


JOB SPECIAL PROVISIONS TABLE OF CONTENTS (ROADWAY)


(Job Special Provisions shall prevail over General Special Provisions whenever in conflict therewith.)

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Job No.: J5P3574  
Route: Route 50  
County: Osage

 <p>COLLIN J. WILCOX NUMBER PE-2019035614</p> <p>THIS SHEET HAS BEEN SIGNED, SEALED, AND DATED ELECTRONICALLY</p>	<p><b>MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION</b> 105 W. CAPITOL AVE. JEFFERSON CITY, MO 65102 Phone 1-888-275-6636</p>
	<p><b>LOCHMUELLER GROUP, INC.</b> 411 North 10th Street, Suite 200 St. Louis, MO 63101 Certificate of Authority: F00508273 Consultant Phone: (314) 621-3395</p>
	<p>JOB NUMBER: J5P3574 OSAGE COUNTY, MO DATE PREPARED: 4/8/2024</p>
	<p>ADDENDUM DATE: <b>R002 5/6/2024</b></p>
<p>Only the following items of the Job Special Provisions (Roadway) are authenticated by this seal: All (except those listed on next sheet)</p>	

Job No.: J5P3574  
Route: Route 50  
County: Osage

 <p>THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.</p>	<b>MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION</b> 105 W. CAPITOL AVE. JEFFERSON CITY, MO 65102 Phone 1-888-275-6636
	<b>BARTLETT &amp; WEST, INC.</b> 601 Monroe St., Suite 201 Jefferson City, MO 65101 Certificate of Authority: 000167 Consultant Phone: 314-384-5531
	If a seal is present on this sheet, JSP's have been electronically sealed and dated.
	JOB NUMBER: J5P3574 OSAGE COUNTY, MO DATE PREPARED: 4/8/2024
	ADDENDUM DATE:

Only the following items of the Job Special Provisions (Roadway) are authenticated by this seal: Work Zone Traffic Management (JSP-02-06N), Culvert Extension, Lump Sum Temporary Traffic Control JSP-22-01A

JOB  
SPECIAL PROVISION

A. General - Federal JSP-09-02J

**1.0 Description.** The Federal Government is participating in the cost of construction of this project. All applicable Federal laws, and the regulations made pursuant to such laws, shall be observed by the contractor, and the work will be subject to the inspection of the appropriate Federal Agency in the same manner as provided in Sec 105.10 of the Missouri Standard Specifications for Highway Construction with all revisions applicable to this bid and contract.

**1.1** This contract requires payment of the prevailing hourly rate of wages for each craft or type of work required to execute the contract as determined by the Missouri Department of Labor and Industrial Relations and requires adherence to a schedule of minimum wages as determined by the United States Department of Labor. For work performed anywhere on this project, the contractor and the contractor's subcontractors shall pay the higher of these two applicable wage rates. State Wage Rates, Information on the Required Federal Aid Provisions, and the current Federal Wage Rates are available on the Missouri Department of Transportation web page at [www.modot.org](http://www.modot.org) under "Doing Business with MoDOT", "Contractor Resources". Effective Wage Rates will be posted 10 days prior to the applicable bid opening. These supplemental bidding documents have important legal consequences. It shall be conclusively presumed that they are in the bidder's possession, and they have been reviewed and used by the bidder in the preparation of any bid submitted on this project.

**1.2** The following documents are available on the Missouri Department of Transportation web page at [www.modot.org](http://www.modot.org) under "Doing Business with MoDOT"; "Standards and Specifications". The effective version shall be determined by the letting date of the project.

General Provisions & Supplemental Specifications

Supplemental Plans to July 2023 Missouri Standard Plans  
For Highway Construction

These supplemental bidding documents contain all current revisions to the published versions and have important legal consequences. It shall be conclusively presumed that they are in the bidder's possession, and they have been reviewed and used by the bidder in the preparation of any bid submitted on this project.

B. ADA Compliance and Final Acceptance of Constructed Facilities JSP-10-01C

**1.0 Description.** The contractor shall comply with all laws pertaining to the Americans with Disabilities Act (ADA) during construction of pedestrian facilities on public rights of way for this project. An ADA Checklist is provided herein to be utilized by the contractor for verifying compliance with the ADA law. The contractor is expected to familiarize himself with the plans involving pedestrian facilities and the ADA Post Construction Checklist prior to performing the work.

**2.0 ADA Checklist.** The contractor can locate the ADA Checklist form on the Missouri Department of Transportation website:

<https://www.modot.org/forms-contractor-use>

**2.1** The ADA Checklist is not to be considered all-inclusive, nor does it supersede any other contract requirements. The ADA checklist is a required guide for the contractor to use during the construction of the pedestrian facilities and a basis for the commission's acceptance of work. Prior to work being performed, the contractor shall bring to the engineer's attention any planned work that is in conflict with the design or with the requirement shown in the checklist. This notification shall be made in writing. Situations may arise where the checklist may not fully address all requirements needed to construct a facility to the full requirements of current ADA law. In those situations, the contractor shall propose a solution to the engineer that is compliant with current ADA law using the following hierarchy of resources: 2010 ADA Standards for Accessible Design, Draft Public Rights of Way Accessibility Guidelines (PROWAG) dated November 23, 2005, MoDOT's Engineering Policy Guidelines (EPG), or a solution approved by the U.S. Access Board.

**2.2** It is encouraged that the contractor monitor the completed sections of the newly constructed pedestrian facilities in attempts to minimize negative impacts that his equipment, subcontractors or general public may have on the work. Completed facilities must comply with the requirements of ADA and the ADA Checklist or have documented reasons for the non-compliant items to remain.

### **3.0 Coordination of Construction.**

**3.1** Prior to construction and/or closure on an existing pedestrian path of travel, the contractor shall submit a schedule of work to be constructed, which includes location of work performed, the duration of time the contractor expects to impact the facility and an accessible signed pedestrian detour compliant with MUTCD Section 6D that will be used during each stage of construction. This plan shall be submitted to the engineer for review and approval at or prior to the pre-construction conference. Accessible signed detours shall be in place prior to any work being performed that has the effect of closing an existing pedestrian travel way.

**3.2** *When consultant survey is included in the contract, the contractor shall use their survey crews to verify that the intended design can be constructed to the full requirements as established in the 2010 ADA Standards. When 2010 ADA Standards do not give sufficient information to construct the contract work, the contractor shall refer to the PROWAG.*

**3.3** When consultant survey is not included in the contract, the contractor shall coordinate with the engineer, prior to construction, to determine if additional survey will be required to confirm the designs constructability.

**4.0 Final Acceptance of Work.** The contractor shall provide the completed ADA Checklist to the engineer at the semi-final inspection. ADA improvements require final inspection and compliance with the ADA requirements and the ADA Checklist. Each item listed in the checklist must receive either a "YES" or an "N/A" score. Any item receiving a "NO" will be deemed non-compliant and shall be corrected at the contractor's expense unless deemed otherwise by the engineer. Documentation must be provided about the location of any non-compliant items that are allowed to remain at the end of the construction project. Specific details of the non-compliant items, the ADA requirement that the work was not able to comply with, and the specific reasons

that justify the exception are to be included with the completed ADA Checklist provided to the engineer.

**4.1** Slope and grade measurements shall be made using a properly calibrated, 2 foot long, electronic digital level approved by the engineer.

**5.0 Basis of Payment.** The contractor will receive full pay of the contract unit cost for all sidewalk, ramp, curb ramp, median, island, approach work, cross walk striping, APS buttons, pedestrian heads, detectible warning systems and temporary traffic control measures that are completed during the current estimate period as approved by the engineer. Based upon completion of the ADA Checklist, the contractor shall complete any necessary adjustments to items deemed non-compliant as directed by the engineer.

**5.1** No direct payment will be made to the contractor to recover the cost of equipment, labor, materials, or time required to fulfill the above provisions, unless specified elsewhere in the contract documents.

C. Contract Liquidated Damages JSP-13-01C

**1.0 Description.** Liquidated Damages for failure or delay in completing the work on time for this contract shall be in accordance with Sec 108.8. The liquidated damages include separate amounts for road user costs and contract administrative costs incurred by the Commission.

**2.0 Period of Performance.** Prosecution of work is expected to begin on the date specified below in accordance with Sec 108.2. Regardless of when the work is begun on this contract, all work on all projects (job numbers) shall be completed on or before the Contract Completion date specified below. Completion by this date shall be in accordance with the requirements of Sec 108.7.1.

Notice to Proceed Date: June 20, 2024  
Contract Completion Date: December 26, 2024

**2.1 Calendar Days.** The count of calendar days will begin on the date the contractor starts any construction operations on the project.

Job Number	Calendar Days	Daily Road User Cost
J5P3574	N.A	\$2,300

**3.0 Liquidated Damages for Contract Administrative Costs.** Should the contractor fail to complete the work on or before the contract completion date specified in Section 2.0, or within the number of calendar days specified in Section 2.1, whichever occurs first, the contractor will be charged contract administrative liquidated damages in accordance with Sec 108.8 in the amount of **\$1,500** per calendar day for each calendar day, or partial day thereof, that the work is not fully completed. For projects in combination, these damages will be charged in full for failure to complete one or more projects within the above specified contract completion date or calendar days.

**4.0 Liquidated Damages for Road User Costs.** Should the contractor fail to complete the work on or before the contract completion date specified in Section 2.0, or within the number of calendar days specified in Section 2.1, whichever occurs first, the contractor will be charged road user costs in accordance with Sec 108.8 in the amount specified in Section 2.1 for each calendar day, or partial day thereof, that the work is not fully completed. These damages are in addition to the contract administrative damages and any other damages as specified elsewhere in this contract.

D. Work Zone Traffic Management JSP-02-06N

**1.0 Description.** Work zone traffic management shall be in accordance with applicable portions of Division 100 and Division 600 of the Standard Specifications, and specifically as follows.

**1.1 Maintaining Work Zones and Work Zone Reviews.** The Work Zone Specialist (WZS) shall maintain work zones in accordance with Sec 616.3.3 and as further stated herein. The WZS shall coordinate and implement any changes approved by the engineer. The WZS shall ensure all traffic control devices are maintained in accordance with Sec 616, the work zone is operated within the hours specified by the engineer, and will not deviate from the specified hours without prior approval of the engineer. The WZS is responsible to manage work zone delay in accordance with these project provisions. When requested by the engineer, the WZS shall submit a weekly report that includes a review of work zone operations for the week. The report shall identify any problems encountered and corrective actions taken. Work zones are subject to unannounced inspections by the engineer and other departmental staff to corroborate the validity of the WZS's review and may require immediate corrective measures and/or additional work zone monitoring.

**1.2 Work Zone Deficiencies.** Failure to make corrections on time may result in the engineer suspending work. The suspension will be non-excusable and non-compensable regardless if road user costs are being charged for closures.

**2.0 Traffic Management Schedule.**

**2.1** Traffic management schedules shall be submitted to the engineer for review prior to the start of work and prior to any revisions to the traffic management schedule. The traffic management schedule shall include the proposed traffic control measures, the hours traffic control will be in place, and work hours.

**2.2** The traffic management schedule shall conform to the limitations specified in Sec 616 regarding lane closures, traffic shifts, road closures and other width, height and weight restrictions.

**2.3** The engineer shall be notified as soon as practical of any postponement due to weather, material or other circumstances.

**2.4** In order to ensure minimal traffic interference, the contractor shall schedule lane closures for the absolute minimum amount of time required to complete the work. Lanes shall not be closed until material is available for continuous construction and the contractor is prepared to diligently pursue the work until the closed lane is opened to traffic.

**2.5 Traffic Congestion.** The contractor shall, upon approval of the engineer, take proactive measures to reduce traffic congestion in the work zone. The contractor shall immediately

implement appropriate mitigation strategies whenever traffic congestion reaches an excess of 10 minutes to prevent congestion from escalating to 15 minute or above threshold. If disruption of the traffic flow occurs and traffic is backed up in queues of 15 minute delays or longer, then the contractor shall immediately review the construction operations which contributed directly to disruption of the traffic flow and make adjustments to the operations to prevent the queues from reoccurring. Traffic delays may be monitored by physical presence on site or by utilizing real-time travel data through the work zone that generate text and/or email notifications where available. The engineer monitoring the work zone may also notify the contractor of delays that require prompt mitigation. The contractor may work with the engineer to determine what other alternative solutions or time periods would be acceptable.

### **2.5.1 Traffic Safety.**

**2.5.1.1 Recurring Congestion.** Where traffic queues routinely extend to within 1000 feet of the ROAD WORK AHEAD, or similar, sign on a divided highway or to within 500 feet of the ROAD WORK AHEAD, or similar, sign on an undivided highway, the contractor shall extend the advance warning area, as approved by the engineer.

**2.5.1.2 Non-Recurring Congestion.** When traffic queues extend to within 1000 feet of the ROAD WORK AHEAD, or similar, sign on a divided highway or to within 500 feet of the ROAD WORK AHEAD, or similar, sign on an undivided highway infrequently, the contractor shall deploy a means of providing advance warning of the traffic congestion, as approved by the engineer. The warning location shall be no less than 1000 feet and no more than 0.5 mile in advance of the end of the traffic queue on divided highways and no less than 500 feet and no more than 0.5 mile in advance of the end of the traffic queue on undivided highways.

### **3.0 Work Hour Restrictions.**

**3.1** Except for emergency work, as determined by the engineer, and long term lane closures required by project phasing, all lanes shall be scheduled to be open to traffic during the five major holiday periods shown below, from 12:00 noon on the last working day preceding the holiday until 6:00 a.m. on the first working day subsequent to the holiday unless otherwise approved by the engineer.

Memorial Day  
Labor Day  
Thanksgiving  
Christmas  
New Year's Day

**3.1.1 Independence Day.** The lane restrictions specified in Section 3.1 shall also apply to Independence Day, except that the restricted periods shall be as follows:

<b>When Independence Day falls on:</b>	<b>The Holiday is Observed on:</b>	<b>Halt Lane Closures beginning at:</b>	<b>Allow Lane Closures to resume at:</b>
Sunday	Monday	Noon on Friday	6:00 a.m. on Tuesday
Monday	Monday	Noon on Friday	6:00 a.m. on Tuesday
Tuesday	Tuesday	Noon on Monday	6:00 a.m. on Wednesday
Wednesday	Wednesday	Noon on Tuesday	6:00 a.m. on Thursday
Thursday	Thursday	Noon on Wednesday	6:00 a.m. on Friday
Friday	Friday	Noon on Thursday	6:00 a.m. on Monday
Saturday	Friday	Noon on Thursday	6:00 a.m. on Monday

**3.1.2** The contractor’s working hours will be restricted for the Special Events as shown below. All lanes shall be scheduled to be open to traffic during these Special Events.

Osage County Fair (July 11-13, 2024)

**3.2** The contractor shall not perform any construction operation on the roadway, roadbed or active lanes, including the hauling of material within the project limits, during restricted periods, holiday periods or other special events specified in the contract documents.

**3.3** The contractor shall be aware that traffic volume data indicates construction operations on the roadbed between the following hours will likely result in traffic queues greater than 15 minutes. Based on this, the contractor’s operations will be restricted accordingly unless it can be successfully demonstrated the operations can be performed without a 15 minute queue in traffic. It shall be the responsibility of the engineer to determine if the above work hours may be modified. Working hours for evenings, weekends and holidays will be determined by the engineer. The contractor may not work during the following listed hours:

Route 50 Eastbound:

All dates:

6:00 a.m. - 9:00 a.m. Monday through Friday

9:00 a.m. - 1:00 p.m. Saturday

Fall 2024 and Spring 2025 Semester at State Tech (Starting 8/19/2024)

9:00 a.m. – 6:00 p.m. Monday through Friday

Route 50 Westbound:

All dates:

3:00 p.m. - 6:00 p.m. Monday through Friday

5:00 p.m. - 9:00 p.m. Saturday

Fall 2024 and Spring 2025 Semester at State Tech (Starting 8/19/2024)

6:00 a.m. – 3:00 p.m. Monday through Friday

**4.0 Detours and Lane Closures.**

**4.1** When a changeable message sign (CMS) is provided, the contractor shall use the CMS to notify motorists of future traffic disruption and possible traffic delays one week before traffic is

shifted to a detour or prior to lane closures. The CMS shall be installed at a location as approved or directed by the engineer. If a CMS with Communication Interface is required, then the CMS shall be capable of communication prior to installation on right of way. All messages planned for use in the work zone shall be approved and authorized by the engineer or its designee prior to deployment.

**4.2** Except as shown in the temporary traffic control sheets or approved by the engineer, at least one lane of traffic in each direction shall be maintained at all times except for brief intervals of time required when the movement of the contractor's equipment will seriously hinder the safe movement of traffic. Periods during which the contractor will be allowed to interrupt traffic will be designated by the engineer.

**5.0 Basis of Payment.** No direct payment will be made to the contractor to recover the cost of equipment, labor, materials, or time required to fulfill the above provisions, unless specified elsewhere in the contract document. All authorized changes in the traffic control plan shall be provided for as specified in Sec 616.

E. Emergency Provisions and Incident Management JSP-90-11A

**1.0** The contractor shall have communication equipment on the construction site or immediate access to other communication systems to request assistance from law enforcement or other emergency agencies for incident management. In case of traffic accidents or the need for law enforcement to direct or restore traffic flow through the job site, the contractor shall notify law enforcement or other emergency agencies immediately as needed. The area engineer's office shall also be notified when the contractor requests emergency assistance.

**2.0** In addition to the 911 emergency telephone number for ambulance, fire or law enforcement services, the following agencies may also be notified for accident or emergency situation within the project limits.

<b>Missouri State Highway Patrol</b> 1-800-525-5555                      Cellular: *55 <u>Troop J Headquarters</u> P.O. Box 568 Jefferson City, MO 65102 Phone: (573) 751-1000	
<b>City of Linn Police Department</b>	1200 E Main St Linn, MO Phone: 573-897-4234
<b>Linn Fire Protection District</b>	210 W Main St Linn, MO Phone: 537-291-8597

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**2.1** This list is not all inclusive. Notification of the need for wrecker or tow truck services will remain the responsibility of the appropriate law enforcement agency.

**2.2** The contractor shall notify law enforcement and emergency agencies before the start of construction to request their cooperation and to provide coordination of services when emergencies arise during the construction at the project site. When the contractor completes this notification with law enforcement and emergency agencies, a report shall be furnished to the engineer on the status of incident management.

**3.0** No direct pay will be made to the contractor to recover the cost of the communication equipment, labor, materials or time required to fulfill the above provisions.

F. Project Contact for Contractor/Bidder Questions JSP-96-05

All questions concerning this project during the bidding process shall be forwarded to the project contact listed below.

Mia Peters, P.E.  
Transportation Project Manager  
Central District  
1511 Missouri Blvd.  
Jefferson City, MO 65102

Telephone Number: 573-751-7690  
Email: [maria.peters@modot.mo.gov](mailto:maria.peters@modot.mo.gov)

All questions concerning the bid document preparation can be directed to the Central Office – Design at (573) 751-2876.

G. Supplemental Revisions JSP-18-01AB

Compliance with [2 CFR 200.216 – Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment](#).

The Missouri Highways and Transportation Commission shall not enter into a contract (or extend or renew a contract) using federal funds to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as substantial or as critical technology as part of any system where the video surveillance and telecommunications equipment was produced by Huawei Technologies Company, ZTE Corporation, Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

Stormwater Compliance Requirements

**1.0 Description.** This provision requires the contractor to provide a Water Pollution Control Manager (WPCM) for any project that includes land disturbance on the project site and the total area of land disturbance, both on the project site, and all Off-site support areas, is one (1) acre or more. Regardless of the area of Off-site disturbance, if no land disturbance occurs on the project

site, these provisions do not apply. When a WPCM is required, all sections within this provision shall be applicable, including assessment of specified Liquidated Damages for failure to correct Stormwater Deficiencies, as specified herein. This provision is in addition to any other stormwater, environmental, and land disturbance requirements specified elsewhere in the contract.

**1.1 Definitions.** The project site is defined as all areas designated on the plans, including temporary and permanent easements. The project site is equivalent to the “permitted site”, as defined in MoDOT’s State Operating Permit. An Off-site area is defined as any location off the project site the contractor utilizes for a dedicated project support function, such as, but not limited to, staging area, plant site, borrow area, or waste area.

**1.2 Reporting of Off-Site Land Disturbance.** If the project includes any planned land disturbance on the project site, prior to the start of work, the contractor shall submit a written report to the engineer that discloses all Off-site support areas where land disturbance is planned, the total acreage of anticipated land disturbance on those sites, and the land disturbance permit number(s). Upon request by the engineer, the contractor shall submit a copy of its land disturbance permit(s) for Off-site locations. Based on the total acreage of land disturbance, both on and Off-site, the engineer shall determine if these Stormwater Compliance Requirements shall apply. The Contractor shall immediately report any changes to the planned area of Off-site land disturbance. The Contractor is responsible for obtaining its own separate land disturbance permit for Off-site areas.

**2.0 Water Pollution Control Manager (WPCM).** The Contractor shall designate a competent person to serve as the Water Pollution Control Manager (WPCM) for projects meeting the description in Section 1.0. The Contractor shall ensure the WPCM completes all duties listed in Section 2.1.

**2.1 Duties of the WPCM:**

- (a) Be familiar with the stormwater requirements including the current MoDOT State Operating Permit for construction stormwater discharges/land disturbance activities; MoDOT’s statewide Stormwater Pollution Prevention Plan (SWPPP); the Corps of Engineers Section 404 Permit, when applicable; the project specific SWPPP, the Project’s Erosion & Sediment Control Plan; all applicable special provisions, specifications, and standard drawings; and this provision;
- (b) Successfully complete the MoDOT Stormwater Training Course within the last 4 years. The MoDOT Stormwater Training is a free online course available at [MoDOT.org](http://MoDOT.org);
- (c) Attend the Pre-Activity Meeting for Grading and Land Disturbance and all subsequent Weekly Meetings in which grading activities are discussed;
- (d) Oversee and ensure all work is performed in accordance with the Project-specific SWPPP and all updates thereto, or as designated by the engineer;
- (e) Review the project site for compliance with the Project SWPPP, as needed, from the start of any grading operations until final stabilization is achieved, and take necessary actions to correct any known deficiencies to prevent pollution of the waters of the state or adjacent property owners prior to the engineer’s weekly inspections;

- (f) Review and acknowledge receipt of each MoDOT Inspection Report (Land Disturbance Inspection Record) for the Project within forty eight (48) hours of receiving the report and ensure that all Stormwater Deficiencies noted on the report are corrected as soon as possible, but no later than stated in Section 5.0.

**3.0 Pre-Activity Meeting for Grading/Land Disturbance and Required Hold Point.** A Pre-Activity meeting for grading/land disturbance shall be held prior to the start of any land disturbance operations. No land disturbance operations shall commence prior to the Pre-Activity meeting except work necessary to install perimeter controls and entrances. Discussion items at the pre-activity meeting shall include a review of the Project SWPPP, the planned order of grading operations, proposed areas of initial disturbance, identification of all necessary BMPs that shall be installed prior to commencement of grading operations, and any issues relating to compliance with the Stormwater requirements that could arise in the course of construction activity at the project.

