   f. Push gland toward socket and center it around pipe with the gland lip against the gasket.
   g. Insert bolts and hand tighten nuts.
   h. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Bolt Size (inches)</th>
<th>Range of Torque (ft-lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5/8</td>
<td>45 to 60</td>
</tr>
<tr>
<td>4 to 24</td>
<td>3/4</td>
<td>75 to 90</td>
</tr>
<tr>
<td>30 to 36</td>
<td>1</td>
<td>100 to 120</td>
</tr>
<tr>
<td>42 to 48</td>
<td>1-1/4</td>
<td>120 to 150</td>
</tr>
</tbody>
</table>
i. All bolts and nuts shall be heavily coated with two 10-mil minimum coats of coal-tar epoxy coating as manufactured by Tnemec, or equal.

j. Restrained mechanical joints shall be in accordance with Section 15101, Ductile Iron Pipe.

2. Ductile Iron Push-On Joint Pipe:
   a. Comply with requirements of Section 15101, Ductile Iron Pipe.
   b. Prior to assembling the joints, the last 8-inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.
   c. Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
   d. Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
   e. Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket which will come in contact with the entering spigot end of pipe. Option, apply a thin film of lubricant to the outside of the spigot of the entering pipe.
   f. For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets which have been scoured or otherwise damaged shall not be used.
   g. Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe jointing operations are in progress.

3. Proprietary Joints:
   a. Pipe which utilizes proprietary joints such as Megalug, by EBBA Iron, Inc.; Lok-Ring, by American Cast Iron Pipe Company; restrained joints described under Article 3.4, or other such joints shall be installed in strict accordance with the manufacturer's instructions.

4. Flanged Joints:
   a. Assemble flanged joints using 1/8-inch ring-type gaskets for raised face flanges. Use full face gaskets for flat face flanges, unless otherwise approved by ENGINEER. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
   b. Bolts shall be tightened in a sequence which will ensure equal distribution of bolt loads.
   c. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. No washers shall be used.
   d. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.
e. After assembly, coat all bolts and nuts with two 8-mil coats of a high-build epoxy or bituminous coating as manufactured by Tnemec, or equal.

5. Mechanical Coupling Joints:
   a. Prior to the installation and assembly of mechanical couplings, the joint ends shall be cleaned thoroughly with a wire brush to remove foreign matter. Following this cleaning, lubricant shall be applied to the rubber gasket or inside of the coupling housing and to the joint ends. After lubrication, the gasket shall be installed around the joint end of the previously installed piece and the joint end of the subsequent piece shall be mated to the installed piece. The gasket shall be positioned and the coupling housing placed around the gasket and over the grooved or shouldered joint ends. The bolts shall be inserted and the nuts screwed up tightly by hand. The bolts shall then be tightened uniformly in order to produce an equal pressure on all parts of the housing. When the housing clamps meet metal to metal, the joint is complete and further tightening is not required.

6. Vitrified Clay Pipe Joints:
   a. Acceptable joints shall be flexible compression type for bell and spigot pipe or flexible compression couplings for plain-end pipe. Compression joints and couplings shall conform to the requirements of ASTM C425.

7. HDPE Pipe:
   a. Joints of HDPE piping system shall be installed in strict accordance with the manufacturer's instructions and shall be of the butt fusion process.

8. Fiberglass Reinforced Polymer Mortar Pipe
   a. Refer to Specification Section 15076.

I. Transitions from One Type of Pipe to Another:
   1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

J. Closures:
   1. Provide all closure pieces shown on the Drawings or required to complete the Work.

3.5 THRUST RESTRAINT

A. Provide thrust restraint on all pressure piping systems and where otherwise shown on the Drawings and specified.

B. Thrust restraint shall be accomplished by means of restrained pipe joints. Concrete thrust blocks shall be used only when specifically shown on the Drawings or as directed by the ENGINEER.

3.6 BACKFILL
A. General
1. Backfill begins after the placement of the pipe bedding/granular embedment. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.
2. Place and compact backfill as construction progresses.
3. Compacted backfill shall be required for the full depth of the trench above the granular pipe embedment material. Where the trench for one pipe passes beneath the trench for another pipe or electrical duct bank, the lower trench shall be compacted to the level of the bottom of the upper trench.
4. Each layer of backfill material shall be compacted by at least two complete coverages of all portions of the surface of each lift using approved compaction equipment. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of the compacting surface of the compactor.
5. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
6. The degree of compaction required for all types of fills shall be as listed below. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.
7. The trench backfill shall be thoroughly compacted to no less than the following densities when tested and determined by ASSHTO T-99 and T-191 or ASTM D 2922 and D 3017. When ASSHTO T-99, Method A or B, and T-191 are used for density determination. The minimum density required is identified below:

<table>
<thead>
<tr>
<th>Material</th>
<th>Percent Compaction (ASTM D 698)</th>
<th>Uncompacted Lift (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Base Course:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below asphalt paving</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Trench Backfill above pipe:</td>
<td>95</td>
<td>12</td>
</tr>
<tr>
<td>Granular Pipe Embedment Material:</td>
<td>100</td>
<td>6</td>
</tr>
</tbody>
</table>

All fill must be wetted and thoroughly mixed to achieve optimum moisture content per Contract requirements. Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.

3.7 GRADING

A. General: Uniformly grade areas within limits of grading shown on the Drawings or specified, including adjacent transition areas. Smooth subgrade surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.
B. Turfed Areas: Finish areas to receive topsoil to within not more than 1-inch above or below the required subgrade elevations.

C. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1-inch above or below the required subgrade elevation.

D. Pavements: Shape surface of areas under pavements to line, grade and cross-section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

E. Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.

F. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density required.

3.8 PAVEMENT SUBBASE COURSE

A. General: Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
   1. Refer to Section 02742, Bituminous Paving.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12-inch width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
   1. When a compacted subbase course is shown on the Drawings to be 6-inches thick or less, place material in a single layer. When shown on the Drawings to be more than 6-inches thick, place material in equal layers, except no single layer more than 6-inches or less than 3-inches in thickness when compacted.

3.9 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations which does not conform to the requirements for fill or is in excess of that required for backfill shall be hauled away by CONTRACTOR and disposed of in compliance with municipal, county, state, federal or other applicable regulations at no additional cost to OWNER.
3.10 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

A. Place 1-1/2 inches of temporary bituminous pavement immediately after backfilling trenches in paved roadways. Maintain the surface of the paved area over the trench in good and safe condition during progress of the entire Work, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfill. Immediately prior to constructing the permanent paving and base, remove and dispose of temporary pavement. Permanent replacement pavement shall be equal to that of the existing roadways unless otherwise shown on the Drawings or specified.

B. Pavement, gutters, curbs, walks, driveways and roadways disturbed or damaged by CONTRACTOR’S operations, except areas designated "New Pavement" or "Proposed Pavement", shall be restored or replaced at CONTRACTOR’S expense to as good condition as they were previous to the commencement of the Work and in accordance with applicable local and state highway specifications.