**3.1 Hold Point.** Following the pre-activity meeting for grading/land disturbance and subsequent installation of the initial BMPs identified at the pre-activity meeting, a Hold Point shall occur prior to the start of any land disturbance operations to allow the engineer and WPCM the time needed to perform an on-site review of the installation of the BMPs to ensure compliance with the SWPPP is met. Land disturbance operations shall not begin until authorization is given by the engineer.

**4.0 Inspection Reports.** Weekly and post run-off inspections will be performed by the engineer and each Inspection Report (Land Disturbance Inspection Record) will be entered into a web-based Stormwater Compliance database. The WPCM will be granted access to this database and shall promptly review all reports, including any noted deficiencies, and shall acknowledge receipt of the report as required in Section 2.1 (f.).

**5.0 Stormwater Deficiency Corrections.** All stormwater deficiencies identified in the Inspection Report shall be corrected by the contractor within 7 days of the inspection date or any extended period granted by the engineer when weather or field conditions prohibit the corrective work. If the contractor does not initiate corrective measures within 5 calendar days of the inspection date or any extended period granted by the engineer, all work shall cease on the project except for work to correct these deficiencies, unless otherwise allowed by the engineer. All impact costs related to this halting of work, including, but not limited to stand-by time for equipment, shall be borne by the Contractor. Work shall not resume until the engineer approves the corrective work.

**5.1 Liquidated Damages.** If the Contractor fails to complete the correction of all Stormwater Deficiencies listed on the MoDOT Inspection Report within the specified time limit, the Commission will be damaged in various ways, including but not limited to, potential liability, required mitigation, environmental clean-up, fines, and penalties. These damages are not reasonably capable of being computed or quantified. Therefore, the contractor will be charged with liquidated damages specified in the amount of \$2,000 per day for failure to correct one or more of the Stormwater Deficiencies listed on the Inspection Report within the specified time limit. In addition to the stipulated damages, the stoppage of work shall remain in effect until all corrections are complete.

**6.0 Basis of Payment.** No direct payment will be made for compliance with this provision.

By signing this contract, the Company certifies it is not currently engaged in and shall not, for the duration of the contract, engage in a boycott of goods or services from the State of Israel, companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel, or persons or entities doing business in the State of Israel as defined by Section 34.600 RSMo. This certification shall not apply to contracts with a total potential value of less than One Hundred Thousand Dollars (\$100,000) or to contractors with fewer than ten (10) employees.

Ground Tire Rubber (GTR) Dry Process Modification of Bituminous Pavement Material

**1.0 Description.** This work shall consist of the dry process of adding ground tire rubber (GTR) to modify bituminous material to be used in highway construction. Existing GTR requirements in Section 1015 pertain to the wet process method of GTR modification that blends GTR with the asphalt binder (terminal blending or blending at HMA plant). The following requirements shall govern for dry process GTR modification. The dry process method adds GTR as a fine aggregate or mineral filler during mix production. All GTR modified asphalt mixtures shall be in accordance with Secs 401, 402, or 403 as specified in the contract; except as revised by this specification.

**2.0 Materials.** The contractor shall furnish a manufacturer’s certification to the engineer for each shipment of GTR furnished stating the name of the manufacturer, the chemical composition, workability additives, and certifying that the GTR supplied is in accordance with this specification.

**2.1 Product Approval.** The GTR product shall contain a Trans-Polyoctenamer (TOR) added at 4.5 % of the weight of the crumb rubber or an engineered crumb rubber (ECR) workability additive that has proven performance in Missouri. Other GTR additives shall be demonstrated and proven prior to use such as a five-year field performance history in other states or performance on a federal or state-sanctioned accelerated loading facility.

**2.2 General.** GTR shall be produced from processing automobile or truck tires by ambient or cryogenic grinding methods. Heavy equipment tires, uncured or de-vulcanized rubber will not be permitted. GTR shall also meet the following material requirements:

<b>Table 1 – GTR Material Properties</b>		
<b>Property</b>	<b>Test Method</b>	<b>Criteria</b>
Specific Gravity	ASTM D1817	1.02 to 1.20
Metal Contaminates	ASTM D5603	≤ 0.01%
Fiber Content	ASTM D5603	≤ 0.5%
Moisture Content	ASTM D1509	≤ 1.0%*
Mineral Filler	AASHTO M17	≤ 4.0%

\*Moisture content of the GTR shall not cause foaming when combined with asphalt binder and aggregate during mix production

**2.3 Gradation.** The GTR material prior to TOR or ECR workability additives shall meet the following gradation and shall be tested in accordance with ASTM D5603 and ASTM D5644.

<b>Sieve</b>	<b>Percent Passing by Weight</b>
No. 20	100
No. 30	98-100
No. 40	50-70
No. 100	5-15

**3.0 Delivery, Storage, and Handling.** The GTR shall be supplied in moisture-proof packaging or other appropriate bulk containers. GTR shall be stored in a dry location protected from rain before use. Each bag or container shall be properly labeled with the manufacturer’s designation for the GTR and specific type, mesh size, weight and manufacturer’s batch or Lot designation.

**4.0 Feeder System.** Dry Process GTR shall be controlled with a feeder system using a proportioning device that is accurate to within  $\pm 3$  percent of the amount required. The system shall automatically adjust the feed rate to always maintain the material within this tolerance and shall have a convenient and accurate means of calibration. The system shall provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds per minute, to verify feed rate. The supply system shall report the feed in 1-pound increments using load cells that will enable the user to monitor the depletion of the GTR. Monitoring the system volumetrically will not be allowed. The feeder shall interlock with the aggregate weight system and asphalt binder pump to maintain correct mixture proportions at all production rates.

Flow indicators or sensing devices for the system shall be interlocked with the plant controls to interrupt mixture production if GTR introduction rate is not within  $\pm 3$  percent. This interlock will immediately notify the operator if GTR introduction rate exceeds introduction tolerances. All plant production will cease if the introduction rate is not brought back within tolerance after 30 seconds. When the interlock system interrupts production and the plant has to be restarted, upon restarting operations; the modifier system shall run until a uniform feed can be observed on the output display. All mix produced prior to obtaining a uniform feed shall be rejected.

**4.1 Batch Plants.** GTR shall be added to aggregate in the weigh hopper. Mixing times shall be increased per GTR manufacturer recommendations.

**4.2 Drum Plants.** The feeder system shall add GTR to aggregate and liquid binder during mixing and provide sufficient mixing time to produce a uniform mixture. The feeder system shall ensure GTR does not become entrained in the exhaust system of the drier or plant and is not exposed to the drier flame at any point after introduction.

**5.0 Testing During Mixture Production.** Testing of asphalt mixes containing GTR shall not begin until at least 30 minutes after production or per additive supplier’s recommendation.

**6.0 Construction Requirements.** Mixes containing GTR shall have a target mixing temperature of 325 F or as directed by the GTR additive supplier. The additive supplier’s recommendations shall be followed to allow for GTR binder absorption/reaction. This may include holding mix in the silo to allow time for binder to absorb into the GTR. Rolling operations may need to be modified.

**7.0 Mix Design Test Method Modification.** A formal mixing procedure from the additive supplier shall be provided to the contractor and engineer that details the proper sample preparation, including blending GTR with the binder or other additives. Samples shall be prepared and

fabricated in accordance with this procedure by the engineer and contractor throughout the duration of the project.

**8.0 Mix design Volumetrics.** Mix design volumetric equations shall be modified as follows:

**8.1** Additional virgin binder added to offset GTR absorption of binder shall be counted as part of the mix virgin binder

**8.2** GTR shall be included as part of the aggregate when calculating VMA of the mix.

**8.2.1** GTR SPG shall be 1.15

**8.3** Mix  $G_{sb}$  used to determine VMA shall be calculated as follows:

$$G_{sb (JMF)} = \frac{(100 - P_{bmv})}{\left(\frac{P_s}{G_{sb}} + \frac{P_{GTR}}{G_{GTR}}\right)}$$

where:

- $G_{sb (JMF)}$  = bulk specific gravity of the combined aggregate including GTR
- $P_{bmv}$  = percent virgin binder by total mixture weight
- $P_s$  = percent aggregate by total mixture weight (not including GTR)
- $P_{GTR}$  = percent GTR by total mixture weight
- $G_{sb}$  = bulk specific gravity of the combined aggregate (not including GTR)
- $G_{GTR}$  = GTR specific gravity

**8.4**  $G_{se}$  shall be calculated as follows:

$$G_{se} = \frac{(100 - P_b - P_{GTR})}{\left(\frac{100}{G_{mm}} - \frac{P_b}{G_b} - \frac{P_{GTR}}{G_{GTR}}\right)}$$

**8.5**  $P_{be}$  shall be calculated as follows:

$$P_{be} = P_b - \frac{P_{ba}}{100} * (P_s + P_{GTR})$$

**9.0 Minimum GTR Amount.** The minimum dosage rate for GTR shall be 5 % by weight of total binder for an acceptable one bump grade or 10 % by weight of total binder for an acceptable two bump grade as detailed in the following table. Varying percentage blends of GTR and approved additives may be used as approved by the engineer with proven performance and meeting the specified requirements of the contract grade.

Contract Binder Grade	Percent Effective Virgin Binder Replacement Limits	Required Virgin Binder Grade	Minimum GTR Dosage Rate
PG 76-22	0 - 20	PG 70-22	5 %
		PG 64-22	10 %
PG 70-22	0 - 30	PG 64-22	5 %
		PG 58-28	10 %

PG 64-22	0 – 40*	PG 58-28	5 %
		PG 52-34	10 %
PG 58-28	0 – 40*	PG 52-34	5 %
		PG 46-34	10 %

\* Reclaimed Asphalt Shingles (RAS) may be used when the contract grade is PG 64-22 or PG 58-28. RAS replacement shall follow the 2 x RAS criteria when calculating percent effective binder replacement in accordance Sec 401.

**Delete Sec 403.19.2 and substitute the following:**

**403.19.2 Lots.** The lot size shall be designated in the contractor’s QC Plan. Each lot shall contain no less than four sublots and the maximum sublot size shall be 1,000 tons. The maximum lot size shall be 4,000 tons for determination of pay factors. Sublots from incomplete lots shall be combined with the previous complete lot for determination of pay factors. When no previous lot exists, the mixture shall be treated in accordance with [Sec 403.23.7.4.1](#). A new lot shall begin when the asphalt content of a mixture is adjusted in accordance with [Sec 403.11](#).

**Delete Sec 106.9 in its entirety and substitute the following:**

**106.9 Buy America Requirements.**

Buy America Requirements are waived if the total amount of Federal financial assistance applied to the project, through awards or subawards, is below \$500,000.

**106.9.1 Buy America Requirements for Iron and Steel.**

On all federal-aid projects, the contractor’s attention is directed to Title 23 CFR 635.410 *Buy America Requirements*. Where steel or iron products are to be permanently incorporated into the contract work, steel and iron material shall be manufactured, from the initial melting stage through the application of coatings, in the USA except for “minimal use” as described herein. Furthermore, any coating process of the steel or iron shall be performed in the USA. Under a general waiver from FHWA the use of pig iron and processed, pelletized, and reduced iron ore manufactured outside of the USA will be permitted in the domestic manufacturing process for steel or iron material.

**106.9.1.1 Buy America Requirements for Iron and Steel for Manufactured items.**

A manufactured item will be considered iron and steel if it is “predominantly” iron or steel. Predominantly iron or steel means that the cost of iron or steel content of a product is more than 50 percent of the total cost of all its components.

**106.9.2** Any sources other than the USA as defined will be considered foreign. The required domestic manufacturing process shall include formation of ingots and any subsequent process. Coatings shall include any surface finish that protects or adds value to the product.

**106.9.3** “Minimal use” of foreign steel, iron or coating processes will be permitted, provided the cost of such products does not exceed 1/10 of one percent (0.1 percent) of the total contract cost or \$2,500.00, whichever is greater. If foreign steel, iron, or coating processes are used, invoices to document the cost of the foreign portion, as delivered to the project, shall be provided and the engineer’s written approval obtained prior to placing the material in any work.

**106.9.4** Buy America requirements include a step certification for all fabrication processes of all steel or iron materials that are accepted per Sec 1000. The AASHTO Product Evaluation and Audit Solutions compliance program verifies that all steel and iron products fabrication processes conform to 23 CFR 635.410 Buy America Requirements and is an acceptable standard per 23 CFR 635.410(d). AASHTO Product Evaluation and Audit Solutions compliant suppliers will not be required to submit step certification documentation with the shipment for some selected steel and iron materials. The AASHTO Product Evaluation and Audit Solutions compliant supplier shall maintain the step certification documentation on file and shall provide this documentation to the engineer upon request.

**106.9.4.1** Items designated as Category 1 will consist of steel girders, piling, and reinforcing steel installed on site. Category 1 items require supporting documentation prior to incorporation into the project showing all steps of manufacturing, including coating, as being completed in the United States and in accordance with CFR Title 23 Section 635.410 Buy America Requirements. This includes the Mill Test Report from the original producing steel mill and certifications documenting the manufacturing process for all subsequent fabrication, including coatings. The certification shall include language that certifies the following. That all steel and iron materials permanently incorporated in this project was procured and processed domestically and all manufacturing processes, including coating, as being completed in the United States and in accordance with CFR Title 23 Section 635.410.

**106.9.4.2** Items designated as Category 2 will include all other steel or iron products not in Category 1 and permanently incorporated in the project. Category 2 items shall consist of, but not be limited to items such as fencing, guardrail, signing, lighting and signal supports. The prime contractor is required to submit a material of origin form certification prior to incorporation into the project from the fabricator for each item that the product is domestic. The Certificate of Materials Origin form ([link to certificate form](#)) from the fabricator must show all steps of manufacturing, including coating, as being completed in the United States and in accordance with CFR Title 23 Section 635.410 Buy America Requirements and be signed by a fabricator representative. The engineer reserves the right to request additional information and documentation to verify that all Buy America requirements have been satisfied. These documents shall be submitted upon request by the engineer and retained for a period of 3 years after the last reimbursement of the material.

**106.9.4.3** Any minor miscellaneous steel or iron items that are not included in the materials specifications shall be certified by the prime contractor as being procured domestically. Examples of these items would be bolts for sign posts, anchorage inserts, etc. The certification shall read "I certify that all steel and iron materials permanently incorporated in this project during all manufacturing processes, including coating, as being completed in the United States and in accordance with CFR Title 23 Section 635.410 Buy America Requirements procured and processed domestically in accordance with CFR Title 23 Section 635.410 Buy America Requirements. Any foreign steel used was submitted and accepted under minor usage". The certification shall be signed by an authorized representative of the prime contractor.

**106.9.5** When permitted in the contract, alternate bids may be submitted for foreign steel and iron products. The award of the contract when alternate bids are permitted will be based on the lowest total bid of the contract based on furnishing domestic steel or iron products or 125 percent of the lowest total bid based on furnishing foreign steel or iron products. If foreign steel or iron products are awarded in the contract, domestic steel or iron products may be used; however, payment will be at the contract unit price for foreign steel or iron products.

**106.9.6 Buy America Requirements for Construction Materials other than iron and steel materials.** Construction materials means articles, materials, or supplies that consist of only one of the items listed. Minor additions of articles, materials, supplies, or binding agents to a construction material do not change the categorization of the construction material. Upon request by the engineer, the contractor shall submit a domestic certification for all construction materials listed that are incorporated into the project.

- (a) Non-ferrous metals
- (b) Plastic and Polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables)
- (c) Glass (including optic glass)
- (d) Fiber optic cable (including drop cable)
- (e) Optical fiber
- (f) Lumber
- (g) Engineered wood
- (h) Drywall

**106.9.6.1 Minimal Use allowance for Construction Materials other than iron or steel.**

“The total value of the non-compliant products is no more than the lesser of \$1,000,000 or 5% of total applicable costs for the project.” The contractor shall submit to the engineer any non-domestic materials and their total material cost to the engineer. The contractor and the engineer will both track these totals to assure that the minimal usage allowance is not exceeded.

**106.9.7 Buy America Requirements for Manufactured Products.**

Manufactured products means:

- (a) Articles, materials, or supplies that have been:
  - (i) Processed into a specific form and shape; or
  - (ii) Combined with other articles, materials, or supplies to create a product with different properties than the individual articles, materials, or supplies.
- (b) If an item is classified as an iron or steel product, a construction material, or a section 70917(c) material under § 184.4(e) and the definitions set forth in this section, then it is not a manufactured product. However, an article, material, or supply classified as a manufactured product under § 184.4(e) and paragraph (1) of this definition may include components that are construction materials, iron or steel products, or section 70917(c) materials.

**106.9.7.1** Manufactured products are exempt from Buy America requirements. To qualify as a manufactured product, items that consist of two or more of the listed construction materials that have been combined together through a manufacturing process, and items that include at least one of the listed materials combined with a material that is not listed through a manufacturing process, should be treated as manufactured products, rather than as construction materials.

**106.9.7.2** Manufactured items are covered under a general waiver to exclude them from Buy America Requirements. To qualify for the exemption the components must comprise of 55% of the value of materials in the item. The final assembly must also be performed domestically.

***Delete Sec 109.14.1 thru Sec 109.14.8 and substitute the following:***

**109.14.1 Monthly Fuel Index.** Each month, the Monthly Fuel Index will be established as the average retail price per gallon for Ultra Low Sulfur Diesel for the Midwest (PADD 2) area as posted on the first Monday of the month by the U.S. Energy Information Administration (EIA). Should the posted price not be available for any reason, the MoDOT State Construction and Materials Engineer will use reasonable methods, at their sole discretion, to establish the Monthly Fuel Index on an interim basis until the EIA resumes its publication.

**109.14.2 Fuel Adjustment Calculation.**

B = Base Fuel Index = Monthly Fuel Index in the month in which the project was let  
C = Current Index = Monthly Fuel Index in the month in which the work was performed  
U = Units of work performed within the current pay estimate period (applicable pay units)  
F = Total Fuel Usage Factor (gal./applicable pay units)

Fuel Adjustment (Dollars) =  $(C - B) \times U \times F$

**109.14.3** Each pay estimate period, a fuel adjustment payment or deduction will be applied for the quantity of work performed that period on each qualifying pay item. For calculation of the fuel adjustment, work performed on the first day of a month will generally be included with the second estimate in the previous month to keep fuel adjustments in sync with MoDOT's normal payment estimate period schedule. The Commission reserves the right to include work performed on the first day of the month with the current month to accommodate financial accounting termini, such as the beginning of the state and federal fiscal years (July 1 and October 1).

**109.14.4** If the bidder wishes to be bound by these specifications, the bidder shall execute the acceptance form in the proposal. Failure by the bidder to execute the acceptance form will be interpreted to mean election to not participate in the price adjustment for fuel.

Disposal of Blast Media and Paint Residue

**1.0 Description.** Whereas Sec 1081.10 requires delivery of Blast Media and Paint Residue (BMPR) produced from bridge coating activities to The Doe Run Company for recycling, and considering the amount of BMPR produced on all active MoDOT projects statewide at any given point in time may exceed the recycling capacity of Doe Run, this provision allows for an alternate method of disposal of BMPR. The contractor, at its discretion, can choose this disposal option or the Doe Run recycle option, when both are available. When Doe Run is not currently capable or agreeable to accept the BMPR, this alternate disposal option shall be considered mandatory, and at no additional cost to the Commission.

**2.0 Disposal in Landfill.** In lieu of delivery to Doe Run for recycling, BMPR material shall be disposed in the appropriate type of approved landfill, as determined by Toxicity Characteristic Leaching Procedure (TCLP) testing. The material must be TCLP tested to determine if it contains a level of hazardous waste such that requires disposal in a hazardous waste landfill. A sampling plan for testing shall be submitted to MoDOT for review and concurrence. Sampling shall be performed by the contractor. MoDOT will witness the sampling to ensure it is conducted per the plan submitted.

**2.1** The contractor shall submit the collected samples to a qualified third-party testing facility to perform TCLP testing. If the sample indicates that the BMPR material qualifies as hazardous waste, then the materials represented by that sample shall be delivered to a licensed hazardous

waste landfill for disposal. The contractor shall be responsible for hiring a licensed hazardous waste transporter to transport the hazardous waste to the landfill. The contractor shall comply with all applicable laws and regulations for storage and shipping of the hazardous waste material. If the testing indicates that the BMPR material qualifies as a special waste, it shall be taken to a certified landfill for disposal. The contractor shall be responsible for the transportation of the special waste material to the certified landfill. The requirement to ship the BMPR material by barrels will be waived. Any alternate containers utilized shall comply with all applicable laws and regulations for shipping this type of special waste material. Copies of all shipping manifests, landfill disposal agreements, and any other legally required documentation shall be provided to the engineer.

**3.0 Basis of Payment.** No payment will be made for any costs associated with this landfill disposal option, including, but not limited to, sampling, testing, delivery, temporary storage, or disposal fees.

H. Contractor Quality Control NJSP-15-42

**1.0** The contractor shall perform Quality Control (QC) testing in accordance with the specifications and as specified herein. The contractor shall submit a Quality Control Plan (QC Plan) to the engineer for approval that includes all items listed in Section 2.0, prior to beginning work.

**2.0 Quality Control Plan.**

- (a) The name and contact information of the person in responsible charge of the QC testing.
- (b) A list of the QC technicians who will perform testing on the project, including the fields in which they are certified to perform testing.
- (c) A proposed independent third party testing firm for dispute resolution, including all contact information.
- (d) A list of Hold Points, when specified by the engineer.
- (e) The MoDOT Standard Inspection and Testing Plan (ITP). This shall be the version that is posted at the time of bid on the MoDOT website ([www.modot.org/quality](http://www.modot.org/quality)).

**3.0 Quality Control Testing and Reporting.** Testing shall be performed per the test method and frequency specified in the ITP. All personnel who perform sampling or testing shall be certified in the MoDOT Technician Certification Program for each test that they perform.

**3.1 Reporting of Test Results.** All QC test reports shall be submitted as soon as practical, but no later than the day following the test. Test data shall be immediately provided to the engineer upon request at any time, including prior to the submission of the test report. No payment will be made for the work performed until acceptable QC test results have been received by the engineer and confirmed by QA test results.

**3.1.1** Test results shall be reported on electronic forms provided by MoDOT. Forms and Contractor Reporting Excel2Oracle Reports (CRE2O) can be found on the MoDOT website. All required forms, reports and material certifications shall be uploaded to a Microsoft SharePoint® site provided by MoDOT, and organized in the file structure established by MoDOT.

**3.2 Non-Conformance Reporting.** A Non-Conformance Report (NCR) shall be submitted by the contractor when the contractor proposes to incorporate material into the work that does not meet

the testing requirements or for any work that does not comply with the contract terms or specifications.

**3.2.1 Non-Conformance Reporting** shall be submitted electronically on the Non-Conformance Report form provided on the MoDOT Website. The NCR shall be uploaded to the MoDOT SharePoint® site and an email notification sent to the engineer.