3.11 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown on the Drawings should be considered approximate.
   2. Determine the true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by CONTRACTOR'S Work already installed. CONTRACTOR to determine connection locations and elevations at primary connection points prior to any mainline pipe installations.
   3. Conform to applicable requirements of Division 1, General Requirements, pertaining to cutting and patching, and connections to existing facilities.

B. Taking Existing Pipelines Out of Service:
   1. Do not take pipelines out of service unless specifically listed below, or approved by ENGINEER.
   2. Notify ENGINEER at least 48 hours prior to taking any pipeline out of service.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown on the Drawings or required with machines specifically designed for this Work.
   2. Install temporary plugs to prevent entry of mud, dirt, water and debris.
   3. Provide all necessary adapters, fittings, pipe and appurtenances required to complete the Work.
   4. Existing pipelines which are cut and abandoned shall be adequately capped or filled with grout, as specified within Contract drawings.

3.12 TESTING OF PIPING
A. General:
1. Test all piping, except as otherwise authorized by ENGINEER.
2. Notify ENGINEER and local authorities having jurisdiction at least 48 hours in advance of testing if their presence is required.
3. Conduct all tests in the presence of the ENGINEER.
4. Remove or protect any pipeline-mounted devices which may be damaged by the test pressure.
5. Provide all apparatus and services required for testing, including but not limited to, the following:
   a. Test pumps, bypass pumps, hoses, calibrated gauges, meters, test containers, valves and fittings.
   b. Temporary bulkheads, bracing, blocking and thrust restraints.
6. Provide air if an air test is required and power if pumping is required.
7. Unless otherwise specified, CONTRACTOR to provide all water required for testing.
8. Repair and retest pipelines that fail to hold specified test pressure or which exceed the allowable leakage rate.
9. Unless otherwise noted, pipelines shall be tested in accordance with City of Phoenix Supplements to MAG Standards.
10. Unless otherwise specified, test pressures required are at the lowest elevation of the pipeline section being tested.

B. Schedule of Pipeline Tests:
1. Refer to Section 15050, Piping Systems, for the type of test required.

D. Required Tests for Gravity Sewer and Storm Drains:
1. Elect to test piping, using either air or water test procedures. Notify ENGINEER, in writing, in advance of all testing, which method he plans to utilize and must follow through with the same method on all pipeline testing.
   a. Gravity sewers shall be tested with either air or water testing; however, storm drains may only be water tested.
   b. Tests shall be performed after backfilling is completed, but shall be performed before final cleanup and acceptance of Work.
   c. Tests shall be performed prior to final acceptance.
   d. Prior to making tests, submit details of his testing procedures, with a description of methods and equipment CONTRACTOR proposes to use, to the ENGINEER for approval. Furnish all necessary labor, equipment, water, watertight bulkheads, rodding machine, generator, pumps and all else necessary to carry out the required tests.
2. Air Test:
   a. Wet and thoroughly clean the inside of the pipe before test is performed.
   b. Insert test plugs in ends of pipe to be tested.
   c. Securely brace test plugs.
   d. Measure and record groundwater height above the pipe invert. All gage pressures in the test shall be increased by the amount of the back pressure due to groundwater submergence.
e. Slowly fill the pipe with air to a pressure of four psig. Maintain pressure between 4 and 3.5 psig for at least two minutes for temperature stabilization.

f. Check all plugs for tightness.

g. With a pressure of approximately four psig in pipe, disconnect air supply.

h. Allow pressure to decrease to 3.5 psig.

i. When the pressure reaches 3.5 psig, record the time required to decrease to 2.5 psig using a stopwatch.

j. The line is considered acceptable if the time for the pressure to decrease from 3.5 psig to 2.5 psig is not less than the amount depicted in MAG Section 611.

k. If the leakage in the section tested exceeds the specified amount, make the necessary repairs or replacements required to reduce the leakage to within the specified limits and the test shall be repeated until the leakage requirement is met.

l. No one shall be allowed in the manhole during air testing.

4. Visual Inspection:

a. Prior to final acceptance, a visual inspection by ENGINEER of all appurtenant structures, (e.g., manholes, chambers, etc.), shall be required. Any visual leaks, regardless of their magnitude shall be repaired by CONTRACTOR.

5. Watertight Sewers:

a. It is imperative that all sewers and appurtenant structures be constructed as watertight as practicable. Adhere rigidly to all requirements of the Contract Documents and follow all directions of the ENGINEER to secure a watertight sewer. If, during the Work or after its completion, any leaks are discovered, they shall be repaired in a satisfactory manner at the expense of CONTRACTOR even though the pipe and appurtenant structures may have already successfully passed the leakage tests.

3.13 DISPOSAL OF WATER

A. Provide suitable means for disposal of test and flushing water so that no damage results to facilities or waterways.

B. Means of disposal of test and flushing water shall be subject to the approval of ENGINEER, local governing authorities and regulatory agencies.

C. Responsibility belongs to CONTRACTOR for any damage caused by water disposal operations.

3.14 CLEANING

A. Cleaning:

1. Thoroughly clean all piping and flush in a manner approved by ENGINEER, prior to placing in service.

2. Piping 12-inches in diameter and larger shall be C.C.T.V inspected from inside and all debris, dirt and foreign matter removed.

3. If piping has not been kept clean during installation, additional pipe cleaning may be required by CONTRACTOR. The Owner will pay for and perform the initial CCTV
inspection for final acceptance. Any additional inspection required due to failure of the initial inspection, shall be paid by the Contractor.

3.15 INSTALLATION OF DETECTABLE PIPE LOCATING TAPE

A. Underground Pipe Locating Tape:
   1. Refer to paragraph 2.3.A of this Section, and Section 15050, Piping Systems.
   2. Detectable pipe locating tape shall be placed above all underground pipelines. Tape shall be buried 12-inches below finished grade directly above entire pipeline length.
   3. Detectable pipe locating tape for reuse water shall be buried on top and in contact with the pipe in addition to 12-inches below finished grade.

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SECTION 15076

FIBERGLASS-REINFORCED POLYMER MORTAR PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified and as required to furnish and install centrifugally cast, fiberglass-reinforced polymer mortar piping.
2. The extent of centrifugally cast, fiberglass-reinforced polymer mortar pipe to be furnished is shown on the Drawings.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Manufacturers of centrifugally cast, fiberglass-reinforced polymer mortar pipe and fittings shall have a minimum of five years experience of producing centrifugally cast, fiberglass-reinforced polymer mortar pipe and fittings, and shall be able to show evidence of at least five installations in satisfactory operation.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
2. ASTM D 3262, Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

C. Shop Tests:
1. Manufacturer shall maintain a continuous quality control program and shall furnish the ENGINEER with certified test reports.
2. Tests shall be witnessed by a Registered Professional Engineer or a member of ASTM, who may be an employee of the manufacturer. The Registered Professional Engineer shall seal and sign all test reports.
3. Cut a three-foot section from each 5,000 feet of each size pipe furnished, and perform the following tests using methods recommended by the ASTM:
b. ASTM D 3262, Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

   c. ASTM D 3681, Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.

1.3 SUBMITTALS

   A. Shop Drawings: Submit for approval the following:
      1. Details of construction, fabrication, and specifications for pipe laminate construction.
      2. Details of piping system including: Location of supports, fittings, anchors, and all accessories necessary for piping system.
      3. Pipe laying schedules.
      4. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation.
      5. Product data including design, details, and testing procedures for the mandrels to be used for deflection testing of both 18” and 20” piping.

   B. A sample piece of pipe approximately three-foot long of each diameter, if requested by ENGINEER.

   C. Test Reports: Submit reports for any tests required above with test specimens.

   D. Certificates: Submit certificates of compliance with referenced standards.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

   A. Refer to Sections 15051, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

   A. Centrifugally cast, fiberglass-reinforced polymer mortar piping system shall be specifically designed, constructed, and installed for the service intended and shall comply with the following service conditions.

      (The remainder of this page was left blank intentionally.)

   B. Service Conditions:
CITY OF PHOENIX: Water Services Department
PROJECT NAME: West Anthem Gravity Sewer Improvements – Phase 1
PROJECT NUMBER: WS90500276

<table>
<thead>
<tr>
<th>Location:</th>
<th>North Phoenix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Pipe Size:</td>
<td>18” &amp; 20”</td>
</tr>
<tr>
<td>Pipe Stiffness:</td>
<td>psi 46</td>
</tr>
<tr>
<td>Min. Wall Thickness/ Pipe Size:</td>
<td>in/in 0.042 &amp; 0.040</td>
</tr>
<tr>
<td>Reinforced Wall Thickness:</td>
<td>in 0.75 &amp; 0.80</td>
</tr>
<tr>
<td>Joint Length:</td>
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<tr>
<td>Fluid Temperature:</td>
<td>°F max 85</td>
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<tr>
<td>Fluid Flow:</td>
<td>gpm 3,000</td>
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<tr>
<td>Fluid Chemical Composition:</td>
<td>Raw Sewage</td>
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<tr>
<td>Fluid: pH</td>
<td>6 to 9</td>
</tr>
<tr>
<td>Fluid Concentration: %</td>
<td>0.02% (220mg/l)</td>
</tr>
<tr>
<td>Fluid Specific Gravity:</td>
<td>0.99</td>
</tr>
</tbody>
</table>

2.2 MATERIALS

A. Resin Systems: The manufacturer shall use only polyester resin systems.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

C. Silica Sand: Sand shall be minimum 98 percent silica with a maximum moisture content of 0.2 percent.

D. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally affect the performance of the product.

E. Elastomeric Gaskets: Gaskets shall be supplied by qualified gasket manufacturers and shall be suitable for the service intended.

2.3 DETAILS OF CONSTRUCTION

A. Pipe shall be manufactured to meet the applicable requirements of ASTM D 3262, Type: centrifugally cast, Liner: flexibilized polymer resin, Grade: gravity sewer pipe Pipe stiffness: 46 psi .

B. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, nonporous, corrosion-resistant, consistent composite structure.
C. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D 4161. The restraint system shall be provided in accordance with the manufacturer’s recommendations. Joints at tie-ins, where required, may utilize fiberglass gasket-sealed closure couplings.

D. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.

E. Diameters: The actual outside diameter of the pipes shall be in accordance with ASTM D 3262.

F. Lengths: Pipe shall be supplied in nominal lengths of 20 feet.

G. Wall thickness: The minimum wall thickness shall be the stated design thickness.

H. End Squareness: Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8-inch.

I. Guides, Anchors and Supports: Guides, anchors and supports shall be as shown on the Drawings and in accordance with the manufacturer’s recommendations. Provide saddle bands and FRP buildup. Support spacing shall not exceed six feet, unless otherwise shown on the Drawings.

J. Expansion Compensation: Have the pipe manufacturer review the piping layout shown on the Drawings to determine the requirement for expansion joints in the piping system. Submit written certification from manufacturer that expansion joints are not required.

K. Product and Manufacturer: Provide one of the following:
   1. Hobas Pipe USA, Inc.
   2. Or equal.

2.4 MAINTENANCE TOOLS AND SPARE MATERIALS

A. Furnish and deliver the following tools and maintenance materials carefully boxed or packaged and plainly marked for recording:
   1. One set of special tools required to maintain and repair the piping.
   2. All materials in kit form to make or repair joints. Kits shall be in a number sufficient to repair ten percent of the joints.
   3. Pipe and fittings equal to ten percent of the installed system.
4. Names and addresses of all manufacturers of fiberglass reinforcements, resins, hardeners and components used to repair and maintain centrifugally cast, fiberglass-reinforced polymer mortar piping system.

B. Store and safeguard tools and materials until completion of the Work, at which time they shall be inventoried, delivered and placed in an area designated by OWNER.

2.5 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be permanently marked with the following:
   1. Name or trademark of manufacturer.
   2. Pipe class and specification designation.
   3. Size and length dimensions.
   4. Date and place of manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

B. For pipe testing, refer to Section 15050, Piping Systems.

C. Pipe testing shall be conducted per manufacture’s recommendations. All pipe joints shall be tested.

D. Acceptance testing (deflection, low pressure air, and infiltration testing) shall be performed at least 30 days after installation and backfill. This shall include fill, grading, road base, paving, concrete, landscaping, manhole completion, gravity sewer cleaning, visual testing with CCTV, and all superimposed loads in place. Air testing and infiltration testing shall take place after the mandrel testing of the pipeline.

3.2 PIPE TESTS

A. For buried piping leakage tests, refer to Section 15051, Buried Piping Installation. Contractor shall at its own expense locate and repair the cause of leakage and retest pipeline, and all leakage shall be repaired.

B. Pipe Deflection: After installation including completion of backfilling, removal of stulls, and before acceptance of Work, all pipes shall be tested for excessive deflection by pulling a mandrel through the pipe, or other acceptable methods acceptable to the Engineer. Diametrical deflection shall not exceed three percent (3%) up to 30 days followings installation. Testing for pipe acceptance shall be performed at or after 30 days. Contractor may wish to perform testing immediately following installation to ensure themselves that their installation methods are successful. Pipe with diametrical deflection exceeding three percent (3%) of the
nominal inside diameter shall be uncovered and the bedding and backfill replaced as required to prevent excessive deflection. Retesting shall be performed at least 30 days after installation and re-backfilling.

C. The maximum allowable diametrical deflection after the 12 months shall not exceed five percent (5%).

++ END OF SECTION ++
APPENDIX A

NATIONWIDE PERMIT (NWP) VERIFICATION
SUBJECT: Nationwide Permit (NWP) Verification

Patty Kennedy
City of Phoenix Water Services Department
200 W. Washington St
Phoenix, Arizona  85003

Dear Ms. Kennedy:

I am responding to your request (SPL-2018-00252), dated July 9, 2018, for a Department of the Army permit for your proposed project, West Anthem Water and Wastewater Infrastructure. The proposed project (33.863834/-112.150624) is within Sections 15, 22, 27, and 34 of Township 6 North, Range 2 East, and Sections 3 and 11 of Township 5 North, Range 2 East and Sections 15 and 22 of Township 6 North, Range 2 East, and Section 2 of Township 5 North, Range 2 East in the City of Phoenix, Maricopa County, Arizona.