**3.2.2** The contractor shall propose a resolution to the non-conforming material or work. Acceptance of a resolution by the engineer is required before closure of the non-conformance report.

#### **4.0 Work Planning and Scheduling.**

**4.1 Two-week Schedule.** Each week, the contractor shall submit to the engineer a schedule that outlines the planned project activities for the following two-week period. The two-week schedule shall detail all work and traffic control events planned for that period and any Hold Points specified by the engineer.

**4.2 Weekly Meeting.** When work is active, the contractor shall hold a weekly project meeting with the engineer to review the planned activities for the following week and to resolve any outstanding issues. Attendees shall include the engineer, the contractor superintendent or project manager and any foreman leading major activities. This meeting may be waived when, in the opinion of the engineer, a meeting is not necessary. Attendees may join the meeting in person, by phone or video conference.

**4.3 Pre-Activity Meeting.** A pre-activity meeting is required in advance of the start of each new activity, except when waived by the engineer. The purpose of this meeting is to review construction details of the new activity. At a minimum, the discussion topics shall include: safety precautions, QC testing, traffic impacts, and any required Hold Points. Attendees shall include the engineer, the contractor superintendent and the foreman who will be leading the new activity. Pre-activity meetings may be held in conjunction with the weekly project meeting.

**4.4 Hold Points.** Hold Points are events that require approval by the engineer prior to continuation of work. Hold Points occur at definable stages of work when, in the opinion of the engineer, a review of the preceding work is necessary before continuation to the next stage.

**4.4.1** A list of typical Hold Point events is available on the MoDOT website. Use of the Hold Point process will only be required for the project-specific list of Hold Points, if any, that the engineer submits to the contractor in advance of the work. The engineer may make changes to the Hold Point list at any time.

**4.4.2** Prior to all Hold Point inspections, the contractor shall verify the work has been completed in accordance with the contract and specifications. If the engineer identifies any corrective actions needed during a Hold Point inspection, the corrections shall be completed prior to continuing work. The engineer may require a new Hold Point to be scheduled if the corrections require a follow-up inspection. Re-scheduling of Hold Points require a minimum 24-hour advance notification from the contractor unless otherwise allowed by the engineer.

**5.0 Quality Assurance Testing and Inspection.** MoDOT will perform quality assurance testing and inspection of the work, except as specified herein. The contractor shall utilize the inspection

checklists provided in the ITP as a guide to minimize findings by MoDOT inspection staff. Submittal of completed checklists is not required, except as specified in 5.1.

**5.1** Inspection and testing required in the production of concrete for the project shall be the responsibility of the contractor. Submittal of the 501 Concrete Plant Checklist is required.

**6.0 Basis of Payment.** No direct payment will be made for compliance with this provision.



**I. Utilities JSP-93-26F**

**1.0** For informational purposes only, the following is a list of names, addresses, and telephone numbers of the known utility companies in the area of the construction work for this improvement:

<u>Utility Name</u>	<u>Known Required Adjustment</u>	<u>Type</u>
AT&T Andy Erickson 33 Fitzgerald Camdenton, MO Phone: 636-925-3787 Cell: 314-223-2966 Email: <a href="mailto:Andrew.r.erickson@att.com">Andrew.r.erickson@att.com</a>	Yes  See 3.0	Communications
Three Rivers Electric Cooperative Ted Neuner 1324 E Main St Linn, MO 65051 Phone: 573-644-9000 Email: <a href="mailto:tneuner@threeiverselectric.com">tneuner@threeiverselectric.com</a>	Yes  See 4.0	Electric
Osage County PWSD3 15 Co Rte 305 Linn, MO 65051 Scott Strobe Phone: 573-690-5903 Email: <a href="mailto:strobebackhoeservice@outlook.com">strobebackhoeservice@outlook.com</a>	Yes  See 5.0	Water
City of Linn Derek McCubbin 1200 E Main St, PO Box 498 Phone: 573-645-5208 Linn City Hall Phone: 573-897-2236 Email: <a href="mailto:derek@cityoflinn.com">derek@cityoflinn.com</a>	None	Sewer

Ameren Missouri Tammy Kolb 1310 Industrial Dr. Jefferson City, MO 65109 Phone: 314-861-5114 Email: <a href="mailto:tkolb@ameren.com">tkolb@ameren.com</a>	Yes  See 6.0	Electric
Cable America Eric Wyant 11422 Schenck Dr Maryland Heights, MO 63043 Phone: 573-647-0598 Email: <a href="mailto:eric.wyant@fidelitycommunications.com">eric.wyant@fidelitycommunications.com</a>	Yes  See 7.0	Communications
Sho-Me Technologies Brad Baker PO Box D Marshfield, MO 65706 Phone: 417-536-3067 Email: <a href="mailto:bbaker@shometech.com">bbaker@shometech.com</a>	Yes  See 8.0	Communications

**1.1** The existence and approximate location of utility facilities known to exist, as shown on the plans, are based upon the best information available to the Commission at this time. This information is provided by the Commission "as-is" and the Commission expressly disclaims any representation or warranty as to the completeness, accuracy, or suitability of the information for any use. Reliance upon this information is done at the risk and peril of the user, and the Commission shall not be liable for any damages that may arise from any error in the information. It is, therefore, the responsibility of the contractor to verify the above listing information indicating existence, location and status of any facility. Such verification includes direct contact with the listed utilities.

**2.0** Project Specific Provisions: The Contractor shall be aware there are numerous utilities present within the project limits.

**3.0 AT&T**

AT&T advised they have underground facilities within the project limits. AT&T advised they have a handhole and buried facilities (~STA 681+94.14 RTE 50 & STA 1+67.26 RTE CC) that are impacted by the road project. AT&T advised they plan to relocate their facilities inside the new northern R/W line. AT&T's contractor (Star Construction) plans to mobilize on site one week after Three Rivers Electric Coop. completes their relocation work in order to allow their contractor to mobilize on site and commence with AT&T's relocation work. AT&T's relocation is shown on the contract plans. AT&T advised they will plan to complete their relocation work within four (4) weeks after Star Construction commences work. AT&T advised they are scheduled to complete their work by May 24, 2024

#### 4.0 Three Rivers Electric Cooperative

Three Rivers Electric Cooperative advised they have underground and aerial utilities within project limits. Three Rivers Electric Cooperative advised they have electric lines and junction boxes to be relocated inside new north R/W (~STA 680+00 to STA 685+50 Route 50). Three Rivers Electric Cooperative advised their subcontractor in combination with Three Rivers Electric Coop field staff plan to complete all of their relocation work impacted by the road project within two (2) weeks of commencing work. AT&T advised they plan to complete all of their relocation work by April 19, 2024.

#### 5.0 Osage County PWSD #3

Osage County PWSD #3 have various relocations required along north side of Route 50. All of Osage County PWSD3 relocations are included in the project plans (see Water Main Relocation JSP). Osage County PWSD #3 has retained Bartlett and West to provide design plans for the work and they will perform construction inspection for MoDOT. **The contractor is advised Public Water Supply District #3's watermain relocation work is critical to commence as a first order of work, prior to any proposed roadwork located on the north side of the project limits.** It should be noted that some of the relocation work will require coordination during installation of new facilities. Any questions and concerns related to the relocation of watermain facilities should be directed to Terris Cates, Senior Project Manager, Bartlett & West ([terris.cates@bartwest.com](mailto:terris.cates@bartwest.com)).

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#### 6.0 Ameren Missouri

Ameren has various aerial lines power poles and guy poles to relocate within the project limits (~STA 687+96.78 to STA 703+10 Route 50). Ameren advised they plan to have all relocation work complete before the road contractor's NTP date (June 13, 2024).

#### 7.0 Cable America

Cable America has communications underground coaxial and fiber in two areas of conflict within project limits. Cable America advised the following: Conflict #1: Cable America will wreck out abandoned line on west side of Route CC and relocate to east side of Route CC to avoid proposed storm sewer structures (STA 1+67.26 RTE CC). Conflict #2: Cable America will rebury the line under the North Outer Drive to 3' minimum depth. Cable America advised their relocations are schedule to be complete by March 29, 2024.

#### 8.0 Sho-Me Technologies

Sho-Me Technologies advised they have various conflicts within the project limits involving buried fiber and hand holes. Sho-Me Technologies advised they plan to relocate the underground fiber cable to the back of the new MoDOT R/W line between ~STA 681+15 and 703+20. Sho-Me plans to start their relocation work one week after Three Rivers Cooperative and AT&T completes their relocation work. Sho-Me advised they only have two (2) weeks of work to complete their relocations. Sho-Me advised they plan to complete their work a week by June 13, 2024 (date of road contractor's NTP).

### J. Access to Commercial and Private Entrances

**1.0 Description.** While working on entrances or adjacent properties, the contractor shall make every reasonable effort to minimize any interference to the properties and to complete the work diligently. Under no circumstances shall the contractor block ingress/egress to and from businesses during the normal business hours of each business unless as approved by the property owner and engineer.

**2.0 Construction Requirements.** On all entrances, the contractor shall keep one-half of the entrance open at all times. On narrow entrances it may be necessary for the contractor to provide temporary aggregate to provide access to the property. The contractor shall remove and dispose of the temporary aggregate following completion of the entrance. For properties with more than one entrance the contractor may construct one entire entrance at a time with the approval of the property owner and the engineer.

**3.0 Basis of Payment.** No direct payment will be made to the contractor for any expenses incurred for compliance with this provision.

K. Property Owner Notification

**1.0 Description.** It shall be the contractor's responsibility to inform and notify the adjacent property owner 48 hours prior to starting any construction activities that may impact driveway and parking lot access or occur along the frontage of the property owner's parcel. Notification shall be in written form and include the contractor's contact information, the Engineer's contact information, and an estimated schedule of work and the associated impacts.

**2.0 Basis of Payment.** No direct payment will be made to the contractor for the labor, equipment, material, or time required to comply with this provision.

L. Removal and Delivery of Existing Signs JSP-12-01C

**1.0 Description.** All Commission-owned signs removed from the project shall be disassembled, stored, transported, and disposed of as specified herein. Sign supports, structures and hardware removed from the project shall become the property of the contractor.

**2.0 Disassembly and Delivery.**

**2.1** All Commission-owned signs, (excluding abandoned billboard signs), designated for removal in the plans, or any other signs designated by the Engineer, shall be removed from the sign supports and structures, disassembled, stored, transported, and delivered by the contractor to the recycling center for destruction.

**2.2** The contractor shall coordinate and make arrangements with the recycling center for delivery of the signs. Sign panels shall be disassembled and/or cut into sizes as required by the recycling center.

**2.3** The contractor shall provide the Engineer with a "Sign Delivery Certification" attesting to completion of delivery of all existing sign material from the project to the recycler. In addition, the contractor shall provide to the Engineer a final "Sign Certification of Destruction" from the recycler that documents the total pounds of scrap sign material received from the project and attests that all such material will not be re-purposed and will be destroyed in a recycling process. The contractor can locate the required certification statements from the Missouri Department of Transportation website:

<https://www.modot.org/forms-contractor-use>

**2.4** Funds received from the disposal of the signs from the recycling center shall be retained by the Contractor.

**3.0 Basis of Payment.** All costs associated with removing, disassembling and/or cutting, storing, transporting, and disposing of signs shall be considered as completely covered by the contract unit price for Item No. 202-20.10, "Removal of Improvements", per lump sum.

M. Concrete Tinting

**1.0 Description.** This work shall consist of coloring the concrete truck apron as specified in the plans.

**2.0 Full Depth Colored Concrete Material – Truck Aprons**

Coloring of full depth concrete material for truck aprons shall be performed using one of the following approved coloring systems, or an equivalent approved by the engineer, or in accordance with the manufacturers recommendations:

- a.) Stampcrete Integral Color, SC-21 Brick Red
- b.) Solomon Colors SGS Integral Colors, 417 Brick Red
- c.) Davis Colors Integral Color, 160 Brick Red

**3.0 Sample.** A minimum of 10 working days prior to the placement of the colored concrete, the contractor shall submit a sample of the colored concrete section to the engineer. The sample shall be constructed using the identical process for coloring the concrete. If, in the opinion of the engineer, changes need to be made to the color, a new sample shall be submitted before final approval will be given. The minimum size sample shall be 2 ft. by 2 ft. No direct pay will be made for providing this sample, regardless of the number of samples required by the engineer in order to achieve the desired surface and color of the concrete.

**5.0 Basis of Payment.**

Payment for full depth coloring of the 8 inch concrete apron, including all materials, equipment, labor, and any other incidental work necessary to complete this item shall be considered as completely covered by Item No. 502-99.05, Misc Concrete Truck Apron, 8" per square yard.

N. Culvert Extension

**1.0 Description.** This work shall consist of extending the reinforced box culvert at station 696+99.81 on the upstream end to accommodate roadway widening.

**2.0 Material Requirements.** All materials shall comply with the Missouri Standard Specifications for Highway Construction as referenced in sections 703, 706, and 501.

**3.0 Construction Requirements.** This work shall consist of all work to extend a single reinforced box culvert, including a Class B-1 concrete, reinforcing steel, excavation, granular backfill, and any other work necessary to extend the box culvert.

**3.1** All work shall be done in accordance with the following standard drawings:

- 703.10J, Concrete Single Box Culvert – Straight Wings (Squared);
- 703.38A, Concrete Box Culvert – Cutting Details;
- Other referenced standard drawings

**4.0 Method of Measurement.** No final measurement shall be made.

**5.0 Basis of Payment.** Payment for all labor, equipment, and materials necessary to install the culvert extension shall be made and considered completely covered by the contract unit price bid for:

Item Number	Unit	Description
703-99.01	LS	Misc. Culvert Extension

O. Microwave Radar Detection

**1.0 Description.** This work shall consist of providing microwave radar detectors for signalized installations that will support both stop bar advance detection for high speed approaches to signalized intersections as shown in the plans. The radar units shall additionally include an integral full color camera able to stream video and detection data to local and remote monitors. The video component shall not be used for actuation of stop bar or advance detection zones. Detectors shall be in accordance with the Missouri Standard Specifications for Highway Construction (latest version) and installed to provide detection at locations as shown on the plans or as directed by the Engineer in accordance with Section 902. If any information conflicts between Section 902 and this JSP, the JSP shall supersede.

**2.0 Detector Zones.** For each advanced detection zone, the following zones shall be configured:

- Stop Bar (as shown in the plans)
- Dilemma Zone
- Advance Data Collector

**2.1 Dilemma Zones.** Dilemma zone detection shall be required for the following approaches for high speed dilemma zone detection:

- Eastbound and Westbound US 50 at Route CC
- Eastbound and Westbound US 50 at Technology Drive

**3.0 Installation Requirements.** Provide, install and test the radar detection units and cabinet interface to detect stop bar, dilemma zone, and data collector function. This specification sets forth the provisions for a radar detection system that detects vehicles, pedestrians, bicycles, and motorcycles on roadways approaching the signalized intersections included in the project. The radar detection system shall include the following features:

- Shall be able to configure up to 32 detection zones per sensor.
- Shall be able to operate in a temperature range between -30 degrees F and 165 degrees F
- The radar sensor shall be forward fire
- The sensor shall operate in the 24 GHz band
- The sensor shall be housed in a sealed IP-67 enclosure

- The housing shall allow the radar to be adjusted to allow proper alignment between the sensor and the traveled road surface
- The radar sensor shall have the ability to track up to 64 independent objects simultaneously with a speed detection range of 0 to 150 miles per hour +/- 1.0 miles per hour
- The video camera imbedded within the radar sensor unit shall have the following features:
  - The camera shall produce a useable video image of the features of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 0.003 lux to 10,000 lux.
  - The camera imager luminance signal to noise ratio (S/N) shall be more than 50 dB with the automatic gain control (AGC) disabled.
  - The camera imager shall employ three dimensional dynamic noise reduction (3D-DNR) to remove unwanted image noise.
  - The camera imager shall employ wide dynamic range (WDR) technology to compensate for wide dynamic outdoor lighting conditions. The dynamic range shall be greater than 100 dB.
  - The camera shall be digital signal processor (DSP) based and shall use a CCD sensing element and shall output color video with resolution of not less than 540 TV lines. The color CCD imager shall have a minimum effective area of 811(h) x 508(v) pixels.
  - The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter. The electronic shutter shall operate between the range of 1/60th to 1/90,000th second.
  - The camera shall utilize automatic white balance.
  - The camera shall include a fixed focal length lens with fixed focus.

#### **4.0 Power and Communications.**

- Power and communications cabling shall be installed per manufacturer specifications
- The radar sensor shall operate at 48 VDC powered by a single outdoor-rated CAT5E cable connected to a power over ethernet conversion unit located in the signal cabinet
- Shielded RJ-45 connectors shall be used for connection of various hardware components of the detector system
- The ethernet cable shall convey power, communications, and video for a distance up to 1,000 feet
- Power consumption shall be 8 watts during typical operation
- SDLC Functionality - The system shall have the capability of monitoring phase information and passing that information and other system data such as "time" from the controller to radar detection processor modules. The system shall also accept data from radar processor modules and relay the information to the controller. The unit shall provide a maximum of 64 detector outputs to the controller via the SDLC interface. The interface to the controller shall be accomplished by the use of the TS-2 SDLC port and protocol in accordance with the TS-2 specifications. The module shall be able to be configured to respond to BIU addresses 8, 9, 10 and 11 or a combination thereof. One LED indicator shall be provided for the TS-2 SDLC interface. The indicator shall be used to inform the user of any communication activity on the SDLC port.

**4.1 Contact Closure Card.** Contact closure outputs shall be provided. Four (4) contact closure outputs shall be provided for the radar sensor processor in a rack-mount configuration. Additionally, the system shall allow the use of extension modules to provide up to 32 open contact closures per radar sensor input. Each contact closure output shall be capable of sinking 30mA at 24VDC. Open contact closure outputs will be used for vehicle detection indicators as well as discrete outputs for alarm conditions. The processor outputs shall be compatible with NEMA standard detector racks assignments and installed per the manufacturer specifications.

**4.2 Lightning Surge Protection.** The radar detection system shall include surge protection hardware installed per manufacturer specifications. The hardware shall be accepted by the engineer before installation in the cabinet. Surge protection shall be provided for both input power and power connection to each sensor unit.

**5.0 Sensor Software.** The radar detection system software shall meet the following requirements:

- Detection zones shall be programmed via an embedded application displayed on a video monitor and a keyboard and a pointing device connected to the central control unit for the system. The menu shall facilitate placement of detection zones and setting of zone parameters or to configure system parameters. A separate computer shall not be required for programming detection zones or to view system operation. All programming function shall occur on live video images; no snapshots or still images are allowed.
- The sensor system software shall store up to five completely independent detection zone patterns in non-volatile memory. The system can switch to any one of the five different detection patterns within 1 second of user request via menu selection with the pointing device. Each configuration shall be uniquely labeled and able to be edited by the user for identification. The currently active configuration indicator shall be displayed on the monitor.
- The system shall detect vehicles in real time as they travel across each detection zone.
- The system shall accept new detection patterns from an external, or remote, computer through the Ethernet port when the external computer uses the correct communications protocol for downloading detection patterns. A Windows™-based software designed for local or remote connection and providing video capture, real-time detection indication and detection zone modification capability shall be provided with the system.
- The system shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.
- The system shall send its detection patterns to an external computer through the Ethernet port when requested when the external computer uses the appropriate communications protocol for uploading detection patterns.
- The system shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference or loss of the radar signal.
- The system shall default to a safe condition, such as a constant call on each active detection channel, in the event of environmental conditions impeding the radar sensor performance.
- Up to 32 detection zones per sensor input shall be supported and each detection zone must be user-sizeable to suit the site and the desired vehicle detection region.
- A single detection zone shall be able to replace multiple inductive loops and the detection zones shall be OR'ed as the default or may instead be AND'ed together to indicate vehicle presence on a single approach of traffic movement.
- When a vehicle is detected within a detection zone, a visual indication of the detection shall activate on the radar overlay display to confirm the detection of the vehicle for the zone.

- Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, sensor placement, and detection zone location, and these accuracy levels do not include allowances for occlusion due to sensor location.
- The system shall provide dynamic zone reconfiguration (DZR). DZR sustains normal operation of existing detection zones when one zone is being added or modified during the setup process. The new zone configuration shall not go into effect until the configuration is saved by the operator.
- Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.
- The system shall process the radar signals from each sensor at 75mS intervals. Multiple processors shall process all radar signals simultaneously.
- The system shall process the video input from each camera at 30 frames per second. Multiple processors shall process all video inputs simultaneously.
- Detection zone outputs shall be individually configurable to allow the selection of presence, pulse, extend, and delay outputs. Timing parameters of pulse, extend, and delay outputs shall be user definable between 0.1 to 25.0 seconds.
- Up to eight (8) detection zones per sensor view shall have the capability to count the number of vehicles detected. The count value shall be internally stored for later retrieval through the Ethernet port. The zone shall also have the capability to calculate and store average speed and lane occupancy at user-selectable bin intervals of 10 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes and 60 minutes.
- In addition to the count type zone, the system shall be able to calculate average speed and lane occupancy for all of the zones independently. These values shall be stored in non-volatile memory for later retrieval.
- The system shall employ color overlays on the video output.
- The system shall have the ability to show controller phase status (green, yellow, or red) for up to 8 phases. These indications shall also be color coded.
- The user shall have the ability to enable or disable the display of the phase information on the radar output.
- The system shall have the capability to change the characteristics of a detection zone based on external inputs such as signal phase. Each detection zone shall be able to switch from one zone type (i.e. presence, extension, pulse, etc.) to another zone type based on the signal state. For example, a zone may be a “count” zone when the phase is green but change to a “presence” zone type when the phase is not green. Another application would be zone type of “extension” when the signal phase is green and then “delay” when red.
- The system shall have the capability to control the output of each zone based on a minimum or maximum speed. The minimum speed can be set from 0 mph (0 kph) to 249 mph (400 kph). The maximum speed can be set between 1 mph (1 kph) to 250 mph (402 kph).
- The system software shall aid the user in drawing additional detection zones by automatically drawing and placing zones at appropriate locations with only a single click of the mouse. The additional zone shall utilize geometric extrapolation of the parent zone when creating the child zone. The process shall also automatically accommodate lane marking angles and zone overlaps.
- When the user wishes to modify the location of a zone, the system software shall allow the user move a single zone, multiple zones or all zones simultaneously.

- When the user wishes to modify the geometric shape of the zone, the system software shall allow the user to change the shape by moving the zone corner or zone sides.
- The system shall display the actual pitch angle as reported by the radar sensor.
- The system shall display the actual roll angle as reported by the radar sensor.
- On screen zone identifiers shall be modifiable by the user. The user shall be allowed to select channel output assignments, zone type, input status, zone labels or zone numbers to be the identifier.
- This section sets forth the minimum requirements for the system to provide a single point interface to remote and local users. The system shall also have the capability to stream up to four simultaneous video streams over an Ethernet interface.
- The user interface shall provide capabilities to enable multiple rack-mounted radar detection processors to be locally and remotely accessed from a single point via an Ethernet connection.
- The device shall allow the operator to view four videos simultaneously or any one video by controls embedded in the system. The on-screen display for the video stream shall provide the user with information on real-time detection per zone and signal phasing information in a user-friendly format. If the end-user is utilizing Siemens M50 or M60 controllers, additional functionality shall be provided to be compatible with the Siemens phase data I/O.
- Local user access to detection programming shall be limited to the detection processor unit that is currently being displayed on the monitor.
- All local programming and setup parameters for the detection processor shall be user accessible through the interface unit without requiring the user to swap user interface cables between video detection processors.
- Remote access to the device shall be through the built-in Ethernet port via access software running on a Microsoft Windows based personal computer.
- A Windows OS remote access firmware shall also be available for remote setup and diagnostics of the interface unit.
- The system shall support streaming video technology using H.264 standards to allow the user to monitor video detection imagery over the Ethernet interface. Motion JPEG streaming video shall not be allowed.
- The interface unit shall allow four independent streams, two from each video processor, to be transported via Ethernet to four independent streaming video players simultaneously in D1 resolution.
- The interface unit shall support the streaming and display of four concurrent streams in D1 resolution.
- The interface shall allow the user to change the unit's Ethernet network settings of IP address, subnet mask and default gateway.
- The system shall allow the user to upload new application firmware through the use of the interface, remotely or on-site.
- In addition to the primary system setup and control software, a separate Windows OS based software shall be provided that will allow users to remotely view video streams from any system configured and setup from their network. This software will allow users to view live video streams in a 2x2 or 3x3 configuration, and allow users to group any number of individual system units in the field into unique groups.
- An iOS and Android based application will be provided to remotely view video streams from the system. This application shall allow the user to choose between any number of pre-configured intersection locations. The live video from any cameras at that location will be viewable on an iOS product, including the vehicle and bicycle detections occurring in real-time.

## **6.0 Construction Requirements.**

**6.1 Mounting Location.** All mounting hardware shall be installed per manufacturers specifications. The sensor unit shall be mounted as follows:

- At a height between 21 feet and 33 feet from the roadway grade directly below the sensor unit. Exact heights shall be determined by the contractor as part of testing to confirm data quality and functionality described in this specification and noted in the plans.
- The radar units shall be mounted over the center of the receiving lanes for each approach to allow for up to 600 feet detection upstream from the sensor units.
- in a forward-fire position, looking towards either approaching or departing traffic.

The preferred mounting location for each approach is shown in the plans. The contractor may adjust location if needed due to constraints with cabling, mounting or optimal detection view. Radar mounting location adjustments shall be approved by the Engineer prior to installation.

**6.2 Card Rack Interface.** Install the contact closure card in the card rack and configure based on manufacturer's instructions to provide all needed detection outputs. Any power supply cards for the induction card rack needed for proper operation of the radar units or associated processor hardware shall be provided and installed by the contractor.

**6.3 Support.** A factory certified representative from the supplier shall be available for on-site assistance for a minimum of one day during installation and shall provide up to one (1) day of local training after the radar detector systems have been installed and are operational.

**6.4 Acceptance Testing.** The contractor shall develop a proposed test procedure for the radar detection units and submit it to the Engineer for approval. It must include visual verification of vehicle detections being received, and verification of dilemma zone detection and outputs to a 98% level of accuracy. Count data logs shall be verified at a 95% level of accuracy. Each detector shall be tested separately. Revise the proposed test procedure until it is acceptable to the Engineer. Provide all equipment and personnel needed to safely conduct the tests. Arrange for the Engineer's representative to witness the tests. Provide the Engineer a report documenting the result of the tests.

## **7.0 Documentation.**

**6.1** Prior to purchasing the sensor system, the contractor shall submit a PDF of catalog cut sheets and the IP67 environmental testing results to the Engineer for approval.

**6.2** The contractor shall provide one copy of the operation and maintenance manuals for the sensor system to be stored in the cabinet, as well as an electronic PDF version.

**6.3** Contractor shall provide one copy of the software and any cables needed to interface with the system.

**8.0 Construction Requirements.** Construction requirements shall conform to Sec 902.

**9.0 Method of Measurement.** Method of measurement shall conform to Sec 902.

**10.0 Basis of Payment.** Measurement and payment for work covered by this specification shall include all equipment, materials, tools, labor, programming, testing, and documentation necessary to provide a complete radar detection system per intersection and shall be paid at the contract unit price as follows:

Item No.	Type	Description
902-49.65	Each	Detector, Microwave

P. Fiber Optic Cable and Connections

**1.0 Description.** This work shall consist of installing, splicing and terminating fiber optic cables. All work and materials shall comply with Section 902.12.6 of standard specs as modified by the following.

**2.0 Materials.** Fiber optic cable shall be of loose tube construction. Provide certification by an independent testing laboratory that the cable meets all requirements of Rural Utilities Service Bulletin 1753F-601a *Minimum Performance Specification for Fiber Optic Cables* ([http://rurdev.sc.egov.usda.gov/SupportDocuments/UTP\\_Bulletins\\_175\\_3F-601a.pdf](http://rurdev.sc.egov.usda.gov/SupportDocuments/UTP_Bulletins_175_3F-601a.pdf)). The cable shall be gel free, all dielectric, and have 12 fibers per tube. The cable sheath shall have length markings in feet and shall indicate that the unit of measure is feet. The cable shall have single mode fibers whose attenuation does not exceed 0.35 dB/km and 0.25 dB/km for 1310 nm and 1550 nm signals, respectively. The cable shall have a short-term tensile rating of at least 600 lbs. The cable shall have an operating temperature range of -40° C to 70° C. The cables shall be constructed with 12 fibers per tube, 6 tubes per cable (72 SMFO), or 12 fibers per tube, 4 tubes per cable (48 SMFO), or 12 fibers per tube, two tubes per cable (24 SMFO), or as 12 fibers per tube, one tube per cable (12 SMFO)

**2.1 Connectors** shall be ST compatible, with ceramic ferrules. They shall be suitable for use in traffic cabinets and shall be designed for single mode fibers.

**2.2 Pigtail.** Pigtails shall be factory-made, buffered, and strengthened with aramid yarn to reduce the possibility that accidental mishandling will damage the fiber or connection. Pigtails shall be yellow. They must use the type of connector specified in Sec 2.2 of this provision. Each must contain one fiber. Length shall suffice to provide two feet of slack after installation. No direct payment for pigtails will be made and will be subsidiary to cabinet and fiber bid items.

**2.3 Jumper.** Jumpers shall meet the requirements for pigtails but shall have a connector on each end. The second connector shall be as specified in Sec 2.2 of this provision except where a different connector is required for compatibility with the equipment to which the jumper connects. Length shall suffice to provide approximately five feet of slack after installation. Jumper cables contain a pair of fibers. Quantities shown in the plans for fiber optic jumpers were estimated to the best knowledge of the design engineer and have a built-in 20% contingency.

**2.4 Splice Trays or Cassettes.** Contractor shall be responsible to provide splice trays or cassettes that allow field connection of terminations as shown in the plans. Splice trays shall be aluminum with clear plastic covers, designed for outdoor use. Each tray shall accommodate 24 fusion splices. The trays shall have a black powder coat finish. The trays shall have both perforations for cable ties and crimp able metal tabs for buffer tube strain relief. No direct payment will be made for splice trays or cassettes and will be subsidiary to cabinet and fiber bid items.

**2.5 Rack-Mounted Interconnect Center.** An interconnect center is an Equipment Cabinet that has a patch panel built into one of its walls. Within the interconnect center, fibers in cables are spliced to pigtails and the pigtails are plugged into the patch panel from the inside. This allows jumper cables (not part of the interconnect center) to plug into the patch panel from the outside, connecting the fibers to equipment in the cabinet or to other fibers on the patch panel. Within an interconnect center, some fibers may be spliced to the corresponding fiber in a mating cable, rather than to a pigtail. Other fibers may be coiled, unterminated. The enclosure shall have brackets and all other hardware required for rack mounting in an EIA standard 19-in. equipment rack. It shall take up no more than three rack units (1¾ inch each) in the cabinet. It shall have front and rear doors. It shall be made of powder-coated aluminum. The enclosure shall hold at least four splice trays or cassettes meeting the requirements of Sec 2.5 of this provision. Contractor shall provide enough trays for all splices made in the interconnect center. The enclosure's patch panel shall have at least 48 positions or as indicated on the plans, compatible with the connectors specified in Sec 2.2 of this provision. It shall have provisions for cable strain relief and for connector labeling.

**2.6 Wall-Mounted Interconnect Center.** The enclosure shall be designed for wall or panel mounting and occupy no more than 350 square inches of wall space. It shall be made of powder coated aluminum and have a gasketed, hinged door. It shall have provisions for cable strain relief and connector labeling. Enclosure shall be a Corning WCH-04P or pre-approved equal. It shall have a patch panel that holds 4 panels or more as indicated on the plans, compatible with the connectors specified in Sec 2.2 of this provision. It shall accommodate at least six splice trays or cassettes as specified in Section 2.5 of this provision and shall be equipped with enough trays for all the splices made in the interconnect center.

**3.0 Certifications.** The fiber optic cable shall be factory certified to meet the requirements in this specification. In addition, the manufacturer shall certify that the fiber optic cable has a life expectancy of 20 years.

**4.0 Documentation.** Provide the Engineer with a copy of the final as-built documentation in Visio and/or MicroStation formats and any relevant notes that would aid in the understanding of the fiber configuration.

## **5.0 Construction Requirements.**

**5.1 Cable Installation.** Prior to installation, perform such tests as indicated in Sec 3.6 of this provision to confirm that the cable is in good condition and complies with the specifications. Any defects found after installation will be deemed the fault of the contractor. Install the cable such that the optical and mechanical characteristics of the fiber are not degraded. Do not violate the minimum bend radius or the maximum tension, both during and after installation. Before any cable installation is performed, provide the Engineer with four copies of the cable manufacturer's recommended maximum pulling tensions for each cable size. These pulling tensions shall be specified for pulling from the cable's outer jacket. Also, provide a list of the minimum allowable cable bending radius and the cable manufacturer's approved pulling lubricants. Only those lubricants approved by the cable manufacturer will be permitted. If the cable is pulled by mechanical means, use a clutch device to ensure the allowable pulling tension is not exceeded. Also, attach a strain gauge to the pulling line at the cable exit location, and at a sufficient distance from the take-up device, such that the strain gauge can be read throughout the entire cable pulling operation. Do not leave the let-off reel unattended during a pull, in order to minimize the chance of applying excess force, center pull, or back feeding. Use

an approved lubricant, in the amount recommended by the cable manufacturer, to facilitate pulling the cable. After the cable has been installed, wipe the exposed cable in a pull box, junction box, or field terminal cabinet clean of cable lubricant with a cloth before leaving the pull box, junction box, or cabinet. In each intermediate pull box, store a minimum of 50 feet of slack fiber optic cable for each cable that passes through the pull box. Store slack cable neatly on the walls of the pull box using racking hardware acceptable to the Engineer. Additional slack cable that is included in the pay quantity includes 50 LF of each cable at a splice point within the agency fiber pull box. Seal the fiber optic cable ends to prevent the escape of the filling compound and the entry of water. Label every cable immediately upon installation. Label the cables at every point of access, including junction boxes, pull boxes, and termination points. Use self-laminating vinyl labels at least 1.5" wide and long enough that the translucent portion of the label completely covers the white area bearing the legend. The vinyl shall have a layer of pressure sensitive acrylic adhesive. The labels shall resist oil, water, and solvents and shall be self-extinguishing. The legend shall be machine printed in letters at least 3/32" high. Consult with the Engineer concerning the desired method of identifying each cable. Labeling cables is incidental to the installing the cable and will not be paid separately.

**5.2 Splicing.** Splice all optical fibers, including spares, to provide continuous runs. Splices shall be allowed only in equipment cabinets and splice enclosures except where shown on the plans. Make all splices using a fusion splicer that automatically positions the fibers using either the Light Injection and Detection (LID) system or the High-resolution Direct Core Mounting (HDCM) system. Provide all equipment and consumable supplies. Secure each spliced fiber in a protective groove. Completely re-coat bare fibers with a protective room temperature vulcanizing (RTV) coating, gel or similar substance, prior to insertion in the groove, so as to protect the fiber from scoring, dirt or micro bending. Prior to splicing to a fiber installed by others, measure and record the optical loss over that fiber. See Sec 3.6 of this provision. Use a different splice tray for each buffer tube color. If an enclosure contains multiple buffer tubes of the same color, but none of the fibers in one of the tubes are spliced to fibers in other tubes of the same color, use a separate splice tray for that tube. Splicing quantities were estimated to the best of the design engineer's knowledge and the quantity listed in the plan quantities has a built in 20% contingency.

**5.3 Terminations.** Terminate fibers by splicing them to factory-made pigtailed. Cap all connectors that are not connected to a mating connector. If the existing termination panel does not have the capacity to conform to the project documents and specifications, it is the contractor's responsibility to replace or expand the termination panel at no additional cost to the project.

**5.4 Jumper Management.** Use spiral wrap to guide and protect bundles of jumpers between the patch panel and equipment. Affix the spiral wrap to the wall of the field terminal cabinet or vertical member of the rack. Label the jumpers at each end, numbering them sequentially.

**5.5 Hardened Ethernet Switch – Commission Furnished, Contractor Installed.** The Contractor shall install layer 2 ethernet switches, power supplies, and mounting hardware furnished by the Commission. Miscellaneous cabling and hardware necessary to install the ethernet switches and connect to various signal hardware and grounding buses shall be the responsibility of the Contractor. The ethernet switches will be programmed by the Commission. The Contractor shall provide at least two (2) weeks notice of intent to install the ethernet switches, and coordinate pick up of the ethernet switch hardware from the Commission facility. Upon connection to the existing ethernet switch in the maintenance facility adjacent to the project, the Contractor shall have personnel available in the field to assist the Commission in

connectivity testing to the ethernet switches and other networked devices within the project area.

## 6.0 Acceptance Testing

6.1 **General.** Test the fiber after installation, including all splicing and terminations. For each fiber optic link terminated at the field terminal cabinet patch panels, determine whether the optical loss is within the limits permitted by these specifications. A link is a continuous segment of fiber between one connector (or unterminated end) and another connector (or unterminated end).

Test Procedure. For each fiber link, follow this procedure:

- For each fiber link, the Contractor shall test one fiber strand per each tube of the fiber cable. If any individual fiber in a tube is found to be broken or nonfunctioning, the Contractor shall test at a minimum two (2) additional random fibers from the same tube to confirm that the fiber acceptance issue is not widespread. If additional fibers in tube are found to be deficient, corrective measures, including replacement of the cable through the identified trouble segment, may be required at the Engineer's discretion, at no additional cost to the project.
- Calculate the maximum allowable losses for the contractor installed fiber link, both at 1310 nm and at 1550 nm. Use the following formula:
  - Maximum link loss = (Fiber length in km) x (0.35 for 1310 nm and 0.25 for 1550 nm)
  - + (Number of fusion splices) x (0.05)
  - + (Number of mechanical splices [for temp. connection]) x (0.3)
  - + (Number of connections) x (0.5)
- Provide this calculation to the engineer along with the test results
- Provide the engineer documentation that the optical time domain reflectometer to be used in testing has been calibrated and is working properly.
- Use an optical time domain reflectometer to assess the losses along the contractor furnished and installed fiber paths. Record the result at both 1310 nm and 1550 nm. Arrange for the engineer or his representative to witness these tests.
- Use an optical time domain reflectometer and other test equipment to troubleshoot the link. Take whatever corrective action is required, including cable replacement, to achieve a loss less than the calculated maximum.

Test Result Documentation. Contractor shall prepare a line diagram showing each of the fiber links and the individual strands tested in this project. For the cables installed in this project, preparer shall show the field terminal cabinets, splices, and pigtailed. On each line representing a link or fiber strand, show the maximum allowable loss and the actual loss. The actual loss shall be the one measured after all corrective actions have been taken. Submit this diagram to the Engineer, along with the calculations for the maximum allowable loss. Submit the diagrams and calculations in an electronic format acceptable to the Engineer.

## 7.0 Basis of Payment

Measurement and payment for items covered by this specification include the documentation and acceptance testing, in addition to all materials and equipment necessary for a fully operational system.

Payment for the following bid items will be made as follows:

Item No.	Type	Description
910-83.54	LF	Fiber Optic Cable, 48-Strand, Single Mode
910-99.02	Each	Fusion Splice, Single Mode
910-99.02	Each	Fiber Optic Pigtail, Single Mode
910-99.02	Each	Fiber Optic Jumper, Single Mode
910-99.02	Each	Rack-Mounted Interconnect Center
910-99.02	Each	Hardened Ethernet Switch – Layer 2, Install Only

### Q. Conduit

**1.0 Description.** Furnish and install conduits as shown on the plans and as described within this section. The plans depict conduit routing in schematic form only. Determine final routing based on actual field conditions at each site, including utility locator service markings, to assure no conflicts with existing utilities. Inspect the project area prior to submittal of bid to determine the types and extent of incidental removal, relocation and replacement items to include in the unit price of conduit and pull boxes.

**2.0 Material** Conduits shall meet the requirements of current MoDOT Standard Specifications Sec 1060. Non-metallic rigid conduit shall be color coded orange for communication cable and black for power cable. Pull ropes or tapes shall be polypropylene with a minimum tensile strength of 600 pounds. Pull ropes or tapes are incidental to the cost of conduit. Locator wire shall be stranded copper wire, AWG 14, type THHN, with blue insulation, and is incidental to the cost of the conduit. 2 Inch, rigid steel conduit shall be used for building entries as indicated in the plans.

### 3.0 Construction Requirements.

**3.1 General.** The contractor shall comply with Sec 902.16, except as noted in this special provision. Warning tape shall be furnished and installed in all trenches containing conduit. Pull ropes shall be furnished and installed in all empty conduit cells. Install locator wire in all underground non-metallic conduits and into each pull box or base. Affix the wire to the sidewall of each pull box. Locator wire is incidental to the conduit and will not be paid for separately. Non-metallic duct shall not be spliced. All runs shall be continuous.

### 3.2 Directional Drilling.

**3.2.1 Preliminary Site Work.** Determine all utility locations near the path of the proposed bore, including depth. Use this information to avoid damage to utilities and/or facilities within the work area. Provide this information, including the sources, to the engineer a minimum of five working days prior to boring. Do not bore until the engineer approves that submittal. Prior to boring, expose

all utilities for which it is customary and safe to do so.

**3.2.2 Boring.** The diameter of the drilled hole shall conform to the outside diameter of the conduit as closely as practical. Pressure grout, as directed by the engineer, to fill any voids which develop during the installation operation. Remove and replace any conduit damaged in directional drilling operations at no expense to the project.

**3.2.3 Drilling Fluids.** The use of water and other fluids in connection with the drilling operation will be permitted only to the extent necessary to lubricate cuttings. Jetting will not be permitted, and the use of water alone as a drilling fluid will not be permitted. Use a drilling fluid/slurry consisting of at least 10% high grade, processed Bentonite to consolidate excavated material, seal the walls of the hole, and furnish lubrication for subsequent removal of material and immediate installation of the pipe.

**3.2.4** Provide a means of collecting and containing drilling fluid/slurry that returns to the surface, such as slurry pit, or a method approved by the engineer. Provide measures to prevent drilling fluids from entering storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto sidewalks, other pedestrian walkways, driveways, or streets. Immediately remove any slurry that is inadvertently deposited on pedestrian walkways. Transport waste drilling slurry from the site and dispose of it. Do not allow slurry to enter wetlands. Protect wetlands using appropriate soil erosion control measures approved by the engineer.

**3.2.5 Drilling Control.** Use a digital walkover locating system to track the drill head during the bore. At minimum, the locating system shall be capable of determining the pitch, roll, heading, depth, and horizontal position of the drill head at any point along the bore. During each drilling operation, locate the drill head every 10 feet along the bore and prior to crossing any underground utility or structure. Upon completion of the drilling operation and conduit installation, furnish the engineer with an as-built profile drawing and plan drawing for the drilled conduit showing the horizontal and vertical locations of the installed conduit.

**3.3 Wall and Building Penetrations.** Penetrations of existing concrete retaining walls or buildings shall be performed by the drilling, or other approved construction means, of an opening with a minimum diameter of 1 inch greater than the outside diameter of the conduit(s) to be inserted through the wall. Reinforcing bars shall be located on the fill face of any retain walls using non-destructive scanning techniques. Openings shall be located to avoid cutting or otherwise damaging reinforcing bars on the fill face side of retaining walls or damaging structural elements or equipment within buildings. Sufficiently remove any rough edges from the wall or building opening to prevent damage to the conduit(s). The penetrations shall be filled with a Type III epoxy grout conforming to Sec 1039. The cost of wall and building penetrations will be considered incidental to the unit price of conduit.

**3.4 Install Conduit into Existing Pull Box.** Where indicated on the plans, install a proposed conduit into an existing pull box. No direct payment will be made for installing conduit into an existing pull box.

**3.4.1** Carefully expose the outside of the existing pull box without disturbing any existing conduits or cabling.

**3.4.2** Drill the appropriately sized hole for the entering conduit at a location within the pull box that will not disturb the existing cabling, and that will not hinder the installation of new cabling within the installed conduit.

3.4.3 Fill any void area between the drilled hole and the conduit with an engineer approved filling material to protect against conduit movement and the entry of fill material.

3.4.4 Backfill shall be carefully tamped in place. All disturbed areas shall be restored in accordance with standard specifications and these provisions.

**ITS Pull Boxes.** ITS Pull boxes shall be installed per plan and as required to allow the successful installation of the fiber cables per manufactures recommendations. ITS Pull Boxes at traffic signal locations, building penetrations, or Cross-Connect cabinets shall be Class 5. ITS Pull Boxes in-line on conduit run shall be Class 2.

3.4.5 All pull boxes shall be affixed with a permanent label identifying the function of the pull box and the maintaining agency. Material, method, and legend of labeling shall be approved by the engineer.

3.4.6 All pull boxes installed within sidewalks or raised paved shoulders shall be installed flush with the surrounding pavement, with slip-resistant cover, allowing for ADA- compliant pedestrian path. Any sidewalk pavement removed and replaced shall be incidental to the cost of the conduit.

#### **4.0 Shop Drawing Submittal Requirements.**

4.1.1 Contractor shall develop shop drawings illustrating the material and method for externally mounting rigid conduit on bridge structures or retaining walls for new conduit segments along various routes. These shop drawings shall be submitted to the Engineer for review and approval. Contractor shall include in the bid time for two sets of revisions to the shop drawings to incorporate Engineers review comments. Final shop drawings and calculations showing support system design shall be signed and sealed by a Professional Engineer registered in the State of Missouri. Contractor shall provide Engineer with a copy of the approved final shop drawings in MicroStation and PDF format. Catalog cuts shall be provided for all conduit types.

#### **5.0 Basis of Payment.**

5.1 Conduit may be installed by either directional boring or trenching regardless of how installation is shown on the plans based on Contractors preferred method of installation, unless specifically noted on the plans due to some specific installation limitations. All conduit shall be paid for at the unit rate per the Bid Items below regardless of installation method.