Because this project would result in a discharge of dredged and/or fill material into waters of the U.S., a Department of the Army permit is required pursuant to Section 404 of the Clean Water Act (33 USC 1344; 33 CFR parts 323 and 330).

I have determined construction of your proposed project, if constructed as described in your application, would comply with NWP 12 Utility Line Activities. Specifically, and as shown in the enclosed figures, you are authorized to:

1. UNW-B (upstream segment): Permanently impact 0.001 acre for access road construction, temporarily impact 0.005 acre for wastewater sewer and waterline installation and construction access

2. UNW-B (downstream segment): Permanently impact 0.001 acre for access road construction, temporarily impact 0.005 acre for wastewater sewer and waterline installation and construction access

3. UNW-C: Temporarily impact 0.003 acre for construction access

4. Deadman Wash: Permanently impact 0.004 acre for access road construction and temporarily impact 0.017 acre for wastewater sewer installation and construction access

5. UNW-E: Temporarily impact 0.008 acre for in-kind culvert replacement and waterline installation
For this NWP verification letter to be valid, you must comply with all of the terms and conditions in Enclosure 1. Furthermore, you must comply with the non-discretionary Special Conditions listed below:

Cultural Resources:

Pursuant to 36 C.F.R. section 800.13, in the event of any discoveries during construction of either human remains, archeological deposits, or any other type of historic property, the Permittee shall notify the Corps’ Archeology Staff within 24 hours (Danielle Storey at 213-452-3855 OR Meg McDonald at 213-452-3849). The Permittee shall immediately suspend all work in any area(s) where potential cultural resources are discovered. The Permittee shall not resume construction in the area surrounding the potential cultural resources until the Corps Regulatory Division re-authorizes project construction, per 36 C.F.R. section 800.13.

This verification is valid through March 18, 2022. If on March 18, 2022 you have commenced or are under contract to commence the permitted activity you will have an additional twelve (12) months to complete the activity under the present NWP terms and conditions. However, if I discover noncompliance or unauthorized activities associated with the permitted activity I may request the use of discretionary authority in accordance with procedures in 33 CFR part 330.4(e) and 33 CFR part 330.5(c) or (d) to modify, suspend, or revoke this specific verification at an earlier date. Additionally, at the national level the Chief of Engineers, any time prior to March 18, 2022, may choose to modify, suspend, or revoke the nationwide use of a NWP after following procedures set forth in 33 CFR part 330.5. It is incumbent upon you to comply with all of the terms and conditions of this NWP verification and to remain informed of any change to the NWPs.

A NWP does not grant any property rights or exclusive privileges. Additionally, it does not authorize any injury to the property, rights of others, nor does it authorize interference with any existing or proposed Federal project. Furthermore, it does not obviate the need to obtain other Federal, state, or local authorizations required by law.
Thank you for participating in the Regulatory Program. If you have any questions, please contact Leanne Van Tuyl at (602) 230-6991 or via e-mail at Leanne.VanTuyl@usace.army.mil. Please help me to evaluate and improve the regulatory experience for others by completing the form at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey.

Sincerely,

Sallie Diebolt
Chief, Arizona Branch
Regulatory Division

Enclosures:
Certificate of Compliance
Fig. 1: State Location Map
Fig 2. Project Location Map
Fig 3. Floodplain Map
Figs 4A-4D: Impact Maps
Enclosure 1: NWP 12 Utility Line Activities
CERTIFICATE OF COMPLIANCE WITH
DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: SPL-2018-00252

Name of Permittee: Patty Kennedy, City of Phoenix Water Services Department

Date of Issuance: August 20, 2018

Upon completion of the activity authorized by this permit and the mitigation required by this permit, sign this certificate, and return it by ONE of the following methods;

1) Email a digital scan of the signed certificate to Leanne.VanTuyl@usace.army.mil
OR
2) Mail the signed certificate to
   U.S. Army Corps of Engineers
   ATTN: Regulatory Division SPL-2018-00252
   3636 N CENTRAL AVE, SUITE 900
   PHOENIX, ARIZONA 85012-1939

I hereby certify that the authorized work and any required compensatory mitigation has been completed in accordance with the NWP authorization, including all general, regional, or activity-specific conditions. Furthermore, if credits from a mitigation bank or in-lieu fee program were used to satisfy compensatory mitigation requirements I have attached the documentation required by 33 CFR 332.3(l)(3) to confirm that the appropriate number and resource type of credits have been secured.

___________________________________ ________________________________
Signature of Permittee   Date
Figure 1. State Location Map

West Anthem Water & Wastewater Infrastructure
Phoenix, Arizona
Figure 2. Project Location Map

West Anthem Water & Wastewater Infrastructure
Phoenix, Arizona

Legend

- Project Limits
- BLM
- Game and Fish
- Private
- State Trust

Source: USGS Quad.
Biscuit Flat, Ariz. (1983)
Figure 3. Floodplain Map
West Anthem Water & Wastewater Infrastructure
Phoenix, Arizona

Legend

- Project Limits

Source: FEMA National Flood Hazard Layer GIS Web Mapping Service
LEGEND

Permanent Impact UNW-B (upstream segment) 0.001 Acres. Due to construction of decomposed granite maintenance road

Temporary Impact UNW-B (upstream segment) 0.005 Acres. Due to construction zone access

Waters of the U.S.
Flow Direction
Photo Point Number and Direction
Project Limits

FIGURE 4A IMPACTS MAP
Sta 249+00 - 253+50
West Anthem Water & Wastewater Infrastructure

06/15/2018
FIGURE 4C  IMPACTS MAP

Sta 198+00 - 202+50

West Anthem Water & Wastewater Infrastructure

Legend

- **Permanent Impact Deadman Wash** - 0.004 Acres
  Due to construction of decomposed granite maintenance road

- **Temporary Impact Deadman Wash** - 0.017 Acres
  Due to construction zone access

- **Flow Direction**

- **Waters of the U.S.**

- **Project Limits**

**Sta 198+00 - 202+50**

- **Future Roadway by Others**

- **Install 12" Wide 6" Thick Stabilized Decomposed Granite Maintenance Road**
  With Watershed LS Per COP DSC, Sec. 1.044

**N PIONEER ROAD**

**040 20 Feet**

**Permanent Impact Deadman Wash** - 0.004 Acres
- Due to construction of decomposed granite maintenance road

**Temporary Impact Deadman Wash** - 0.017 Acres
- Due to construction zone access
Temporary Impact UNW-E - 0.008 Acres
Due to in-kind replacement of existing culvert

Waters of the U.S.

Flow Direction

Project Limits

LEGEND

FIGURE 4D IMPACTS MAP
Sta 14+00 - 18+00
West Anthem Water & Wastewater Infrastructure

04/24/2018
A. General Information

This document is an aid to understanding the terms and conditions of your nationwide permit (NWP) by bringing together information issued separately in: (1) the Federal Register (82 FR 1860-2008)*, (2) the Special Public Notice for NWP "Reissuance of the Nationwide Permits and Issuance of Final Regional Conditions for the Los Angeles District”*, and (3) the Clean Water Act Section 401 water quality certification decisions (401 WQCs)* issued by the White Mountain Apache Tribe, Hopi Tribe, Hualapai Tribe, Navajo Nation, U.S. Environmental Protection Agency, and Arizona Department of Environmental Quality. Please note that website addresses enclosed herein may have been changed and updated since publication of the original document.

1) Pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and/or Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq) the U.S. Army Corps of Engineers (Corps) published the "Issuance and Reissuance of Nationwide Permits" in the Federal Register (82 FR 1860-2008) on January 6, 2017. These NWPs are in effect from March 19, 2017 through March 18, 2022 unless modified, reissued, or revoked before that time. It is incumbent upon the permittee to remain informed of changes to the NWPs.

2) The Los Angeles District of the Corps issued a Special Public Notice (March 22, 2017) announcing final regional conditions for NWPs to ensure protection of high value waters within the State of Arizona.

3) The Los Angeles District of the Corps requested and obtained for the entire State of Arizona the 401 WQC decision for all NWPs on all tribal lands from the White Mountain Apache Tribe, Hopi Tribe, Hualapai Tribe, Navajo Nation, and U.S. Environmental Protection Agency on all non-tribal lands from the Arizona Department of Environmental Quality.

A description of all NWPs and 401 WQCs can be found in the "Nationwide Permits for Arizona" Special Public Notice.*


Key Sections:
B. Nationwide Permit Terms (page 1)     C. Nationwide Permit General Conditions (page 2)
D. District Engineer’s Decision (page 8)  E. Nationwide Permit Regional Conditions (page 9)
F. 401 Water Quality Certifications (page 10)

B. Nationwide Permit Terms

12. Utility Line Activities. Activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the United States, provided the activity does not result in the loss of greater than 1/2-acre of waters of the United States for each single and complete project.

Utility lines: This NWP authorizes discharges of dredged or fill material into waters of the United States and structures or work in navigable waters for crossings of those waters associated with the construction, maintenance, or repair of utility lines, including outfall and intake structures. There must be no change in pre-construction contours of waters of the United States. A “utility line” is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquescent, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone, and telegraph messages, and internet, radio, and television communication. The term “utility line” does not include activities that drain a water of the United States, such as drainage tile or french drains, but it does apply to pipes conveying drainage from another area.

Material resulting from trench excavation may be temporarily sidecast into waters of the United States for no more than three months, provided the material is not placed in such a manner that it is dispersed by currents or other forces. The district engineer may extend the period of temporary side casting for no more than a total of 180 days, where appropriate. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. The trench cannot be constructed or backfilled in such a manner as to drain waters of the United States (e.g., backfilling with extensive gravel layers, creating a french drain effect). Any exposed slopes and stream banks must be stabilized immediately upon completion of the utility line crossing of each waterbody.

Utility line substations: This NWP authorizes the construction, maintenance, or expansion of substation facilities associated with a power line or utility line in non-tidal waters of the United States, provided the activity, in combination with all other activities included in one single and complete project, does not result in the loss of greater than 1/2-acre of waters of the United States. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters of the United States to construct, maintain, or expand substation facilities.

Foundations for overhead utility line towers, poles, and anchors: This NWP authorizes the construction or maintenance of foundations for overhead utility line towers, poles, and anchors in all waters of the United States, provided the foundations are the minimum size necessary and separate footings for each tower leg (rather than a larger single pad) are used where feasible.

Access roads: This NWP authorizes the construction of access roads for the construction and maintenance of utility lines, including overhead power lines and utility line substations, in non-tidal waters of the United States, provided the activity, in combination...
with all other activities included in one single and complete project, does not cause the loss of greater than 1/2-acre of non-tidal waters of the United States. This NWP does not authorize discharges into non-tidal wetlands adjacent to tidal waters for access roads. Access roads must be the minimum width necessary (see Note 2, below). Access roads must be constructed so that the length of the road minimizes any adverse effects on waters of the United States and must be as near as possible to pre-construction contours and elevations (e.g., at grade corduroy roads or geotextile/gravel roads). Access roads constructed above pre-construction contours and elevations in waters of the United States must be properly bridged or culverted to maintain surface flows.

This NWP may authorize utility lines in or affecting navigable waters of the United States even if there is no associated discharge of dredged or fill material (See 33 CFR Part 322). Overhead utility lines constructed over section 10 waters and utility lines that are routed in or under section 10 waters without a discharge of dredged or fill material require a section 10 permit.

This NWP authorizes, to the extent that Department of the Army authorization is required, temporary structures, fills, and work necessary for the remediation of inadvertent returns of drilling fluids to waters of the United States through sub-soil fissures or fractures that might occur during horizontal directional drilling activities conducted for the purpose of installing or replacing utility lines. These remediation activities must be done as soon as practicable, to restore the affected waterbody. District engineers may add special conditions to this NWP to require a remediation plan for addressing inadvertent returns of drilling fluids to waters of the United States during horizontal directional drilling activities conducted for the purpose of installing or replacing utility lines.

This NWP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the utility line activity. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum expected high flows. After construction, temporary fills must be removed in their entirety and the affected areas returned to pre-construction conditions. Remediation activities must be done as soon as practicable, to restore the affected waterbody. District engineers may add special conditions to this NWP to require a remediation plan for addressing inadvertent returns of drilling fluids to waters of the United States during horizontal directional drilling activities conducted for the purpose of installing or replacing utility lines.

**Notification:** The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if any of the following criteria are met: (1) the activity involves mechanized land clearing in a forested wetland for the utility line right-of-way; (2) a section 10 permit is required; (3) the utility line in waters of the United States, excluding overhead lines, exceeds 500 feet; (4) the utility line is located within a jurisdictional area (i.e., water of the United States), and it runs parallel to or along a stream bed that is within that jurisdictional area; (5) discharges that result in the loss of greater than 1/10-acre of waters of the United States; (6) permanent access roads are constructed above grade in waters of the United States for a distance of more than 500 feet; or (7) permanent access roads are constructed in waters of the United States with impervious materials. (See general condition 32.) (Authorities: Sections 10 and 404)

**Note 1:** Where the utility line is constructed or installed in navigable waters of the United States (i.e., section 10 waters) within the coastal United States, the Great Lakes, and United States territories, a copy of the NWP verification will be sent by the Corps to the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), for charting the utility line to protect navigation.

**Note 2:** For utility line activities crossing a single waterbody more than one time at separate and distinct locations, or multiple waterbodies at separate and distinct locations, each crossing is considered a single and complete project for purposes of NWP authorization. Utility line activities must comply with 33 CFR 330.6(d).