5.1.1 The pay items for conduit and pullboxes are:

<b>Item No.</b>	<b>Type</b>	<b>Description</b>
910-52.00	LF	Conduit, 2 In., Rigid, In Trench
910.88.11	EA	Pull Box, Preformed, Class 2
910-88.16	EA	Pull Box, Preformed, Class 5

R. Combination Pad Mounted 120V/240V Power Supply and Lighting Controller with Uninterruptible Power Supply (UPS)

**1.0 Description.** This work shall consist of furnishing and installing combination 120/240 volt signal and lighting power supply and uninterruptible power supply (UPS).

**2.0 UPS Requirements.** The traffic signals being constructed at the intersections within the project limits shall include an “Uninterruptible Power Supply” specifically constructed and NEMA approved for traffic signal operations.

**2.1 UPS Location and Cabling.** The UPS shall be installed separately from the signal cabinet and shall be installed in the same cabinet as the power supply and lighting controller station. In addition to the power cables from the UPS to the signal cabinet, the contractor will route but not connect an outdoor rated CAT-6 cable between the UPS RJ-45 port and the Ethernet switch in the signal cabinet. The contractor shall also install a 7-conductor serial cable and make the appropriate connections from the UPS to the traffic signal cabinet. The **On battery** contact (C-1) on the inverter should be programmed to energize when the UPS provides battery backup. The normally open contact should be wired to provide logic ground to Alarm 2 when the UPS is in battery backup mode. This should indicate a Special Status 2 alarm in the signal controller alarm screen. The **Low Battery** contact (C-2) on the inverter should be programmed to energize when the UPS drops below a preset voltage level, typically set at 40%. The normally open contact should be wired to provide logic ground to Test Point A when the UPS is in Low Battery mode. This should indicate a Special Status 3 alarm in the signal controller alarm screen. The **Arrestor** contact should be wired to provide logic ground to Test Point B and generate a Special Status 4 alarm in the signal controller alarm screen. The **Timer #1** contact (C-4) on the inverter should be programmed to energize after the UPS is in inverter mode for **three (3)** hours. The normally closed contract should be wired in series with the remote flash output to allow for the circuit to open after **three (3)** hours and bring the signal to flash after the side streets service. The remote flash parameters shall be programmed to red/red flash, unless directed otherwise by the Engineer. The CAT-6 cable and serial cable will be run in a separate conduit from the power cables into the cabinet. All conduits will be internal and not visible from the exterior of either the UPS or signal cabinet. The contractor shall verify all control wiring with the manufacture of the traffic signal cabinet assembly for accuracy and compatibility and perform test to ensure proper operation. The contractor shall be responsible for all controller programming to mask the TS2 features to this setup. Upon completion of all controller programming, contractor shall notify contractor’s or Commission’s Traffic Engineer (depending on assignment) for uploading into Commission’s central signal control system.

**2.2 UPS Input Specifications.** Each UPS system shall have the following input requirements:

- (a) A nominal input voltage of 120 VAC.
- (b) An input voltage range of 85 to 175 VAC.
- (c) Two (2) input voltage boost modes.
- (d) Boost-1 shall increase the input voltage from 94 to 115 VAC.
- (e) Boost-2 shall increase the input voltage from 85 to 101 VAC.
- (f) Two (2) input voltages buck modes.
- (g) Buck-1 shall decrease the input voltage from 154 to 124 VAC.
- (h) Buck-2 shall decrease the input voltage from 175 to 142 VAC.

A user configurable power quality (PQ) option with default values of:

- (a) High line disqualify shall be 130 VAC.

- (b) High line qualify shall be 128 VAC.
- (c) Low line qualify shall be 105 VAC.
- (d) Low line disqualify shall be 100 VAC.
- (e) Input current shall be less than 16A with nominal voltage, full load on the output and charger set at 10A.
- (f) 50/60Hz automatic frequency detection with built-in class A EMI filter and transient suppression.

**2.3 UPS Output Specifications.** Each UPS system shall have the following output requirements:

- (a) The output voltage of the UPS shall be 120 VAC  $\pm$ 10% in line mode.
- (b) The output voltage of the UPS shall be 120 VAC  $\pm$ 6% in backup mode.
- (c) The output frequency of the UPS shall be 60Hz  $\pm$ 5% in line mode.
- (d) The output frequency of the UPS shall be 60Hz  $\pm$ 5% in backup mode.
- (e) The output waveform of the UPS shall be sinusoidal.
- (f) The output voltage total harmonic distortion (THD) shall be less than 3% with a resistive load.
- (g) The efficiency of the UPS at nominal line voltage shall be greater than 98%.
- (h) The efficiency of the UPS in backup mode shall be greater than 84%.
- (i) The step-load response of the UPS shall be full recovery in ½-cycle @ 50% change with a resistive load.
- (j) The transfer time of the UPS line to back up and backup to line shall be 5ms typical.
- (k) The line qualification time of the UPS shall be user selectable at 3, 10, 20, 30, 40 and 50 seconds.
- (l) The line qualification time of the UPS default shall be three (3) seconds.

**2.4 UPS Battery and Charger Specifications.** Each UPS system shall have the following specifications for the battery and charger:

- (a) The nominal battery voltage of the UPS shall be 48 VDC.
- (b) The battery charger current of the UPS shall be user programmable for 3, 6, and 10 A.
- (c) The battery charger current default setting for the UPS shall be 6A.
- (d) The battery charger in the UPS shall turn OFF when the battery temperature is 50°C.
- (e) The UPS shall have a user programmable temperature compensated battery charger with setting for -2.5, -4, -5 and -6 mV/°C/Cell.
- (f) The UPS shall have a temperature compensated battery charger with a default setting of -5 mV/°C/Cell. The UPS shall have a battery charge with a float voltage of 56VDC maximum.
- (g) The UPS shall have a user configurable low battery warning.
- (h) The UPS shall have a default low battery warning set at 47VDC to indication 40% remaining battery capacity.
- (i) The UPS shall have a low battery shutdown set for 42VDC (10.5VDC per battery).

**2.5 UPS Protection Specifications.** Each UPS system shall have the following specifications for protection:

- (a) The UPS shall have a 250VAC @ 20A input circuit breaker.
- (b) The UPS shall have a 50A battery circuit breaker.
- (c) The UPS shall have electronic short circuit protection when operating in backup mode.
- (d) The UPS shall indicate an overload warning with a flashing alarm LED when the load is between 95% and 105% of the rated output for the UPS.
- (e) The UPS shall shutdown in two (2) minutes when operating in backup mode when the load is between 106% and 115% of the rated output for the UPS, and the fault LED shall turn ON. The fault LED shall clear when the overload is removed and the utility line power

returns.

(f) The UPS shall shutdown in one (1) minute when operating in backup mode when the load is greater than 115% and the fault LED shall turn ON. The fault LED shall clear when the overload is removed and the utility line power returns.

(g) The UPS shall disable the backup mode function when operating in line mode if the load exceeds 115% of the rated output for the UPS. The alarm shall be reset when the overload condition is removed.

(h) The UPS shall display an alarm LED if the battery ambient temperature is greater than 75°C and disable the backup mode function. The alarm shall clear when the battery ambient temperature is less than 70°C.

(i) The UPS shall display a fault LED when operating in backup mode and shutdown the inverter if the internal temperature is greater than 110°C. The fault shall clear when the utility power returns and the internal temperature is less than 90°C.

(j) The UPS shall have output over-voltage protection to electronically shutdown the UPS if the output voltage exceeds 132VAC.

(k) The UPS shall disable the battery charger in two (2) seconds and display an alarm LED if the battery voltage exceeds 59VDC. The alarm shall be cleared and charge enabled when the battery voltage drops to less than 57VDC.

(l) The UPS shall limit the charger voltage to 52VDC in the event the battery probe is not installed.

(m) The UPS shall have a battery circuit breaker with reverse polarity protection. The battery circuit breaker shall trip in the event the battery polarity is wired incorrectly.

(n) The UPS shall have protection for electrical backfeed to the utility that meets UL 1778 and CSA C22.2 No. 107.1.3 requirements.

(o) The UPS shall have user-selectable settings that are password protected.

(p) The UPS shall be cooled by a variable speed fan that is microprocessor and PWM controlled.

(q) The fan shall be OFF when the ambient temperature is less than 40°C.

(r) The UPS shall display an alarm LED to indicate the fan is enabled but not turning.

(s) The UPS shall have a fan that is field replaceable.

**2.6 UPS Displays, Controls and Diagnostics Specifications.** Each UPS system shall have the following specifications for the noted features:

(a) The UPS shall have a two (2) line/20-character LCD display and control panel that can be rotated for easy user interface.

(b) The UPS shall have event and alarm logging with time/date stamping for up to 100 historical events.

(c) The UPS shall have six (6) independently programmable control relays for control and report functions.

(d) The UPS shall have two (2) independently programmable timers 0 to 8hr with two (2) time- of-day restrictions on each timer.

(e) The UPS shall be equipped with a RS-232 port, which can be connected to a laptop.

(f) The UPS shall be equipped with a SNMP Ethernet card.

**2.7 Programmable Dry Contacts.** Each UPS system shall have the following requirements for the noted features relating to dry contacts:

(a) The UPS shall have six (6) sets of normally open (NO) and normally closed (NC) single pole double-throw (SPDT) dry contact relays rated for 250VAC @1A.

(b) The UPS shall have five (5) sets of dry contact relays that are user programmable, C1 through C5, and one relay contact that is factory configured, C6.

(c) The UPS shall have dry contact relays that are user programmable via either the RS-

- 232 or (optional) Ethernet communication ports to activate under the following conditions:
- (d) ON BATTERY. The relay is energized whenever the UPS switches to battery power.
  - (e) LOW BATTERY. The relay is energized when the battery has reached a user defined low battery level of remaining useful capacity. This alarm is latched when a qualified line returns or the inverter shuts down. The default setting is 47VDC (~40%) of remaining useful battery capacity.
  - (f) TIMER 1. The relay is energized after being in backup mode for a given amount of time. This timer is adjustable from 0 to 8hr. The default setting is two (2) hours.
  - (g) ALARM. The relay is activated after a specific or general alarm is detected. The alarm conditions include: line frequency, low output voltage, no temperature probe, overload,
  - (h) unconnected batteries, high temperature (>55°C) and low temperature (<-20°C).
  - (i) FAULT. The relay is activated after a specific or general fault is detected. These faults include: short circuit, low battery voltage (<41VDC), high battery voltage (> 59VDC), overload and over temperature (>75°C).
  - (j) OFF. The relay is disabled and will not activate under any condition.
  - (k) TIMER 2. Same as TIMER 1.
  - (l) TIMER 3. Same as TIMER 1.
  - (m) AC/DC FAN CONTROL. The relay is activated when the battery ambient temperature is greater than 35°C or at a user programmable threshold from 25 to 55°C @ 5°C increments.
  - (n) The UPS shall have a default dry contact relay configuration
    - of: C1      ON BATT
    - C2      LOW BATT
    - C3      LOW BATT
    - C4      TIMER
    - C5      ALARM
    - C6      48VDC

**2.8 Mechanical.** Each UPS system shall have the following mechanical requirements:

- (a) The UPS shall have AC input and AC output terminal blocks mounted on the front panel. The terminal blocks shall be a 3 pole, 35 amp, 300 volt Eurostyle socket terminal strip (22-8 AWG).
- (b) The UPS shall have six (6) user programmable dry contact relay terminal blocks on the front panel. The terminal blocks shall be 3 pole, 35 amp, 300 volt PLUGGABLE TERMINAL BLOCK (12-26 AWG)
- (c) The UPS shall have one (1) user input and one (1) Automatic Transfer Switch (ATS) terminal block on the front panel. The terminal blocks shall be 3 pole, 35 amp, 300 volt PLUGGABLE TERMINAL BLOCK (12-26 AWG).
- (d) The UPS shall have a DE-9 RS-232 connector on the front panel.
- (e) The UPS shall have an RJ45 Ethernet connector on the front panel.
- (f) The UPS shall have a battery connector on the front panel. The battery connector shall be a 50 amp SB® series type battery connector (16-6 AWG).
- (g) The UPS shall have a RJ14 battery temperature probe connector on the front panel.

**2.9 Environmental.** Each UPS system shall have the following environmental requirements:

- (a) The operating temperature range of the UPS shall be -40° to 55°C with the capability of operating @ 800W for up to 2hr at 74°C ambient.
- (b) The storage temperature range of the UPS shall be -40° to 75°C.
- (c) The operating and storage humidity (non-condensing) range of the UPS is up to 95% RH.
- (d) The altitude operating range of the UPS is up to 12,000ft with a de-rating of 2°C per 1000ft above 4500ft.

- (e) The UPS shall be shipped in materials designed to meet requirements for ISTA program.
- (f) The UPS shall pass electrical safety standards UL1778, CSA 22.2 No. 107.3, EN50091-1-1-2 and EN60950.
- (g) The UPS shall pass emission standards FCC Subpart J Level A for conducted and radiated EMI CISPR22, EN55022 Level A for conducted and radiated EMI.
- (h) The UPS shall pass Immunity standards:
  - EN61000-4-2: ESD (Electrostatic discharge).
  - EN61000-4-3: Radiated immunity.
  - EN61000-4-4: EFT (Electrical fast transient).
  - EN61000-4-5: Surge.
  - EN61000-4-6: Conducted (Power and signal lines).
  - EN61000-4-8: Power frequency magnetic.
  - EN61000-3-2: Harmonic distortion.
- (i) The UPS shall display agency approval mark "cCSAus" on the manufacturer's nameplate label.

**2.10 Manual Bypass Switch.** Each UPS system shall include a manual bypass switch (MPS). UATS assemblies that include items referenced individually need not be duplicated. The MPS shall have the following specifications:

- (a) The MPS shall be a self-contained module separate from the UPS
- (b) The MPS shall be shelf or rack mountable.
- (c) The MPS shall have terminal blocks labeled "AC Input", "AC Output", "To UPS" and "From UPS".
- (d) The MPS shall be a Break-Before-Make rotary switch.
- (e) The MPS shall be rated at 120VAC @ 20A.
- (f) The MPS shall have a 5-15R duplex receptacle connected to utility line.
- (g) The MPS shall have a 5-15R receptacle labeled "Optional LA-P" to facilitate a plug-in surge suppressor.
- (h) The MPS shall have a 5-15R receptacle labeled "Optional Battery Heater Mat" to provide non-standby power to a battery heater mat.
- (i) The MPS shall have two (2) positions: one labeled "UPS" to connect the utility line to the UPS, and one labeled "Bypass" to connect the utility line to the load.
- (j) The MPS shall have a 15A circuit breaker labeled "AC Input".
- (k) The MPS shall have a 15A circuit breaker labeled "AC Output".

**2.11 Automatic Transfer Switch.** Each UPS system shall include an automatic transfer switch (ATS) with the following requirements:

- (a) The ATS shall be rated for 120VAC @ 40A.
- (b) The ATS shall be shelf or rack mountable.
- (c) The ATS shall transfer the load to UPS when the utility line fails or is unqualified.
- (d) The ATS shall transfer the load to utility line when the utility line is available and qualified.
- (e) The ATS shall be activated by a 48VDC input from the UPS.
- (f) The ATS shall have a terminal block labeled "L IN", "NEUT", "GRD" and "L OUT".
- (g) The ATS shall have a six (6) foot line cord labeled "UPS IN".
- (h) The ATS shall have a six (6) foot line cord labeled "UPS OUT".
- (i) The ATS shall have a 5-15R duplex receptacle connected to utility line.
- (j) The ATS shall have a 5-15R receptacle labeled "Optional LA-P" to facilitate a plug-in surge suppressor.
- (k) The ATS shall have a 5-15R receptacle labeled "Optional Battery Heater Mat" to provide non-standby power to a battery heater mat.

**2.12 Automatic Bypass Switch.** Each UPS system shall include an automatic bypass switch (ABS) with the following requirements:

- (a) The ABS shall be rated for 120VAC @ 20 amps.
- (b) The ABS shall be shelf or rack mountable.
- (c) The ABS shall connect the UPS to the load to allow the UPS to continuously power the load.
- (d) The ABS shall transfer the load to utility line when there is no UPS output voltage.
- (e) The ABS shall be activated by the 120VAC from the UPS.
- (f) The ABS shall have a terminal block labeled "L IN", "NEUT", "GRD" and "L OUT".
- (g) The ABS shall have a six (6) foot line cord labeled "UPS IN".
- (h) The ABS shall have a six (6) foot line cord labeled "UPS OUT".
- (i) The ABS shall have a 5-15R duplex receptacle connected to utility line.
- (j) The ABS shall have a 5-15R receptacle labeled "Optional LA-P" to facilitate a plug-in surge suppressor.
- (k) The ABS shall have a 5-15R receptacle labeled "Optional Battery Heater Mat" to provide non-standby power to a battery heater mat.
- (l) The ABS dimensions shall be 4.6"H x 4.75"W x 6.5"D.
- (m) The ABS weight shall be 4lbs.

**2.13 Generator Transfer Switch.** Each UPS system shall include a generator transfer switch (GTS) with the following requirements:

- (a) The GTS shall sense when a portable generator is connected and transfer the load to the generator after a 30s delay.
- (b) The GTS shall be rated for 120VAC @ 20A.
- (c) The GTS shall be shelf or rack mountable.
- (d) The GTS shall have a terminal block labeled "AC INPUT", "AC OUTPUT" and "GENERATOR INPUT".

**2.14 UPS Batteries.** The batteries for the UPS system shall meet the following requirements:

- (a) The batteries shall be Absorbent Glass Mat (AGM) type specifically designed for outdoor use.
- (b) The batteries shall be designed for "Float Service" to provide 100% out-of-box runtime capacity.
- (c) The batteries shall have a five (5) year full replacement, non-prorated warranty.
- (d) The battery capacity rating at 20hr shall be 94Ah.
- (e) The battery shall be 12VDC.
- (f) The number of batteries in the system shall be four (4) or eight (8).
- (g) The batteries shall be connected to provide 48VDC.
- (h) Batteries for each location shall provide full power for all devices shown on the plans that are powered through the signal cabinet for three (3) hours and then send the signal into all red flash and power that state for an additional three (3) hours.

**2.15 Battery Heater Mat.**

- (a) The battery heater mats shall be available in four (4) battery and single (1) battery sizes.
- (b) The single battery heater mat shall allow for a Master-Slave configuration so two (2) or more mats can be ganged together.
- (c) The battery heater mats shall plug into a 120VAC/5-15 receptacle.
- (d) The battery mats shall be thermally controlled, turning ON at 5°C and turning OFF at 15°C.
- (e) The battery mats shall be thermally fused for 82°C to prevent thermal runaway.

**2.16 Battery Charge Management System.** Each UPS system shall have a battery charge

management system with the following requirements:

- (a) The battery charge management system shall spread the charge voltage equally across all batteries.
- (b) The battery charge management system shall compensate for batteries with different internal resistances.
- (c) The battery charge management system shall have a quality of final balance of  $\pm 100\text{mV}$  maximum between any two (2) batteries in the string.
- (d) The battery charge management system shall have reversed polarity protection.
- (e) The battery charge management system shall be designed to CSA C22.2 No. 107.1 and UL 1778 Standards for safe unattended operation.

**2.17 Surge Suppression.** Each UPS system shall have the following requirements for surge suppression:

- (a) The surge suppression shall provide protection from voltage transients appearing on the utility line.
- (b) The surge suppression shall be a plug-in module that is field replaceable.
- (c) The surge suppression shall have a LED indicator that turns OFF when the module is no longer providing protection.
- (d) The surge suppression shall have a clamping voltage of 150VAC.
- (e) The surge suppression shall have a response time of less than one (1) nanosecond.

**2.18 Construction Requirements.** Construction requirements shall conform to Sec 902. Any exceptions to these requirements will be approved by the Engineer before system installation.

**3.0 Method of Measurement.** Method of measurement shall conform to Sec 902.

**4.0 Basis of Payment.** Payment for furnishing and installing pad mounted combination units shall include all excavation, materials, equipment, tools, labor, CAT-5 cable and work incidental thereto, and shall be considered to be completely covered by the contract unit price for:

Item No.	Type	Description
902-99.02	Each	Combination Pad Mounted 120V/240V Power Supply And Lighting Controller with UPS

S. Audible Pedestrian Push Buttons (APS) and Signing

**1.0 Description.** Audible pedestrian pushbuttons and signing will be required for all pedestrian indications at all the intersections as noted in the contract plans.

**2.0 Installation.** Audible signals should be installed as part of a pushbutton assembly.

**3.0 Equipment.**

**3.1 Walk Indications.** Accessible pedestrian signals shall have both audible and vibrotactile walk indications.

**3.2 Vibrotactile.** Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton that vibrates during the walk interval. Tactile arrow shall be located on the pushbutton that vibrates during the walk interval. Tactile arrow shall be located on the pushbutton, have high visual contrast (light on dark or dark on light), and shall be aligned parallel to the direction of travel

on the associated crosswalk.

**3.3 Audible.** Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk.

**3.4 Pushbutton signage.** In addition to standard pedestrian sign requirements, all pushbuttons for the locations mentioned in 1.0 shall have additional signage to indicate crosswalk direction by use of a tactile arrow and the name of the street containing the crosswalk served by the audible pedestrian signal. The sign shall be located immediately above the push button mechanism and parallel to the crosswalk controlled by the button. The street name shall be the name of the street or reasonable abbreviation whose crosswalk is controlled by the push button. Signage shall comply with ADA Accessibility Guidelines (ADAAG) 703.2 specifications for Braille and raised print.

**3.4.1 Arrow.** Signs shall include a tactile arrow aligned parallel to the crosswalk direction. The arrow shall be raised 0.8 mm (.03 inch) minimum and shall be 4 mm (1.5 in) minimum in length. The arrowhead shall be open at 45 degrees to the shaft and shall be 33 percent of the length of the shaft. Stroke width shall be 10 percent minimum and 15 percent maximum of arrow length. The arrow shall contrast with the background.

**3.4.2 Street Name.** Accessible pedestrian signals (APS) shall include street name information aligned parallel to the crosswalk direction and shall comply with adopted PROWAG requirements or shall provide street name information in audible format.

#### **4.0 Performance.**

**4.1 Audible Locator Tone.** Locator tone that tells the pedestrian that the intersection is equipped with APS and where it is. Pushbutton locator tones shall have duration of 0.15 seconds or less, and shall repeat at 1-second intervals. Pushbutton locator tones shall be intensity responsive to ambient sound, and be audible 6 to 12 feet from the pushbutton, or to the building line. The locator tone shall operate during the DON'T WALK and flashing DON'T WALK intervals only and shall be deactivated when the pedestrian signal is not operative.

**4.2 Verbal Wait Message.** Acknowledge tone that tells the pedestrian that they have placed a call and informational message that tells the pedestrian to "Wait to cross" street name at intersecting street name.

**4.3 Verbal Walk Message.** The verbal messages shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. If available, the audio tone feature will not be used. The verbal message that is provided at regular intervals throughout the timing of the walk interval shall be the term "walk sign," which will be followed by the name of the street to be crossed.

**4.4 Volume.** Automatic volume adjustment in response to ambient traffic sound level will be provided up to a maximum volume of 100 dB. The units shall be responsive to ambient noise level changes up to no more than 5 dB louder than ambient sound. Tone or voice volume measured at 36 inches from the unit shall be 2dB minimum and 5dB maximum above ambient noise level. At installation, signal system is to be adjusted to be audible at no more than 5 to 12 feet from the system.

#### **5.0 Documentation and Support.**

**5.1 Operation and Maintenance Manuals.** Two copies of the operation and maintenance manuals for each station shall be included.

**5.2 USB with Audible Messages.** The Contractor shall provide two copies of USB data card to the Engineer that contains files for the manufacturer's audible messages for complete operation of all APS signals at all stations.

**6.0 Construction Requirements.** Construction requirements shall conform to Sec 902, 1061, and 1092.

**7.0 Method of Measurement.** Method of measurement shall conform to Sec 902.

**8.0 Payment.** Payment for the audible signals will be for each unit per bid item, 902-99.02, "Audible Accessible Pedestrian Pushbutton and Sign" per each. This will include all wiring, power adaptors, and installation hardware needed. Payment for signing will be included in the pay item for the Pedestrian Push Button (APS).

T. Optional Pavements JSP 06-06H

**1.0 Description.** This work shall consist of a pavement composed of either Portland cement concrete or asphaltic concrete constructed on a prepared subgrade. This work shall be performed in accordance with the standard specifications and as shown on the plans or established by the engineer.

**2.0** The quantities shown reflect the total square yards of pavement surface designated for each pavement type as computed and shown on the plans.

**2.1** No additional payment will be made for asphaltic concrete mix quantities to construct the required 1:1 slope along the edge of the pavement, or for tack applied between lifts of asphalt.

**2.2** No additional payment will be made for aggregate base quantities outside the limits of the final surface area as computed and shown on the plans. When A2 shoulders are specified, payment for aggregate base will be as shown on the plans.

**2.3** The contractor shall comply with Sections 401 through 403 for the asphalt option and Sections 501 and 502 for the concrete option.

**2.4** Pavement options composed of Portland cement concrete shall have contrast pavement marking for intermittent markings (skips), dotted lines, and solid intersection lane lines. The pavement markings shall be in accordance with Section 620. No additional payment will be made for the contrast pavement markings.

**3.0 Method of Measurement.** The quantities of concrete pavement will be measured in accordance with Section 502.14. The quantities of asphaltic concrete pavement will be measured in accordance with Section 403.22.

**4.0 Basis of Payment.** The accepted quantity of the chosen option will be paid for at the contract unit bid price for Item 403-99.05, Optional Pavement, per square yard.

**4.1** For projects with previously graded roadbeds, any additional quantities required to bring the roadway subgrade to the proper elevation will be considered completely covered by the pay item for Subgrading and Shouldering.

**4.2 Price Adjustment for Fuel.** If the contractor accepts the option for fuel adjustment in the bid proposal, a fuel adjustment will be applied in accordance with Sec 109.14 for the type of pavement constructed.

U. Temporary Long-Term Rumble Strips JSP-13-04C

**1.0 Description.** The work shall include furnishing, installing, maintaining and removing long-term rumble strips, as shown in the plans, or as designated by the engineer.

**2.0 Material.**

**2.1** The long-term rumble strips shall be 10 feet to 12 feet in length, fabricated from a polymer material, and be orange in color.

**2.2** The long-term rumble strips shall have a minimum width of 4 inches, but no greater than 6 inches. The long-term rumble strips shall have a minimum thickness of 0.25 inch, but no greater than 0.50 inch.

**2.3** The long-term rumble strips shall have a pre-applied adhesive backing for securing to the asphalt or concrete roadway surface.

**3.0 Construction.** Long-term rumble strips layout and spacing shall be in accordance with the plans or as approved by the engineer. The long-term rumble strips shall be installed and removed in accordance with manufacturer's recommendation. The contractor shall monitor and repair, and maintain if necessary the long-term rumble strips until removed.

**3.1** Each set shall consist of five individual strips spaced ten to twelve feet on center.

**3.2** The long-term rumble strips removal process shall not damage the roadway surface. If any damage occurs to the pavement during the removal of long-term rumble strips, the contractor shall replace or repair the damaged pavement at no cost to the Commission.

**4.0 Method of Measurement.** Measurement of long-term rumble strips will be per each complete set of five strips.

**5.0 Basis of Payment.** The accepted quantity of Temporary Long-Term Rumble Strips sets will be paid for at the contract unit price for 616-20.02, Temporary Long-Term Rumble Strips, per each set. The long-term rumble strips unit bid price shall include the cost of all labor, equipment and materials to install, maintain, and remove the rumble strips.

V. Airport Requirements

**1.0 Description.** The project is located near a public use airport or heliport or is more than 200 feet above existing ground level, which requires adherence to Federal Aviation Regulation Part 77 (FAA Reg Part 77). "Near" to a public use airport or heliport is defined as follows:

20,000 feet (4 miles) from an airport with a runway length of at least 3,200 feet  
10,000 feet (2 miles) from an airport with runway length less than 3,200 feet  
5,000 feet (1 mile) from a public use heliport

**2.0** The maximum height of the improvement and the equipment operating while performing the improvements was assumed to be **50.0 feet** above the current travelway during the process of evaluating the project for compliance with FAA Reg Part 77.

**2.1** If the contractor's height of equipment or if the improvement itself is beyond the assumed height as indicated in Sec 2.0, the contractor will work with the resident engineer to fill out the Form 7460-1, or revise the original Form 7460-1 based upon the proposed height and resubmit, if necessary, for a determination by FAA on compliance with FAA Reg Part 77. Further information can be found in MoDOT's Engineering Policy Guide 235.8 Airports. If the Form 7460-1 must be filed, the associated work shall not be performed prior to the FAA determination, which could take up to 45 days.

**2.2** If the contractor's height of equipment and the improvement itself is below the assumed height as indicated in Sec 2.0, no further action is necessary to fulfill the requirements set forth in FAA Reg Part 77.

**3.0** The maximum height of the signal equipment was assumed to be **36.0 feet** above the current travelway during the process of evaluating the project for compliance with FAA Reg Part 77.

**3.1** It is required that **FAA Form 7460-2, Notice of Actual Construction or Alternation, be e-filed any time the project is abandoned or within 5 days after the construction reaches its greatest height in compliance with FAA Reg Part 77.**

**4.0 Basis of Payment.** There will be no direct payment for any work associated with this provision. Contract time extension will be given for the time necessary to obtain or revise the FAA permit. Any delays or costs incurred in obtaining the revised permit will be noncompensable.

W. Watermain Relocation

**1.0 Description.** Plans and specifications for the watermain relocation work are included as attachments to the contract plans and specifications. The contractor shall refer to these documents for all watermain relocation items.

X. Maintaining Shoulder Drop-off

**1.0** Project work areas shall be staged to minimize shoulder edge drop-off. Any pavement edge treatment required by Standard Plan 619.10 shall be placed at the contractor's expense. The need for edge treatment is determined by the contractor's method of operations.

**2.0 Basis of Payment.** No direct payment will be made to the contractor to recover the cost of equipment, labor, materials or time required to fulfill the above provision. All costs shall be completely covered and included in the bid item prices for the aggregates for base, type A2 shoulder, asphalt concrete mixtures and optional pavement.

Y. Curb and Gutter, Special

**1.0 Description.** This work shall consist of constructing Curb and Gutter, Special as shown on the plans. All work (including materials, construction requirements, method of measurement, and basis of payment) shall follow Section 609.10 of the Missouri Standard Specifications for Highway Construction. The contractor shall refer to the plans for additional details.

Z. Lump Sum Temporary Traffic Control JSP-22-01A

**1.0 Delete Sec 616.11 and insert the following:**

**616.11 Method of Measurement.** Measurement for relocation of post-mounted signs will be made to the nearest square foot of sign area only for the signs designated for payment on the plans. All other sign relocations shall be incidental. Measurement for construction signs will be made to the nearest square foot of sign area. Measurement will be made per each for each of the temporary traffic control items provided in the contract.

**616.11.1 Lump Sum Temporary Traffic Control.** No measurement will be made for temporary traffic control items grouped and designated to be paid per lump sum. The list of lump sum items provided in the plans or contract is considered an approximation and may be subject to change based on field conditions. This is not a complete list and may exclude quantities for duplicate work zone packages used in simultaneous operations. The contractor shall provide all traffic control devices required to execute the provided traffic control plans for each applicable operation, stage, or phase. No measurement will be made for any additional signs or devices needed except for changes in the traffic control plan directed by the engineer.

**2.0 Delete Sec 616.12 and insert the following:**

**616.12 Basis of Payment.** All temporary traffic control devices authorized for installation by the engineer will be paid for at the contract unit price for each of the pay items included in the contract. Whether the devices are paid individually, or per lump sum, no direct payment will be made for the following:

- (a) Incidental items necessary to complete the work, unless specifically provided as a pay item in the contract.
- (b) Installing, operating, maintaining, cleaning, repairing, removing, or replacing traffic control devices.
- (c) Covering and uncovering existing signs and other traffic control devices.
- (d) Relocating temporary traffic control devices, including permanent traffic control devices temporarily relocated, unless specifically included as a pay item in the contract.
- (e) Worker apparel.
- (f) Flaggers, AFADs, PFDs, pilot vehicles, and appurtenances at flagging stations.

- (g) Furnishing, installing, operating, maintaining, and removing construction-related vehicle and equipment lighting.
- (h) Construction and removal of temporary equipment crossovers, including restoring pre-existing crossovers.
- (i) Provide and maintaining work zone lighting and work area lighting.

**616.12.1 Lump Sum Temporary Traffic Control.** Traffic control items grouped together in the contract or plans for lump sum payment shall be paid incrementally per Sec 616.12.1.1. Alternately, upon request from the contractor, the engineer will consider a modified payment schedule that more accurately reflects completion of traffic control work. No payment will be made for any additional signs or devices needed except for changes in the traffic control plan directed by the engineer. Additional items directed by the engineer will be paid for in accordance with Sec 109.4. No adjustment to the price will be made for overruns or underruns of other work or for added work that is completed within existing work zones.

**616.12.1.1 Partial payments.** For purposes of determining partial payments, the original contract amount will be the total dollar value of all original contract line items less the price for Lump Sum Temporary Traffic Control (LSTTC). If the contract includes multiple projects, this determination will be made for each project. Partial payments will be made as follows:

- (a) The first payment will be made when five percent of the original contract amount is earned. The payment will be 50 percent of the price for LSTTC, or five percent of the original contract amount, whichever is less.
- (b) The second payment will be made when 50 percent of the original contract amount is earned. The payment will be 25 percent of the price for LSTTC, or 2.5 percent of the original contract amount, whichever is less.
- (c) The third payment will be made when 75 percent of the original contract amount is earned. The payment will be 20 percent of the price for LSTTC, or two percent of the original contract amount, whichever is less.
- (d) Payment for the remaining balance due for LSTTC will be made when the contract has been accepted for maintenance or earlier as approved by the engineer.

**616.12.1.2** Temporary traffic control will be paid for at the contract lump sum price for Item:

Item No.	Unit	Description
616-99.01	Lump Sum	Misc. Lump Sum Temporary Traffic Control

AA. Access to Commercial and Private Entrances

**1.0 Description.** While working on entrances or adjacent properties, the contractor shall make every reasonable effort to minimize any interference to the properties and to complete the work diligently. Under no circumstances shall the contractor block ingress/egress to and from businesses during the normal business hours of each business unless as approved by the property owner and engineer.

**2.0 Construction Requirements.** On all commercial and residential entrances the contractor shall keep one-half of the entrance open at all times. On commercial entrances less than 20' wide it may be necessary for the contractor to provide temporary aggregate to provide access to the property. The contractor shall remove and dispose of the temporary aggregate following completion of the entrance. For properties with more than one entrance the contractor may construct one entrance at a time with the approval of the property owner and engineer.

**2.1** The contractor shall complete the entrances as quickly as possible and shall take no longer than **4 weeks** to complete any one entrance unless otherwise stated elsewhere in job special provisions.

**3.0 Property Owner Agreements.** Agreements made with property owners during the negotiation of easements and rights of way listed in the Property Owner Notification special provision, shall be adhered to and shall supersede the requirements in the Access to Commercial and Private Entrances special provision.

**4.0 Basis of Payment.** No direct payment will be made to the contractor for any expenses incurred for compliance with this provision.

BB. Access to Parcel 6 Casper's Conoco

**1.0 Description.** The contractor shall complete the entrances as quickly as possible and shall take no longer than **2 weeks** to complete either entrance to the property.

**2.0 Basis of Payment.** No direct payment will be made to the contractor for any expenses incurred for compliance with this provision.

CC. Property Owner Notification

**1.0 Description.** It shall be the contractor's responsibility to inform and notify the adjacent property owner 48 hours prior to starting any construction activities that may impact driveway and parking lot access or occur along the frontage of the property owner's parcel, unless specified more specifically in a property owner agreement, or here. The notification shall be in written form and include the contractor's contact information, the Engineer's contact information, and an estimated schedule of work and the associated impacts.

Parcel 1 Contact: 100 Grande Properties, Kenneth Miller (573) 508-5359

Parcel 2 Contact: Band Properties, Caleb Bax (573) 508-3567

Parcel 4 Contact: Northern Lights Development, Steve Johannesmeyer (573) 508-4845

1.1 The following Property Owners shall be given the number of days-notice specified below.

Parcel 3: Contact owner by phone 1 week in advance of construction. Contact: Rodney Wolfe (owner) of Wolfe Apartments at (573) 291-7459.

Parcel 6: Contact owner by phone 1 week in advance of construction. Contact: Tim Thielen (owner) of Casper's Conoco at (573) 338-1744.

Parcel 7: Contact owner by phone 1 week in advance of construction. Contact: Tony Keeth (owner) of Parts City Auto Parts at (573) 280-3157.

Parcel 8: Contact tenant by phone 2 weeks in advance of construction. Contact: Brad Sieg (Director, Lakeside Books, tenant) of STAT JV I, LLC at (573) 417-3061 (office) and (573) 291-2669 (cell).

Parcels 5 & 9: Contact owners by phone at least 2 weeks in advance of construction. Contact: Amy Ames (chief of staff) (573) 897-5224 (office) and (573) 680-5257 (cell). She is very difficult to reach and rarely answers her phone, so both numbers should be used and at minimum leave voicemails for her at each number.

Parcel 10: Contact owner by phone 1 week in advance of construction. Contact: Tony Gier (owner) of Eagle Stop gas station at (573) 392-6150.

**2.0 Basis of Payment.** No direct payment will be made to the contractor for labor, equipment, material, or time required to comply with this provision.

 **ADDED**

**DD. Liquidated Damages for Winter Months JSP-04-17A**

Delete Sec 108.8.1.3 (a)

Liquidated damages for failure to complete the work on time shall not be waived from December 15 to March 15, both dates inclusive.

 **DELETED**

~~DD. Delayed Possession of Right of Way — Parcel 8~~

~~1.0 Description. The Contractor's attention is directed toward the following parcels which could be subject to delayed possession.~~

~~(a) Parcel 8 — STAT JV I, LLC — The property rights are being acquired to construct a substantial portion of the project. Possession is estimated to be obtained by the project Notice to Proceed. By May 2, 2024, the status of the parcel will be evaluated to determine how to proceed with the project.~~

~~1.1 The contractor shall inform itself of the location of this tract. The contractor is not allowed access to this parcel until instructed by the Engineer.~~

~~1.2 The contractor shall schedule its work utilizing the available right of way until this tract is cleared for construction, which is estimated to be prior to the Notice to Proceed for construction. However, this date expressly is not a warranty by or contractually binding on the Commission as the date the tract will be clear for construction. No encroachment, storage of equipment and materials or construction on this tract shall be permitted until the contractor is notified by the engineer that this tract has been acquired.~~

~~1.3 The contractor shall have no claim for damage for delay, disruption, interference or otherwise as a result of the unavailability of Parcel 8.~~

2 REVISSED

**EE. Personal Property Within Parcels Requiring Special Attention**

**1.0 Description.** The contractor's attention is directed toward the following parcels which could contain items of personal property.

(a) **Parcel 5 - REGENTS OF STATE TECHNICAL COLLEGE OF MISSOURI** – There is a business sign and 3 light poles that are privately owned and still located within the right of way and/or easements.

(b) **Parcel 7 - TK RENTALS, LLC** – There is a business sign that is privately owned and still located within the right of way and/or easements.

(c) **Parcel 9 - OSAGE COUNTY COMMUNITY CENTER, INC.** – There is a light pole that is privately owned and still located within the right of way and/or easements.

2 REVISSED

(d) **Parcel 8 - STAT JV I LLC** – There is a business sign and 3 light poles that are privately owned and still located within the right of way and/or easements.

**1.1** The Contractor shall inform itself of the location of these tracts. The contractor is allowed to access these tracts and perform construction activities therein. However, the Contractor is not allowed disturb or otherwise impede the use of the aforementioned privately owned improvements unless directed by the Engineer.

**1.2** The Contractor shall schedule its work utilizing the available right of way until this tract is fully cleared for construction, which is estimated to be prior to the Notice to Proceed for construction. However, this date expressly is not a warranty by or contractually binding on the Commission as the date the **four (4) three (3)** tracts will be fully clear for construction. The Engineer shall inform the Contractor when the private property has been removed from the tracts and the owner of the property has been reimbursed for the relocation of said property.

2 REVISSED

2 REVISSED

~~**1.3** The Contractor shall have no claim for damage for delay, disruption, interference or otherwise as a result of the unavailability of Parcel 8.~~

2 ADDED

**FF. Property Owner Agreements – Parcel 8**

**1.0** The Contractor's attention is directed toward the following agreement which was made with the owner of Parcel 8 (STAT JV I, LLC).

**1.1** Prior to the Contractor's entry onto the premises, the Contractor shall coordinate with the occupant of the premises and provide the Owner the following:

(A) At least two (2) business days notice of its intent to enter the premises, and

(B) Evidence of commercial general liability insurance in the amount of \$3,000,000 per occurrence combined single limit for injury or death of one or more persons, and for damage to tangible property (including loss of use), with an aggregate limit of at least \$5,000,000, and which names the owner and all tenants of the premises as additional insureds.

2 ADDED

**GG. OPTIONAL TEMPORARY PAVEMENT MARKING PAINT NJSP-18-07E**

**1.0 Description.** This provision provides the contractor with the option to either complete all Permanent Pavement Marking Paint (PPMP) prior to the time limits specified herein or to apply Temporary Pavement Marking Paint (TPMP) in accordance with Sec 620.10.2 (4 in. width) in all locations shown on the plans as PPMP and delay application of the PPMP until the spring of 2025, as allowed herein. PPMP is defined as Standard Waterborne Paint and High Build Waterborne Paint and does not include Sec 620.20.3 Durable Pavement Markings.

**1.1** No application of PPMP shall occur between October 1, 2024 and March 1, 2025, both dates inclusive, except as stated herein. When the contractor has begun application of PPMP prior to October 1, 2024, and weather limitations stated in Sec 620.20.2.4 can be met, the contractor may complete the PPMP within the first seven (7) calendar days of October. If all (100%) of the PPMP is not completed on or before October 7, 2024, all previously applied PPMP, including any painted markings applied prior to October 1, shall be considered TPMP, and the contractor shall complete the remaining marking with TPMP, and then re-apply PPMP in all planned locations after March 1, 2025. All PPMP shall be completed prior to June 1, 2025. No additional payment will be made for PPMP that is later determined to be TPMP due to the contractor's failure to complete the PPMP within the time specified.

**1.2 Use of TPMP Prior to October 1.** The contractor has the option to apply TPMP in lieu of PPMP prior to October 1, 2024, even when there is sufficient time to complete the PPMP prior to October 1, 2024. For example, the contractor may choose to use TPMP as a base coat for the PPMP on open-graded surfaces in order to achieve higher retroreflectivity readings on the surface coat as compared to a single application.

**1.2.1** The contractor has the option of using TPMP in lieu of Temporary Raised Pavement Markers if applied each day that existing markings are obliterated.

**2.0 Construction Requirements.** TPMP shall be accurately placed in the final planned location and shall be completely covered by the final application of PPMP. Any failure to comply with this requirement shall be corrected by removal of the misplaced pavement markings at the contractor's expense and without marring of the pavement surface.

**2.1** Prior to application of the PPMP on TPMP, TPMP shall be fully cured in accordance with the manufacturer's recommendation, or for a period of 12 hours, whichever is greater.

**3.0 Weather Limitations.** All weather limitations specified in Sec 620 for PPMP and TPMP shall apply. Cold Weather Pavement Marking Paint, in accordance with Sec 620.10.6, shall be used for TPMP when specified weather limitations do not allow the use of waterborne paint. No additional payment will be made for the use of Cold Weather Pavement Marking Paint as TPMP. Cold Weather Pavement Marking Paint is not an allowable substitute for PPMP and shall subsequently be covered with PPMP.

**4.0 Time Exception.** If application of PPMP is to be delayed to the spring of 2025, the contractor shall submit a request to the engineer for a time exception and shall provide a revised work schedule that shows the planned completion of the PPMP.

**4.1** Upon receipt of the time exception request in Section 4.0, the engineer will list "Application of Permanent Pavement Marking Paint" as an exception on the Semi-Final Inspection form, thus granting an exception to the count of contract time thru June 1, 2025, solely for the purpose of

Job No.: J5P3574  
Route: Route 50  
County: Osage

delaying application of PPMP. This time exception shall not apply to any time needed to complete any other work items. Liquidated Damages, as specified elsewhere in this contract, shall remain in effect for all other work items not completed by the contract time limits, as specified elsewhere in this contract, and for PPMP not completed by June 1, 2025.

**5.0 Method of Measurement.** No final measurement will be made for TPMP.

**6.0 Basis of Payment.** Full payment for TPMP will be made at the contract lump sum price even when PPMP is completed prior to the time limitation and TPMP is not used or only partially used.