**Note 3:** Utility lines consisting of aerial electric power transmission lines crossing navigable waters of the United States (which are defined at 33 CFR part 329) must comply with the applicable minimum clearances specified in 33 CFR 322.5(i).

**Note 4:** Access roads used for both construction and maintenance may be authorized, provided they meet the terms and conditions of this NWP. Access roads used solely for construction of the utility line must be removed upon completion of the work, in accordance with the requirements for temporary fills.

**Note 5:** Pipes or pipelines used to transport gaseous, liquid, liquefied, or slurry substances over navigable waters of the United States are considered to be bridges, not utility lines, and may require a permit from the U.S. Coast Guard pursuant to Section 9 of the Rivers and Harbors Act of 1899. However, any discharges of dredged or fill material into waters of the United States associated with such pipelines will require a section 404 permit (see NWP 15).

**Note 6:** This NWP authorizes utility line maintenance and repair activities that do not qualify for the Clean Water Act section 404(f) exemption for maintenance of currently serviceable fills or fill structures.

**Note 7:** For overhead utility lines authorized by this NWP, a copy of the PCN and NWP verification will be provided to the Department of Defense Siting Clearinghouse, which will evaluate potential effects on military activities.

**Note 8:** For NWP 12 activities that require pre-construction notification, the PCN must include any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distinct crossings that require Department of the Army authorization but do not require pre-construction notification (see paragraph (b) of general condition 32). The district engineer will evaluate the PCN in accordance with Section D, “District Engineer’s Decision.” The district engineer may require mitigation to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see general condition 23).

**C. Nationwide Permit General Conditions**

**Note:** To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for a NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. **Navigation.** (a) No activity may cause more than a minimal adverse effect on navigation. (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States. (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the...
Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects from Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the preconstruction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the preconstruction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. (b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. The permittee shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status. (c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/.

17. Tribal Rights. No NWP activity may cause more than minimal adverse effects on tribal rights (including treaty rights), protected tribal resources, or tribal lands.

18. Endangered Species. (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which “may affect” a listed species or critical habitat, unless ESA section 7 consultation addressing the effects of the proposed activity has been completed. Direct effects are the immediate effects on listed species and critical habitat caused by the NWP activity. Indirect effects are those effects on listed species and critical habitat that are caused by the NWP activity and are later in time, but still are reasonably certain to occur. (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA. (c)
Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed activity or that utilize the designated critical habitat that might be affected by the proposed activity. The district engineer will determine whether the proposed activity “may affect” or will have “no effect” to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps’ determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have “no effect” on listed species or critical habitat, or until ESA section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps. (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific permit conditions to the NWP. (e) Authorization of an activity by an NWP does not authorize the “take” of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Title 10 Permit, a Biological Opinion with “incidental take” provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where “take” means to harass, harm, pursue, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word “harm” in the definition of “take” means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. (f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrency from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre-construction notification whether the ESA section 10(a)(1)(B) permit permits the proposed NWP activity or whether additional ESA section 7 consultation is required. (g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their World Wide Web pages at http://www.fws.gov or http://www.fws.gov/ipac and http://www.nmfs.noaa.gov/pr/species/esa/ respectively. (Note: Arizona endangered species information is available at http://www.fws.gov/southwest/es/arizona/Threatened.htm#CountyList)

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for ensuring their action complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting appropriate local office of the U.S. Fish and Wildlife Service to determine applicable measures to reduce impacts to migratory birds or eagles, including whether “incidental take” permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. Historic Properties. (a) In cases where the district engineer determines that the activity may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied. (b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act. If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106. (c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: no historic properties affected, no adverse effect, or adverse effect. Where the non-Federal applicant has identified historic properties on which the activity might have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. (d) For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps. (e) Prospective permittees should be aware that section 110(k) of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally
Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332. (1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee-responsible mitigation. (2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal adverse individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f)). (3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation. (4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). (5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided. (6) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(iii)). (g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs.
example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs. (h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management. (i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when:

(i) The acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

“When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.”

(Transferee)

(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include: (a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions; (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(3) to confirm that the permittee secured the appropriate number and resource type of credits; and (c) The signature of the permittee certifying the completion of the activity and mitigation. The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. Activities Affecting Structures or Works Built by the United States. If an NWP activity also requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a “USACE project”), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission is not authorized by NWP until the appropriate Corps office issues the section 408 permission to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.
32. Pre-Construction Notification. (a) Timing: Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either: (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or (2) 45 calendar days have passed from the district engineer’s receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is “no effect” on listed species or “no potential to cause effects” on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee’s right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information: (1) Name, address and telephone numbers of the prospective permittee; (2) Location of the proposed activity; (3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity; (4) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures. For single and complete linear projects, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans); (5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate; (6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan. (7) For non-Federal permittees, if any listed species or designated critical habitat might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat, the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed activity or utilize the designated critical habitat that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act; (8) For non-Federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act; (9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the “study river” (see general condition 16); and (10) For an activity that requires permission from the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction notification must include a statement confirming that the project proponent has submitted a written request for permission from the Corps office having jurisdiction over that USACE project.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is an NWP PCN and must include all of the applicable information required in paragraphs (b)(1) through (10) of this general condition. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity’s compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity’s adverse environmental effects so that they are no more than minimal. (2) Agency coordination is required for: (i) all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States; (ii) NWPs 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of stream bed; (iii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic
D. District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the individual crossings of waters of the United States to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to streams or of an otherwise applicable limit, as provided for in NWP(s) 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51, 52, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects. For those NWP(s) that have a waivable 300 linear foot limit for losses of intermittent and ephemeral stream bed and a 1/2-acre limit (i.e., NWP(s) 21, 29, 39, 40, 42, 43, 44, 50, 51, 52, or 54), the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects. If the net adverse environmental effects of the proposed activity are more than minimal, then the activity is authorized under the NWP subject to the

2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters (e.g., streams). The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either: (a) that the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the activity is authorized under the NWP subject to the
applicant’s submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31, or to evaluate PCNs for activities authorized by NWPs 21, 49, and 50), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

F. Nationwide Permit Regional Conditions

Of the ten regional conditions effective within the Los Angeles District of the Corps, six apply to projects within Arizona (1-4, 9 and 10). The remaining four regional conditions apply to specific geographic areas, resources, or species not located in Arizona.

The following regional conditions must be complied with for any authorization by a NWP to be valid in the State of Arizona:

Regional Condition 1. For all activities in waters of the U.S. that are suitable habitat for federally listed fish species, including designated critical habitat for such species, the permittee shall design all new or substantially reconstructed linear transportation crossings (e.g. roads, highways, railways, trails, bridges, culverts) to ensure that the passage and/or spawning of fish is not hindered. In these areas, the permittee shall employ bridge designs that span the stream or river, including pier- or pile-supported spans, or designs that use a bottomless arch culvert with a natural stream bed, unless determined to be impracticable by the Corps.