**6.2** If a \$0 bid is entered for TPMP, no payment will be made should TPMP become necessary.

**U.S. HIGHWAY 50 WATERMAIN REROUTING  
SPECIFICATIONS AND CONTRACT DOCUMENTS  
FOR  
OSAGE COUNTY PWSO NO. 3  
LINN, MISSOURI**

**April 2024**

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**BID SCHEDULE  
LUMP SUM AND UNIT PRICE BID  
(1 TO 3)  
BASIS OF PAYMENT  
(4 TO 15)**

<b>CONTRACT - U.S Highway 50 Watermain Rerouting</b>					
<b>Item</b>	<b>Description</b>	<b>Unit</b>	<b>Est. Qty.</b>	<b>Unit Price</b>	<b>Extension</b>
1	Bonding & mobilization expense. This amount shall be limited to no more than 3% of the total Contract amount.	LS	1		
2	Install New 6"Ø SDR-21 PVC Water Main piping with trenching, fittings, and bedding material, complete.	LF	2,100		
3	Finish grading, top soil, seeding, liming, fertilizing & mulching of new water main trenching, connections & restore all disturbed areas to original conditions or better, complete.	LF	1,359		
4	Roadway Bore #1, (45 LF) of 6"Ø RJPVC carrier pipe with HDPE spacers, (40 LF) 12"Ø steel casing with end boots, Plan/Profile Sheets C-5 & C-10, complete.	LF	40		
5	Roadway Bore #2, (60 LF) 6"Ø RJPVC carrier pipe with HDPE spacers, (40 LF) 12"Ø steel casing with end boots, Plan/Profile Sheets C-6 & C-10, complete.	LF	40		
6	Roadway Bore #3, (90 LF) 6"Ø RJPVC carrier pipe with HDPE spacers, (80 LF) 12"Ø steel casing with end boots, Plan/Profile Sheets C-7 & C-11, complete.	LF	80		
7	Open-Cut #1, (30 LF) 6"Ø SDR-21 PVC piping with full depth granular backfill, 1"Ø clean, over the existing gravel Roadway, Plan/Profile sheets C-5, complete.	LF	20		
8	Open-Cut #2, (100 LF) 6"Ø RJPVC carrier pipe with HDPE spacers, (90 LF) 12"Ø steel casing with end boots, 1"Ø clean full depth granular backfill, Plan/Profile Sheet C-6, complete.	LF	90		
9	Open-Cut #3, (40 LF) 6"Ø RJPVC carrier pipe with HDPE spacers, (30 LF) 12"Ø steel casing with end boots, saw-cut concrete pavement, Plan/Profile Sheet C-6, complete.	LF	30		
10	Furnish and install two (2) new 3/4"Ø RUPERLE Eclipse No. 88-55 Water Sampling Stations as shown on Plan Sheet C-5 & C-7, complete.	EA	2		
11	Abandoned Existing 6"Ø water main at various roadway crossing and fill existing pipe with flowable grout as required by MODOT as shown on Plan Sheet C-5 & C-7, complete.	LF	160		
12	Abandoned and remove Existing 6"Ø and 2"Ø water lines at four (4) locations, excavate trench over existing water main, remove and dispose of all existing piping, valves and fittings. Backfill trench with full depth granular 1"Ø clean material, as shown on Plan Sheet C-6 & C-13 complete.	LF	385		
13	Install New 6"Ø SDR-21 PVC water main piping, trenching, fittings, and bedding material, at a depth greater then the required minimum forty-two (42) inches in one (1) section as shown on Plan Sheet C-9, complete.	LF	270		

14	Connection (Tie) into existing 6"Ø PVC water mains with new 6"Ø SDR-21 PVC water mains, wet tapping sleeve, gate valve and valve box tie-in details on Plan Sheet C-12, complete.	EA	7		
15	Furnish, install and connect new 4"Ø Gate Valve between New Water Main and existing 4"Ø water main, Plan Sheet C-4 & C-6, complete.	LS	2		
16	Connect New 1 1/2"Ø service lateral to new 6"Ø water main with 1 1/2"Ø saddles, corporation stops, and fittings, Plan Sheet C-3, C-4 & C-12, complete.	EA	5		
17	Furnish, install and connect new 1 1/2"Ø PVC, SDR-9, CTS, <u>service lateral piping</u> between new water main and new water meter service lateral, Plan Sheet C-3, C-4 & C-12, complete.	LF	30		
18	Furnish and install new 1 1/2"Ø meter service, yoke, meter pit, covers and connect system at designated water meter location, Plan Sheet C-3, C-4 & C-12, complete in place.	EA	3		
19	Connect New 2"Ø service lateral to new 6"Ø water main with 2"Ø saddles, corporation stops, and fittings, Plan Sheet C-5, C-6 & C-12, complete.	EA	2		
20	Furnish, install and connect new 2"Ø PVC, SDR-9, CTS, <u>service lateral piping</u> between new water main and new water meter service lateral, Plan Sheet C-5 & C-12, complete	EA	40		
21	Furnish and install new 2"Ø meter service, yoke, meter pit, covers and connect system at designated water meter location, Plan Sheet C-5, C-6 & C-12, complete in place.	EA	2		
22	Furnish, install and connect 2"Ø RJPVC, SDR-17 pipe in 6"Ø steel casing with spacers between new 6"Ø SDR-21 main and proposed new concrete roadway curbs as shown on Plan Sheet C-6, complete.	LF	45		
23	Furnish, install and connect 6"Ø RJPVC, SDR-21 pipe in 12"Ø steel casing with spacers between new 6"Ø SDR-21 main and proposed new concrete roadway curbs as shown on Plan Sheet C-6, complete.	LF	50		
24	Furnish and install new 6"Ø gate valves & valve box with cover, DIP, on new water mains, Plan Sheet C-6 & C-7, complete.	EA	6		
25	Furnish & install 6"Ø DIP mechanical joint tee fittings on new & existing water mains, complete.	EA	9		
26	Furnish & install 6"Ø DIP mechanical joint 45° elbow fitting on new water main bend point locations, complete.	EA	8		
27	Furnish & install 6"Ø DIP mechanical joint 22-1/2° elbow fittings on new water main bend point locations, as needed, complete.	EA	9		
28	Install new fire hydrants with 6"Ø gate valves into new 6"Ø SDR-21 PVC water system, Plan Sheet C-12, complete.	EA	6		

29	Furnish and install mechanical joint cap with concrete thrust block at end of existing 6"Ø water main, Plan Sheet C-12, Detail No. 3, complete.	EA	7		
30	Furnish and Install combination Air/Vacuum Release Valves with valve pit and marker posts, as shown on Plan Sheet C-13 complete.	EA	3		
31	Furnish, construct, install and connect new reinforced concrete utility vault (8' wide x 14' long) as shown on Plan Sheets C-6 and detailed on C-14, to include all piping and equipment <u>inside</u> the vault, complete.	LS	1		
32	Remove existing gate valves, water meter pits, valve, (D.I.P.) riser box, backflow preventer and backfill, complete. Return all components removed to PWSD No. 3.	EA	10		
33	Clearing, grubbing and disposal for New water distribution system routing, as minimal as possible, but <u>no more</u> than 30 foot wide, complete.	LF	200		
34	Furnish and Install 6"Ø Standard pipe guard post around New Fire Hydrant as Shown on Plan Sheet C-4 and Detailed on C-13, complete.	EA	2		
35	Traffic control & signage for construction & installation of water mains & accessories, in accordance with MoDOT standards, complete.	LS	1		
36	Construction staking, survey layout and staking, complete.	LS	1		
37	Potable water system improvements, as-built surveying, CAD, and plans, complete.	LS	1		
<b>TOTAL CONTRACT BASE BID</b>					<b>\$</b>

## **BASIS OF PAYMENT**

### General

All material and work specified under this Contract shall be paid for as outlined in the Bid Schedule Form. Prices for each item shall include all laboratory tests and reports, surveying, excavation and backfill, removal of surplus excavated material, erosion control, surface restoration, testing the completed unit, the furnishing and installation of all materials required for the complete workable unit including all necessary barricades and traffic control, replacing all damaged conduits, ducts or pipes, drains, sewers, or other structures, and repairing and/or for reseeding any areas that are disturbed outside the construction limits to complete the project as outlined in the Specifications and Construction Drawings. All measurement of unit quantities will be made by the Engineer. No extra payment will be made for any rock that is to be excavated. All excavation is unclassified.

### Bonding and Mobilization Expense (Bid Item 1)

Payment will be on a lump sum basis as outlined in the Bid Schedule. This amount shall be limited to 3 percent of the total Contract amount for each specified Contract outlined in the Bid Form. Payment for this item will only be after 5 percent of the total separate Contract (not including the amount for bonding and mobilization) is completed.

### Furnish and Install SDR-21 PVC Water Mains and Waterlines (Bid Items 2)

Payment will be based on a unit price per linear foot, as outlined in the Bid Schedule. Measurement shall be on top of the ground along the centerline of the trench with deduction for space occupied by valves and fittings. PVC water pipe will be classified according to size and type as contained in the Contract Documents, (Reference Section 02700). Included are labor, materials, equipment, loading, transportation, stringing, installation, trenching, backfilling, restoration of the surface (unless designated for separate payment), testing, flushing chlorination and all incidental work required to complete the installation. Price shall also include all pipe, fittings, end caps, thrust blocking, tracer wire, detector tape, bedding material, and all incidental work required to complete the installation of the water system. Separate unit pricing for various M.J. fittings has been provided in the Bid Schedule for various compact D.I.P. mechanical joints bent, and tee fittings required for construction of the water mains. All other D.I.P. mechanical joint fittings, compact bend, restraint joint connectors, reducers, flange adaptors, sleeves, endcaps, waterlines, tees, and elbows, are included in the unit price per linear foot of pipng installed. Price includes removal and replacement of fences and small structures as needed to install the water main.

Trenching for Water Mains and Waterlines (unclassified)  
(Bid Items 2)

Payment for trenching shall be included in the pipe linear foot unit cost in the Bid Schedule. No additional monies are allotted for trenching, disposing of excavated materials, or bedding. The trench excavation shall be to a point that is a minimum of six inches below the bottom of the pipe. Apply a minimum of forty-two (42) inches of cover measured from the ground surface to the top of pipe, unless otherwise noted, (Section 02700 - Water Systems and Plan Sheet C-13). If over-excavation of the trench bottom occurs, it must be corrected by the addition of properly compacted granular backfill. The cost of materials, equipment, and labor for this corrective work shall be borne by the Contractor unless the over-excavation was specifically ordered by the Engineer due to poor ground conditions. All necessary clearing and grubbing for the waterlines, disposal of materials and vegetation, and all items necessary to provide safety in the working area are provided in Bid Item No. 33. The Contractor shall confine his construction movement within the approved R.O.W. easement, and any disturbance/damage to areas outside the MODOT (R.O.W.) easement will be repaired or replaced at the Contractor's expense. Incidental to the trenching and piping installation shall be minor items that require adjustment or relocation for the water system to be installed such as fences, and movement of small structures, including dog houses, small sheds, etc. Any damage to existing watermains waterlines, sewer laterals, culverts or other existing utilities during trenching operation shall be repaired by the Contractor, as specified by MODOT, the Engineer and the Osage County PWSD No. 3, the same day, at no additional cost to the Owner.

Placement of Pipe Bedding Material Around Water Mains and Waterlines  
(Bid Items 2)

Payment for Bedding Material shall be in the pipe lineal foot unit cost in the Bid Schedule. Water pipeline trenching, excavation, clearance in rock areas and backfilling of bedding material around water mains are specified in Section 02700 – Water Systems of the Technical Specifications. Bedding material will be 1"Ø clean limestone material. Submit type of material and gradation for approval of Engineer. Included in the price will be the cost of labor, bedding material, equipment, loading, transportation, and placement as shown on Typical Trench Bedding Detail, Plan Sheet C-13.

Finish Grading, Topsoil, Seeding, Liming, Fertilizing and Mulching Water Main Trenching and all Disturbed Green Areas (Bid Item 3)

Payment will be based on a unit price per linear foot basis as outlined in the Bid Schedule. Seeding operations shall be applied along trenching operations in green areas, and at all disturbed areas within the MODOT construction easement. If areas are disturbed or damaged outside the construction easement, these areas shall be repaired and seeded at the Contractor's expense. Included in the price will be all labor, materials, equipment, finish grading, topsoil, seeding, liming, fertilizing, and mulching as outlined in the Technical Specifications, Section 02900. Submit proposed grass mixture to the Engineer and PWSD No. 3 for final approval. Contractor shall provide all material invoices to the Engineer. All disturbed areas shall be restored to their original conditions or better.

### Highway Road Boring No. 1, 2, and 3 (Bid Items 4, 5, and 6)

Payment will be based on a unit price per linear foot of steel casing as outlined in the Bid Schedule. The Contractor shall install steel pipe casing by horizontal directional boring under the existing concrete roadways at three (3) locations shown on Plan/Profile Sheets C-5, C-6 and C-7 in accordance with Section 02305 and 02625 of the Technical Specifications. The bore casing pipe will be steel, the carrier pipe will be Restrained Joint PVC with end seals. Included in the unit price bid will be the boring operation, steel casing material, blocking that is required in the casing to bring the carrier to grade, all fittings including the carrier line connection fittings, carrier pipe installation, RACI (or equal) spacing at 6 ft. intervals, seeding, and all labor, equipment, and materials, to construct the (3) roadway bores. No existing concrete pavement or curb and gutting will be disturbed during the Horizontal Directional Drilling Operations. Also, included in the price shall be all labor, material and equipment, excavation incidental thereto, steel casing, installation, backfilling, pit excavation and shoring, restoration of surface, testing and all incidental work required to complete the bores. Measurement shall be on the slope distance along the centerline of the bores. No separate payment will be made for any rock that is required to be excavated or removed during the bore. All rock excavated or removed during the bore shall be included in the price bid per linear foot of steel casing. The existing Highway pavement shall not be disturbed. The Contractor shall stay within the existing MODOT R.O.W. corridor for construction as shown on the Plan Sheets.

### Open-Cut No. 1 Across Gravel Roadway (Bid Item 7)

Payment will be based on a unit price per linear foot of piping at one (1) watermain crossing, as outlined in the Bid Schedule and shown on Plan Sheet C-5. The Contractor shall install new 6"Ø SDR-21 PVC water main piping by open-cut trenching, across this area. Included in the unit price will be all labor, materials, equipment, loading, transportation, bedding, disposal of access material, and compacting of full depth granular 1"Ø clean backfill from the installed piping and bedding material up to the existing ground surface as shown on Plan Sheet C-13, Typical Details "B". Also, included in the unit price shall be all piping, connections, fittings, tracer wire, testing of system, restoration of surface areas and all incidental work required to make complete.

### Open-Cut No. 2 Across Green-Area (Bid Item 8)

Payment will be based on a unit price per linear foot of steel casing at one (1) water main crossings, as outlined in the Bid Schedule and shown on Plan Sheet C-6. The Contractor shall install new 6"Ø RJPVC SDR-21 water main piping in 12"Ø steel casing by open-cut trenching, across this area. Included in the unit price will be all labor, materials, equipment, loading, transportation, bedding, disposal of access material, and compacting of full depth granular 1"Ø clean backfill from the installed steel casing and bedding material up to the existing ground surface as shown on Plan Sheet C-13, Typical Trench Detail "B". Also, included in the unit price shall be all casing and carrier piping, connections, fittings, RACI spacers, end seals, tracer wire, testing of system, restoration of surface areas and all incidental work required to make complete.

### Open-Cut No. 3 Across Concrete Roadway (Bid Item 9)

Payment will be based on a unit price per linear foot of steel casing pipe as outlined in the Bid Schedule. The Contractor shall install new 6"Ø RJPVC SDR-21 water main piping in 12"Ø steel casing by open-cut trenching, across concrete service roadway as shown in Plan Sheet C-6. The existing concrete pavement will be saw-cut, two foot (2) wide for trenching operations. Any damage to the existing concrete pavement greater than two (2) feet in width shall be repaired by the Contractor at no additional cost to the owner. After the water main has been installed, the Contractor will be required to replace the removed concrete pavement with new reinforced concrete pavement in accordance with Section 03200 and 03300 of the Technical Specifications. The thickness of the replacement concrete pavement shall be 6-inches, concrete mix shall be compressing strength (28-days) at 4,000 psi with a maximum water cementitious material ratio of 0.44 (non-air-entrained) 6 bag mix, with maximum slump of 4-inches and No. 4, steel reinforcement bars. Included in the unit price will be all labor, materials, equipment, excavation, loading, transportation, bedding, disposal of access material, compaction of full depth granular 1"Ø clean backfill, steel casing pipe (30 ft), carrier restrained joint PVC, SDR-21 piping (40 ft), with casing spacers and end seals. Also, included in the price shall be all carrier pipe connections and fittings, RACI spacing at 6 ft. intervals, testing of system, restoration of surface area and all incidental work required to make complete.

### Furnish and Install Two (2) New 3/4"Ø New Water Sampling Stations (Bid Item 10)

Payment will be based on a unit price per each installation as outlined in the Bid Schedule. The Contractor shall furnish and install two (2) new 3/4"Ø Kuperle Eclipse No. 88-55, water sampling stations, or approved equal, as shown on Plan Sheets C-5 and C-7. These stations will be non-freezing and supplied with manual hand pumps. Included in the price will be all labor, materials, equipment, excavation and disposal of materials, dewatering if required, bedding, compaction, backfilling, connections, brass saddle, fittings, tracer wire, 4" x 8" x 8" concrete pad for water sampling device, testing of system and restoration of surface area as specified in Section 02900. Submittals are required for approval by the Engineer.

### Abandoned Existing 6"Ø Watermain and Fill with Grout (Bid Item 11)

Payment will be based on a unit price per linear foot as outlined in the Bid Schedule. The Contractor shall place flowable grout fill mix to fill existing pipe volume between abandonment selected points along the abandoned existing 6"Ø watermain as shown on Plan Sheet C-5 and C-7. Comply with Section 03610 – Non Shrink Grout of the Technical Specifications. There are two (2) locations, approximately 160 linear feet of 6"Ø piping to be filled in the field. Included in the unit price will be all labor, materials, equipment, excavation and disposal of materials, compaction, pumping operations, grout mixture, restoration of surface area and seeding operations. Submit grout design mix to the Engineer for approval.

Abandoned Existing 6"Ø and 2"Ø Water Lines by Excavation and Removal of Piping (Bid Item 12)

Payment will be based on a unit price per linear foot as outlined in the Bid Schedule. This process will include locating four (4) sections as shown on Plan Sheet C-6, of existing 6"Ø PVC watermain piping, trench excavation, removal of piping, fittings, existing water meters, lateral service lines, gate valves and riser boxes and disposal. Included in the unit price will be the process of location, excavation, removal and disposal, all labor, materials, equipment, dewatering if required, compaction, and backfill operations with 1"Ø clean full-depth granular backfill material. All existing valves and fittings removed will be returned to PWSD No. 3.

Furnish and Install New 6"Ø SDR-21 PVC Watermain, Excavated Depth Greater than Five (5) Foot (Bid Item 13)

Payment will be based on a unit price per linear foot as outlined in the Bid Schedule. The Contractor shall be required to excavate and install the new 6"Ø SDR-21 watermain at a depth greater than (42 inches) as shown on Plan Sheet C-9. Included in the unit price will be all labor, materials, equipment, pumping equipment if required for dewatering, bracing and shoring of side slopes (due to excavated depths), loading, transportation, stringing, installation, trenching, bedding, tracer wire, D.I.P. fittings, backfilling operation, testing, flushing, chlorination and all incidental work required to make complete. Submit the procedure for bracing and shoring the trenching (side walls) operation to the Engineer for approval before starting excavation. Reference Section 02222, paragraph 3.03 (B) of the Technical Specifications.

Connection (Tie) Between Existing Watermains into New 6"Ø SDR-21 Water Mains (Bid Item 14)

Payment will be based on a unit price per each tie connection as outlined in the Bid Schedule. The Contractor shall connect the existing 6"Ø PVC water mains that are to remain as part of the water distribution system with the new installed water systems to make complete. There are seven (7) wet tap connections as shown on Plan Sheets No. C-3 through C-9. Included in the price will be all labor, materials, equipment, pumping apparatus if required for dewatering, locating existing piping, excavation, bedding, backfill, compaction, thrust blocks, wet tapping sleeve and gate valve, riser box, mechanical joint fittings, piping, flange adapters, reducers, sleeves, couplings, elbows, tees, and all other D.I.P. fittings required to make the connections. The Contractor shall submit a proposed plan to accomplish the above work to the Engineer and Osage County PWSD No. 3 for approval. Each tie connection will be disinfected before connection to the main system. Reference Tapping Sleeve and Valve Details and M.J. Cap Detail 3 on Plan Sheet C-12.

Furnish, Install and Connect New 4"Ø Gate Valve and SDR-21 Piping (Bid Item 15)

Payment will be based on a unit price per each gate valve with tee required for construction. Included in the unit price will be any additional excavation, all labor, materials, equipment, hauling off of excavated material, setting of new gate valve, bedding, thrust block, riser frame and cover, 4"Ø SDR-21 piping, D.I.P. fittings, backfill, gaskets, flushing, chlorination, testing, final clean up, and all other related appurtenance for a complete unit in place. Reference Plan Sheets C-4 and C-6 for location and Plan Sheet C-12, Gate Valve Detail.

Tapping Connections for Service Lateral between New Meter Pit and New 6"Ø SDR-21 Water Mains (Bid Item 16 and 19)

Under this Bid Item, the Contractor shall connect (tap) the new 1 1/2"Ø and 2"Ø service lateral to the new 6"Ø SDR-21 PVC water main after the new main has been approved by the Engineer. Payment will be based on a unit price for each service lateral connection to the new water main as outlined in the Bid Schedule. Included will be the required brass saddles, corporation stops, service clamps, unions, tapping, compression fittings, tracer wire, excavation, surface restoration, bedding, backfill, seeding operations, all labor, materials and equipment, clean-up and all related fittings and other items required to make the connection complete. Reference Plan Sheet C-12.

Furnish, Install and Connect New 1 1/2"Ø and 2"Ø PVC, SDR-9, CTS, Service Lateral Piping Length (Bid Item 17 and 20)

The Contractor shall install the required length of new SDR-9 piping between the new water main tapping connection and the new installed water meter configuration. Payment will be based on a unit price per linear foot for installed SDR-9 piping with bedding and tracer wire. The required length will be measured in the field by the Engineer. Included in the price will be the length of PVC SDR-9 piping, labor, materials, equipment, trenching, bedding, backfill, and all M.J. D.I.P. fittings to make the connection between new meter pit and new water main.

Furnish, Install and Connect New Meter, Yoke, Meter Pit, Covers at Designated Water Meter Location (Bid Item 18 and 21)

Payment will be based on a unit price for the water meter pit to be replaced as outlined in the Bid Schedule. Typical meter service details are shown on Plan Sheet No. C-12. Plan Sheets show the new water meters locations and the new waterline routing plans. Included in the price will be all labor, materials, equipment, excavation, bedding, haul off any excavated material and disposal, installation and connection of all new components, equipment, supply and pipe connections, meter set (yoke) with check valve, unions, fittings, piping, all required clamps, and mechanical end cap fittings to make complete. All new water service lateral piping outside the new meter pit configuration will be SDR-9, PVC, CTS. Contractor will install the existing flow meters in the new meter pits.

Furnish, Install and Connect New 2"Ø Service Lateral (Bid Item 22)

Payment will be based on a unit price per linear foot as outlined in the Bid Schedule. This new 2"Ø service lateral will require Restrained Joint PVC, SDR-17 piping installed in new 6"Ø steel casing with spacers, as shown on Plan Sheet C-6 with 1"Ø clean full-granular backfill. This new service line will be connected to the new 6"Ø SDR-21 watermain, cross existing grass and asphalt surfaces and connect to the existing 2"Ø PVC service line that will remain in place. All existing concrete curb and asphalt pavement will be saw-cut (2' wide) for trenching excavation, reference Plan Sheet C-13, Typical Trench Details. Contractor will be responsible for replacing all asphalt and concrete curb pavement removed (Section 02512). Included in the unit price will be all labor, materials, equipment, loading, transportation, stringing, installation, excavation, bedding, piping, D.I.P. fittings, elbows, brass saddles with corp. stops (2), riser boxes (2), 1"Ø clean full-granular backfill, steel casing, spacers, asphalt and concrete replacement, tracer wire, restoration and seeding operations, testing, flushing and chlorination of system. (Submit a proposed plan to complete this item to the Engineer for approval.)