Regional Condition 2. Nationwide Permits (NWP) 3, 7, 12-15, 17-19, 21, 23, 25, 29, 35, 36, or 39-46, 48-54 cannot be used to authorize structures, work, and/or the discharge of dredged or fill material that would result in the “loss” of wetlands, mudflats, vegetated shallows or riffle and pool complexes as defined at 40 CFR Part 230.40-45. The definition of “loss” for this regional condition is the same as the definition of "loss of waters of the United States" used for the Nationwide Permit Program. Furthermore, this regional condition applies only within the State of Arizona and within the Mojave and Sonoran (Colorado) desert regions of California. The desert regions in California are limited to four USGS Hydrologic Unit Code (HUC) accounting units (Lower Colorado-150301, Northern Mojave-180902, Southern Mojave-181001, and Salton Sea-181002).

Regional Condition 3. When a pre-construction notification (PCN) is required, the appropriate U.S. Army Corps of Engineers (Corps) District shall be notified in accordance with General Condition 32 using either the South Pacific Division PCN Checklist or a signed application form (ENG Form 4345) with an attachment providing information on compliance with all of the General and Regional conditions. The PCN Checklist and application form are available at: [http://www.spl.usace.army.mil/Missions/Regulatory/PermitProcess.aspx](http://www.spl.usace.army.mil/Missions/Regulatory/PermitProcess.aspx). In addition, unless specifically waived by the Los Angeles District, the PCN shall include: a) A written statement describing how the activity has been designed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States; b) Drawings, including plan and cross-section views, clearly depicting the location, size and dimensions of the proposed activity as well as the location of delineated waters of the U.S. on the site. The drawings shall contain a title block, legend and scale, amount (in cubic yards) and area (in acres) of fill in Corps jurisdiction, including both permanent and temporary fills/structures. The ordinary high water mark or, if tidal waters, the mean high water mark and high tide line, should be shown (in feet), based on National Geodetic Vertical Datum (NGVD) or other appropriate referenced elevation. All drawings shall follow the Updated Map and Drawing Standards for the South Pacific Division Regulatory Program (Feb 2016), or most recent update (available at the South Pacific Division website at: [http://www.spd.usace.army.mil/Missions/Regulatory/PublicNoticesandReferences.aspx](http://www.spd.usace.army.mil/Missions/Regulatory/PublicNoticesandReferences.aspx)); c) Numbered and dated pre-project color photographs showing a representative sample of waters proposed to be impacted on the project site, and all waters proposed to be avoided on and immediately adjacent to the project site. The compass angle and position of each photograph shall be documented on the plan-view drawing required in part b of this regional condition; d) Delineation of aquatic resources in accordance with the current Los Angeles District’s Minimum Standards for Acceptance of Aquatic Resources Delineation Reports (available at: [http://www.spl.usace.army.mil/Missions/Regulatory/Jurisdictional-Determination/](http://www.spl.usace.army.mil/Missions/Regulatory/Jurisdictional-Determination/)).

Regional Condition 4. Submission of a PCN pursuant to General Condition 32 and Regional Condition 3 shall be required for specific regulated activities in the following locations: a) All perennial waterbodies and special aquatic sites throughout the Los Angeles District as well as intermittent waters within the State of Arizona for any regulated activity that would result in a loss of waters of the United States. The definition of “loss of waters of the United States” for this regional condition is the same as the definition used for the Nationwide Permit Program. b) All areas designated as Essential Fish Habitat (EFH) by the Pacific Fishery Management Council, and that would result in an adverse effect to EFH, in which case the PCN shall include an EFH assessment and extent of proposed impacts to EFH. EFH Assessment Guidance and other supporting information can be found at: [http://www.westcoast.fisheries.noaa.gov/habitat/fish_habitat/efh_consultations_go.html](http://www.westcoast.fisheries.noaa.gov/habitat/fish_habitat/efh_consultations_go.html). c) All watersheds in the Santa Monica Mountains in Los Angeles and Ventura counties bounded by Calleguas Creek on the west, by Highway 101 on the north and east, and by Sunset Boulevard and Pacific Ocean on the south. d) The Santa Clara River watershed in Los Angeles and Ventura counties, including but not limited to Aliso Canyon, Agua Dulce Canyon, Sand Canyon, Bouquet Canyon, Mint Canyon, South Fork of the Santa Clara River, San Francisquito Canyon, Castaic Creek, Piru Creek, Sespe Creek and the main-stem of the Santa Clara River. e) The Murrieta and Temecula Creek watersheds in Riverside County, California for any regulated activity that would result in a loss of waters of the U.S. The definition of “loss of waters of the United States” for this regional condition is the same as the definition used for the Nationwide Permit Program. f) All waterbodies designated as Essential Fish Habitat (EFH) by the Pacific Fishery Management Council, and that would result in an adverse effect to EFH, in which case the PCN shall include an EFH assessment and extent of proposed impacts to EFH. EFH Assessment Guidance and other supporting information can be found at: [http://www.westcoast.fisheries.noaa.gov/habitat/fish_habitat/efh_consultations_go.html](http://www.westcoast.fisheries.noaa.gov/habitat/fish_habitat/efh_consultations_go.html). g) All waterbodies designated by the Arizona Department of Environmental Quality as Outstanding Arizona Waters (OAWs), within 1600 meters (or 1 mile) upstream and/or 800 meters (1/2 mile) downstream of a designated OAW, and on tributaries to OAWs within 1600 meters of the OAW (see [http://www.azdeq.gov/index.html](http://www.azdeq.gov/index.html)). h) All waterbodies designated by the Arizona Department of Environmental Quality as 303(d)-impaired surface waters, within 1600 meters (or 1 mile) upstream and/or 800 meters (1/2 mile) downstream of a designated impaired surface water, and on tributaries to impaired waters within 1600 meters of the impaired water (see [http://www.azdeq.gov/index.html](http://www.azdeq.gov/index.html)).

Regional Condition 9. Any requests to waive the applicable linear foot limitations for NWPs 13, 21, 29, 39, 40 and 42, 43, 44, 51, 52, and 54, must include the following: a) A narrative description of the affected aquatic resource. This should include known information on: volume and duration of flow; the approximate length, width, and depth of the waterbody and characters observed associated with an Ordinary High Water Mark (e.g. bed and bank, wrack line, or scour marks) or Mean High Water Line; a description of the adjacent vegetation.
community and a statement regarding the wetland status of the associated vegetation community (i.e. wetland, non- wetland); surrounding land use; water quality; issues related to cumulative impacts in the watershed, and; any other relevant information. b) An analysis of the proposed impacts to the waterbody in accordance with General Condition 32 and Regional Condition 3; c) Measures taken to avoid and minimize losses, including other methods of constructing the proposed project; and d) A compensatory mitigation plan describing how the unavoidable losses are proposed to be compensated, in accordance with 33 CFR Part 332.

Regional Condition 10. The permittee shall complete the construction of any compensatory mitigation required by special condition(s) of the NWP verification before or concurrent with commencement of construction of the authorized activity, except when specifically determined to be impracticable by the Corps. When mitigation involves use of a mitigation bank or in-lieu fee program, the permittee shall submit proof of payment to the Corps prior to commencement of construction of the authorized activity.

F. 401 Water Quality Certification (401 WQC)

A 401 WQC is mandatory for any activity that requires a Clean Water Act Section 404 permit. A 401 WQC is required prior to discharging any dredged or fill material into a water of the United States. Only one of the following 401 WQCs listed below will apply to your project. The geographical location of your project will determine which 401 WQC is applicable. The 401 WQCs issued for this NWP will remain in effect through March 18, 2022.

On all "Non-Tribal Lands", lands that are not part of federally recognized Indian Reservation, the Arizona Department of Environmental Quality (ADEQ) is the agency responsible for issuing the 401 WQC.

On all "Tribal Lands", lands that are part of a federally recognized Indian Reservation, the U.S. Environmental Protection Agency (EPA) is responsible for issuing the 401 WQC except where EPA has delegated the 401 WQC authority to the White Mountain Apache Tribe (Fort Apache Indian Reservation), Hopi Tribe (Hopi Indian Reservation), Hualapai Tribe (Hualapai Indian Reservation), or Navajo Nation (Navajo Indian Reservation).

If "Individual Certification" is required you must apply for, receive, and comply with the 401 WQC issued by ADEQ, EPA, or the appropriate Tribe.

Non-tribal Lands - 401 ADEQ WQCs*

ADEQ 401 WQC definitions:

Not Attaining Waters are surface waters that are identified pursuant to CWA Section 305(b) as not attaining (e.g. not meeting surface water quality standards) and as a result, merit special consideration. The current list of Not Attaining Waters (Category 4A, 4B and 4C) is available on the ADEQ website at www.azdeq.gov.

Native Fill means soil, sand, gravel and other natural materials that are similar in physical, chemical and biological composition to existing natural materials in the project area; and which are free from pollutants in quantities and concentrations that can cause or contribute to an exceedance of applicable Surface Water Quality Standards (SWQS).

ADEQ requires that an applicant submit an application to ADEQ for a Water Quality Certification if the proposed activity will occur within the ordinary high water mark of any of the following: An Outstanding Arizona Water; an impaired water; a water that is listed as not attaining; or a lake.

The following 401 water quality conditions apply to regulated discharges of dredged or fill material occurring within the ordinary high water mark (OHWM) of Waters of the US (WUS) under all applicable NWPs (hereinafter referred to as "certified activities"):  

1. Submission of a PCN pursuant to General Condition 32 and Regional Condition 3 shall be required for all waterbodies designated by ADEQ as Not Attaining, within 1600 meters (or 1 mile) upstream and/or 800 meters (or 1/2 mile) downstream of a not attaining water.
2. Any discharge occurring as a result of certified activities of the project shall not cause an exceedance of any Surface Water Quality Standard (SWQS). Applicability of this condition is as defined in A.A.C. R18-11-102.
3. This certification does not authorize the discharge of wastewater, process residues or other waste to any WUS.
4. Runoff of water used for irrigation or dust control for certified activities within WUS shall be limited to the extent practicable and shall not cause downstream erosion, flooding or an exceedance of applicable surface water quality standards (SWQS) in any WUS.
5. Clearing, grubbing, scraping or otherwise exposing erodible surfaces in WUS shall be minimized to the extent necessary for each construction phase or location.
6. Dredged or fill material in WUS shall be placed so that it is stable, meaning after placement, the material does not show signs of excessive erosion, such as gullying, head cutting, caving, block slippage, material sloughing, etc. Dredged or fill material placed in WUS shall not discharge (e.g., via leaching, runoff) pollutants into streams or wetlands at levels exceeding any applicable SWQS.
7. The effectiveness of all pollution control measures, including sediment and erosion control measures, shall be inspected, maintained and modified (as necessary) to reduce pollutants and ensure compliance with SWQS in any WUS.
8. Except where certified activities are intended to permanently alter any WUS, all disturbed areas within WUS shall be restored and (re)vegetated or stabilized. Vegetation shall be maintained on armored banks and slopes to stabilize soil and prevent erosion.
9. Silt laden or turbid water resulting from certified activities shall managed in a manner to reduce sediment load prior to discharging so as not to exceed SWQS in any WUS.
10. Any washing or dewatering of fill material must occur outside of any WUS prior to placement.
11. Acceptable fill material that can be placed in any WUS includes: untreated logs and lumber; natural stone (crushed or not), crushed clean concrete (recycled concrete); native fill; precast, sprayed or cast-in-place concrete (including soil cement and unmodified grouts); steel (including galvanized); plastic; aluminum; and other material that is free from pollutants in quantities or combinations that can cause an exceedance of applicable SWQS. Other fill materials may be placed in WUS with prior written approval from ADEQ.
12. Upon completion of the certified activities, areas within any WUS shall be promptly cleared of all forms, pilings, construction residues, equipment, debris and other obstructions, including temporary structures.

13. If fully, partially or occasionally submerged structures in WUS are constructed of cast-in-place concrete instead of pre-cast concrete, applicant will take steps; e.g., sheet piling or temporary dams, to prevent contact between water (instream and runoff) and the concrete until it cures and until any curing agents have evaporated or otherwise cease to be available; i.e., are no longer a pollutant source.

14. Any permanent WUS crossings other than fords, shall be equipped with conveyances that direct untreated runoff away from WUS.

15. Permanent and temporary pipes and culvert crossings in WUS shall be adequately sized to handle expected flow and properly set with end section, splash pads, headwalls or other structures that dissipate water energy to control erosion.

16. Debris will be cleared as needed from culverts, ditches, dikes and other drainage structures in any WUS to prevent clogging or conditions that may lead to washout.

17. All temporary structures in WUS constructed of imported materials and all permanent structures, including but not limited to, access roadways; culvert crossings; staging areas; material stockpiles; berms, dikes and pads, shall be constructed so as to accommodate overtopping and resist washout by streamflow.

18. Any temporary WUS crossing, other than fords on native material, shall be constructed in such a manner so as to provide armoring of the stream channel. Materials used to provide this armoring shall not include anything easily transportable by flow.

**Tribal Lands - 401 WQCs**

- **Fort Apache Indian Reservation (White Mountain Apache Tribe):** Individual Certification required for all projects.*
- **Hopi Indian Reservation (Hopi Tribe):** Individual Certification required for all projects.*
- **Hualapai Indian Reservation (Hualapai Tribe):** Individual Certification required for all projects.*
- **Navajo Indian Reservation (Navajo Nation):** Individual Certification required for all projects.*
- **All other Indian Reservations (EPA):** 401 WQCs issued by EPA: Contact PM

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**401 WQC Contact Information**

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency/Program</th>
<th>Contact Information</th>
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*Individual Certification required for all projects.*