Furnish, Install and Connect New 6"Ø SDR-21 Watermain to New Concrete Utility Vault (Bid Item 23)

Payment will be based on a unit price per linear foot as outlined in the Bid Schedule. This new 6"Ø service water main will require Restrained Joint PVC, SDR-21 piping installed in new 12"Ø steel casing with 1"Ø clean full-granular backfill. This new watermain service will be connected to the new 6"Ø SDR-21 watermain and continue up to and be connected to the new 6"Ø gate valve outside (south-end) of the new concrete utility vault. Included in the unit price will be all labor, materials, equipment, excavation and disposal of material, bedding, loading, transportation, stringing, installation, tracer wire, piping, steel casing, spacers, 1"Ø clean full granular backfill, D.I.P. fittings, connections, restoration and seeding operations, testing, flushing and chlorination of new system. (Submit a proposed plan to complete this item to the Engineer for approval.)

Furnish and Install New 6"Ø Gate Valves and Valve Boxes (Bid Items 24)

Payment will be on a unit price basis for each new 6"Ø DIP gate valve as outlined in the Bid Schedule. There shall be no extra payment for DIP valve boxes, covers, risers and extensions. The unit price for each gate valve configuration shall include all additional excavation that has not been paid for under the water line unit price including labor, materials, equipment, haul off of excavated material, setting of gate valve, valve box/lid, bedding, pipe fittings and mechanical joints, thrust blocking, riser frame and cover, backfill, restoration of adjacent surface areas, seeding operations, pipe gaskets, final cleanup, tracer wire and all related appurtenances for a complete unit in place. Covers for all gate valve box risers shall be labeled "WATER". No direct payment shall be made for seeding of the disturbed areas. Reference Section 02700 – Water System of the Technical Specifications and Plan Sheet C-12, Gate Valve Detail. Submit all materials for the approval of the Engineer.

Furnish and Install D.I.P. Mechanical Joint Fittings (Tees and Elbows)  
(Bid Items 25, 26 and 27)

Payment will be based on a unit price per each size and type of piping configured fittings required for the construction of the new water system improvements and connections to the existing water mains and waterlines as outlined in the Bid Schedule. Included in the price will be all labor, materials, equipment, installation of the fittings, bedding, thrust blocking, backfill, and all other related appurtenances for a complete unit in place. All other D.I.P. mechanical joint fittings required for the construction of the new water system are included in Bid Item No. 2. Submit all materials for the approval of the Engineer. All miscellaneous items including but not limited to D.I.P., PVC fittings and connections, not listed in the contract required for construction shall be incidental to the construction and included in the unit price in the various Bid Items, by the Contractor, Plan Sheet 2, General Notes, Item No. 14 and 15.

Install New Fire Hydrants into New SDR-21 PVC Water System (Bid Item 28)

Payment will be based on a unit price basis for each fire hydrant and D.I.P. connections, as outlined in the Bid Schedule. There shall be no extra payment for associated gate valves, valve risers and extensions. The unit price for each hydrant shall include all additional excavation that has not been paid for under the water line unit price including labor, materials, equipment, haul off of excavated material, setting of new hydrant and associated gate valve, bedding, thrust blocking, riser frame and cover, piping, D.I.P. fittings, anchor coupling, backfill, restoration of adjacent surface areas, pipe gaskets, flushing, chlorination, testing, final cleanup, and all related appurtenances for a complete unit in place. The cost and installation of a shut off gate valve is included with each hydrant, as shown in Plan Sheet C-12 – Standard Details. Excavated areas shall be backfilled with soils, graded, rocks picked up and disposed, reseeded, limed, fertilized, mulched and restored as specified in Technical Specifications, Section 02900.

Furnish and Install Mechanical Plug at End of New or Existing Water Mains (Bid Item 29)

Payment will be based on a price per each unit as outlined in the Bid Schedule. Included in the price will be all labor, materials, equipment, excavation, D.I.P. mechanical joint plug and cap fittings, concrete thrust block, bedding and backfill. Submit mechanical plug and cap fittings for Engineer approval. Reference Plan Sheet C-12.

Furnish and Install Combination Air/Vacuum Release Valves (Bid Item 30)

Payment will be based on a unit price for each unit as outlined in the Bid Schedule. Included in the unit price will be setting the combination air/vacuum release valves, as shown on Plan Sheet C-13, all labor, materials, equipment, excavation, bedding, schedule 40 PVC drain pipe, fittings, valve pit and cover, tracer wire, thrust blocking, backfill, and restoration of surface area with seeding operations. Submit equipment and release valve configurations to the Engineer for approval.

### Construct New Reinforced Concrete Utility Vault (Bid Item 31)

Payment will be based on a lump sum basis as outlined in the Bid Schedule. The Contractor shall be responsible for the construction of the 8 foot wide by 14 foot long reinforced concrete utility vault with all the required service equipment shown on Plan Sheet No. 14, complete. Included in the lump sum price will be all labor, materials, equipment, construction of reinforced concrete vault, excavation, haul off of excavated material, support bracking for existing piping, setting of all new gate valves, pressure gages, backflow preventer, flow meters, D.I.P. fitting, 4"Ø & 6"Ø SDR-21 piping, connections, adjustable pipe supports, sleeves, A-Lock gaskets, bedding material, (2) Neenah hatch covers, water stops, testing, 1"Ø clean bedding and required backfill, and all related appurtenances for a completed unit in place. Submittals are required as specified in the General Construction Notes; Plan Sheet C-14, for Engineer's approval.

### Remove Existing Gate Valves, Water Meter Pits, Riser Boxes and Backfill (Bid Item 32)

Payment will be based on a unit price for each complete unit removed and backfilled as outlined in the Bid Schedule. Included in the price will be all labor, materials and equipment, excavation, cutting, removal, backfill of excavated area with trenching material, restoration of surface area and seeding operations under Section 02900. The existing water meters will be re-used in the new water meter pits. Remove and return all components to PWSD No. 3.

### Clearing, Grubbing, and Disposal for New Water Distribution System (Bid Item 33)

Payment will be based on a unit price per linear foot, as outlined in the Bid Schedule. Contractor shall cut trees (5' above the ground) and remove trees, shrubs and other vegetation along the proposed new water distribution system routing plans, Plan Sheets C-3 through C-9, to include removing all stumps and roots by excavation and backfilling the void with trenching material. Included in the unit price will be all labor, materials, equipment, excavation, disposal of trees, stump, roots and other vegetation to permit installation of the proposed new water main extension. All distributed areas will be graded and seeded in accordance with Section 02900. The Contractor shall remain within the specified thirty (30) foot construction easement, and any disturbance/damage to areas outside the 30-foot easement will be repaired or replaced at the Contractors expense. Submit a proposed plan for clearing and grubbing operations to the Engineer for approval.

### Furnish and Install 6"Ø Bollard Pipe Guard Post (Bid Item 34)

Payment will be based on a unit price per each unit, as outlined in the Bid Schedule. Included in the price will be all labor, materials, equipment, installation of 6"Ø bollard, post set in concrete, backfilling, surface restoration and seeding operations. Bollard locations are shown on the Plan Sheet C-4 or as directed by the Engineer. Submit shop drawings for Engineer's approval. Reference Plan Sheet C-13 for bollard details.

### Traffic Control and Signage (Bid Item 35)

Payment will be made on a lump sum basis as outlined in the Bid Schedule. Included in the price will be all the required barricades, reflectors, night lighting, and signage based on MoDOT safety standards, labor, materials, and equipment to meet the temporary traffic management plan as required and approved by the Engineer. Submit traffic plan to the Engineer and Osage County PWSD No. 3 for approval. Contractor is required to contact and coordinate with property and business owners, Engineer, Osage County PWSD No. 3, and MoDOT prior to any temporary closing of streets, driveways, parking areas, or loss of water services. Reference General Notes, Item No. 33, on Plan Sheet C-2.

### Construction Survey Layout and Staking (Bid Item 36)

Payment will be made on a lump sum basis as outlined in the Bid Schedule. The plans provide locations for water main routing and infrastructure improvements. The Owner, Site Inspector, and Contractor shall coordinate efforts to verify field locations. All surveying must be performed under the direction of a Missouri registered Engineer or land surveyor, approved by the Engineer. The items that must be layout and staked are the new water main routing, roadway bores, roadway open-cut sections, sampling stations, air/vaccum release valves and concrete utility vault.

### Potable Watermain Rerouting As-Builts (Bid Item 37)

Payment will be on a lump sum basis as outlined in the Bid Schedule. The Contractor shall be responsible for surveying and providing field coordinate data for all actual water main and waterline routing, bend points, service laterals, roadway open-cuts and bores, and all water infrastructure including concrete utility vault, valves, meters, and any and all other pertinent improvements and related data as required by the Engineer and providing a full set of as-built plans to the Owner for all the water infrastructure improvement components. Hard paper red lined plan sheet copies developed during the construction process shall also be provided to the Engineer for further documentation of construction activities. The coordinate system shall be in accordance with the datum as provided by the Engineer. Included in the price will be all labor, materials, equipment, as specified in the Contract Documents.

The following are general conditions and requirements of this project and shall be included in the Bid Schedule costs as they relate to each Bid Item specified in the Contract Documents. It is the Contractor's responsibility to comply with these listed items and the General Construction Notes specified in Plan Sheet C-2 and the Technical Specifications as part of the Contract Documents:

### Labor, Materials, and Equipment

All the above Bid Items identified in the Bid Schedule, include the cost of providing labor, materials, and equipment to provide a complete operational water system project.

### Field Verification

Contractor shall be required and responsible for locating all existing sewer mains and laterals, manholes, force mains, existing water mains, waterlines and service laterals, and connecting the new water system service to the existing or new water mains. These locations shall be considered as incidental to the construction process and will be included in the price of the various Bid items.

### Mechanical Pipe Fittings (D.I.P.)

No additional payment for select mechanical water pipe main fittings, such as DIP compact bends, restrained M.J. connectors, reducers, flange adaptors (other than those specified in the Bid Schedule). These fittings will be considered as part of the water main construction and shall be included in the various Bid Item pricing.

### Pipe Fittings

Ductile Iron: No separate payment for ductile iron fittings, (unless designated in the Bid Schedule). Ductile iron fittings will be considered as part of the potable water system improvements installation. Ductile iron pipe fittings shall be required at all water main bend points, ninety-degree bents shall use 2 – forty-five (45°) fittings with a 2' length of SDR-21 PVC pipe installed between the two (2) fittings.

PVC: No separate payment for PVC fittings. These fittings will be considered as part of the water main and waterline installation and be included in the Bid Item Pricing.

### Bedding Material

Bedding required for all pipe and structures shall be the Contractor's responsibility and will be included in the installation or construction price of the various Bid Items.

### Disposal of Excavated Trenching Materials

The Contractor shall be required and responsible for disposing all excavated trenching material, not used as backfill in green areas. There will be no separate payment for disposal in the Bid Schedule, it shall be considered as incidental to the construction of the new SDR-21 water mains and waterlines and included in the unit price of various Bid Items in the Contract Documents.

### Erosion Control Measure

Erosion control measures used on the project as shown on Plan Sheet C-13 and as specified in Section 02105 and the SWPPP, will be considered as incidental to the construction of the potable water system improvements. Included will be the labor, materials, and equipment to install erosion control measures as necessary. If the straw bales or silt fencing is broken or has failed, the Contractor shall repair or replace the fencing or straw bales at no additional cost to the Owner.

## Structures

The Contractor shall be responsible for setting all structures at the designed elevations shown on the plan and profile sheets, or as directed by the Engineer. It shall be considered as incidental to the construction of the project.

## Excavation for Structures

No direct payment will be made for the excavation shown on the construction drawings. Excavation for the structures are included in the Bid Item price.

## Subgrade Preparation

No direct payment will be made for subgrade preparation and compaction tests, it shall be considered as incidental to the construction and included as part of the unit price of the various Bid Items.

## Rock Fill Under or Around Structures

No extra payment will be made to provide the aggregate to be used under or around structures, but it shall be considered incidental to the specified work; the Contractor shall install and compact, as specified by the Engineer. Included shall be the spreading or placing, forming and any labor and equipment involved in placing the aggregate where required under or around structures, in place.

## Access to Construction Site and Contract Records

The Owner, Engineer, MoDOT, and Missouri Department of Natural Resources, or any of their duly authorized representatives shall have access to the project site and to any books, documents, papers, and records of the Contractor which are directly pertinent to the project for the purpose of making audit, examination, excerpts, and transcriptions. This access availability is included in the project cost.

## Temporary Fencing for Security and Safety

The Contractor shall provide temporary orange barrier fencing for site security and safety during construction of the project. Contractor shall provide a fencing plan to the Engineer for approval to protect farm animals and the public. Included will be the installation, maintenance, and removal after construction, restoration, labor, materials, and equipment, should be considered incidental to the construction of the project.

## Portable Sanitation Facilities

The Contractor shall be responsible for providing adequate and readily accessible portable sanitation facilities for his employees in the field during construction. No direct payment will be made for this item, but it shall be considered as incidental to the construction of the project.

# TECHNICAL SPECIFICATIONS

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## SECTION 02105 EROSION CONTROL

### PART 1 - GENERAL

#### 1.01 RELATED WORK SPECIFIED ELSEWHERE:

- A. Excavating, Backfilling, and Compacting for Utilities: Section 02222.

#### 1.02 DESCRIPTION:

- A. Work Included: Provide and install all materials, equipment, and labor necessary for the control of surface water and as required to provide silt and erosion control structures as specified herein, and in the Storm Water Pollution Prevention Plan (SWPPP).
- B. Permanent Control: Furnish and place mulch or matting on surfaces prepared and seeded under other items, as locations shown on the Drawings, or as directed by the Engineer.
- C. Temporary Control:
  - 1. When the use of hay bales is specified, furnish and place hay bales as a temporary erosion and sediment control device at locations shown on the Drawings, or as directed by the Engineer.
  - 2. When siltation fence is specified, install siltation fence at locations shown on the Drawings, or as directed by the Engineer.
  - 3. When seeding is specified, sow seed of the type specified on the areas as directed by the Engineer.

#### 1.03 SEDIMENT CONTROL GUIDELINES:

- A. U.S. Environmental Protection Agency Publication 430/9-73-007 Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity.
- B. U.S. Department of Agriculture Soil Conservation Service Publication dated July 1975. Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas.

#### 1.04 REVIEW AND/OR INSPECTION OF SEDIMENTATION CONTROL MEASURES:

- A. All construction under this project shall be subject to review and/or inspection by the appropriate State and Federal agencies responsible for ensuring the adequacy of sedimentation control measures.

#### 1.05 STORM WATER POLLUTION PREVENTION PLAN (SWPPP):

- A. The Engineer will develop the Storm Water Pollution Prevention Plan (SWPPP) to maximize the potential benefits of pollution prevention and sediment and erosion control measures at the construction site. The Contractor shall be responsible for the requirements specified in the plan and the reporting process at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.01 MATERIALS:

#### A. Mulch:

1. Late cut, matured, and cured straw or straw.
2. When air-dried in the loose state, the contents of a representative bale shall lose not more than 15 percent of the resulting air-dry weight of the bale.
3. Free from primary noxious weed seeds as stated in the Missouri Seed Law.

#### B. Matting for Erosion Control:

##### 1. Plastic Netting:

- a. The netting shall consist of green degradable polypropylene extended oriented plastic net with bonded joints having openings not to exceed  $4\frac{1}{2}$  square inches with either dimension not to exceed 3".

##### 2. Excelsior Mat:

- a. Wood excelsior, with approximately 80 percent of the fibers having a minimum length of 6".
- b. The wood from which the excelsior is cut shall be properly cured to achieve adequately curled and barbed fibers.
- c. The blanket shall be of consistent thickness, with fibers evenly distributed over the entire area of the blanket.
- d. The blanket shall be covered on the top side with a netting having a maximum mesh size of  $1\frac{1}{2} \times 3$  inches composed of cotton cord, twisted Kraft paper yarn, or degradable extended plastic. The netting shall be entwined with the excelsior mat for maximum strength and ease of handling.
- e. The blanket shall be made smolder resistant with a treatment that shall be nonleaching, non-toxic to vegetation, and shall not be toxic or injurious to humans. In dry-air conditions, the blanket shall not flame or smolder for a distance of more than 12" from where a lighted cigarette is placed on the surface.
- f. The blanket shall weigh at least 0.75 pounds per square yard.

#### C. Staples: No. 11 (or heavier) ungalvanized steel wire, made from lengths of at least 6" each.

#### D. Seed for Erosion Control:

1. For Temporary Control: Annual winter rye grass, as directed by the Engineer and at no additional cost to the OWNER.

- E. Straw Bales:
1. Consist of rectangular-shaped bales of straw or straw weighing at least 50 pounds per bale with a minimum size of 1.0' x 1.5' x 3.0'.
  2. Free from primary noxious weed seeds and rough or woody materials.
- F. Siltation Fence: Envirofence as manufactured by Mirafi Inc. or comparable Siltation fence by Advanced Drainage Systems, Inc. (ADS), American Engineering Fabrics, Inc. or approved equal.

### PART 3 - EXECUTION

#### 3.01 PERFORMANCE:

A. Diverting Surface Water:

1. Build, maintain, and operate all channels, flumes, sumps, and other temporary diversion and protection works needed to divert surface water through or around the construction site and away from the construction work while construction is in progress.
2. Unless otherwise specified, stream diversion must discharge into the same natural drainage way in which its head works are located.

B. Erosion Control Provisions:

1. Construct all haul roads of a durable coarse granular surface material sufficiently protected from erosion through water and wind action by channeling water flow around the structure, protecting side slopes with rip-rap or fiber mats or by using straw bale dikes or stone check dams.
2. Protect areas where existing stream banks are to be excavated by constructing straw dikes at the top of slope to divert storm runoff from the disturbed area or at the toe of the slope to retain sediments, as conditions permit.
3. Straw bale dikes may be required parallel to the stream channels in order to contain sediments from the excavation operation.
4. Prior to removal of all sediment control dikes remove all retained silt or other materials at no additional cost to the Owner.

C. Mulch:

1. Undertake immediately after each area has been properly prepared.
2. When seed for erosion control is sown prior to placing the mulch, place on the seeded areas within 48 hours after seeding.
3. Apply straw that has been thoroughly fluffed at approximately 2 tons per acre unless ordered otherwise.
4. Blowing chopped mulch will be permitted when authorized.

5. Authorization will be given when it can be determined that the mulch fibers will be of such length and applied in such a manner that there will be a minimum amount of matting that would retard the growth of plants.
6. Straw mulch should cover the ground enough to shade it, but the mulch should not be so thick that a person standing cannot see ground through the mulch.
7. Remove matted mulch or bunches.
8. Employ a light covering of loose branches, a system of pegs and strings, or other approved method and remove prior to the acceptance of the project.
9. When specified, use asphalt emulsion as a tie-down, at a rate not less than 100 gallons per acre.
10. Dispose of all baling wire or rope outside the limits of the project in approved areas.

D. Matting:

1. Preparation:
  - a. Surfaces of Ditches and Slopes:
    - 1) Conform to grades and cross sections shown on the Drawings.
    - 2) Finish to a smooth and even condition with all debris, roots, stones, and lumps raked out and removed.
    - 3) Loosen soil surface to permit bedding of the matting.
    - 4) Unless otherwise directed, apply seed prior to placement.
2. Excelsior:
  - a. Unroll in the direction of the flow of water.
  - b. Where strips are laid end to end, butt adjoining ends.
  - c. When adjoining rolls are laid parallel to one another, butt matting snugly.
3. Laying and Joining:
  - a. Except where matting is turned down, spread evenly and smoothly in close contact with the ground.
  - b. Cut out bulging seams and make joints as described above.
  - c. When ordered, additional seed shall be spread over matting, particularly at those locations disturbed by building the slots. Matting shall then be pressed onto the ground with a light lawn roller or by other satisfactory means.
  - d. Drive staples vertically into the ground flush with the surface.

- e. On slopes flatter than 4:1, space staples not more than 3' apart in three rows for each strip, with one row along each edge and one row, alternately spaced, down the center.
  - f. On grades 4:1 or steeper, place staples in the same three rows, but spaced 2' apart.
  - g. On all overlapping or butting edges, double the number of staples, with the spacing halved; all ends of the matting and all required check slots shall likewise have staples spaced every foot. Matting Placed Adjacent to Boulders or Other Obstructions: Staple with no space between the staples, to eliminate any loose edges of matting.
  - h. The above specified spacing of staples may be changed as ordered, depending upon varying factors such as the season of the year or the amount of water encountered or anticipated.
  - i. In driving the staples, take care so as not to form depressions or bulges in the surface of the matting.
4. Other Matting: Approved, alternate matting shall be applied in accordance with the recommendations of the manufacturer and as directed.

E. Seed for Erosion Control:

- 1. Temporary Seeding: Seed with a winter rye grass sown at the rate of approximately 50 pounds per acre on the pure live seed basis.

F. Siltation Fence:

- 1. Install per manufacturer's requirements and in locations shown on the Drawings and as directed by the Engineer.

G. Stone Check Dams: Install where shown on Drawings. Upon completion dams may be spread out evenly to supplement rip-rap protection.

3.02 MAINTENANCE:

- A. If any staples become loosened or raised or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.
- B. Maintain areas mulched or matted, with no extra compensation, until the completion of the Contract.

3.03 STRAW BALES FOR EROSION CONTROL:

- A. Place as ordered to provide for temporary control of erosion or polluting or both.
- B. Stake with the required stakes.
- C. Upon acceptance of the Contract, the bales shall be left in place unless released to the Contractor.

- 3.04 REMOVAL OF TEMPORARY WORKS:
- A. Remove or level and grade to the extent required to present a slightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.
- 3.05 STORM WATER POLLUTION PREVENTION PROGRAM, SWPPP
- A. A DNR Land Disturbance Permit has been obtained by the Owner for this project and shall be made available to the Contractor.
  - B. The Contractor is responsible to adhere to the requirements of the DNR permit.
  - C. The Contractor shall conduct the necessary regular inspections and complete the record keeping during the extent of the contract.
  - D. The Contractor shall provide the Owner a copy of his inspection reports on a monthly basis and shall transfer the Land Disturbance record book to the Engineer during the final inspection.

**END OF SECTION**

## SECTION 02110 SITE PREPARATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Protection or removal of trees and other vegetation.
- B. Topsoil stripping.
- C. Clearing and grubbing.

#### 1.02 RELATED REQUIREMENTS. Construction Drawings.

#### 1.03 PROTECTIONS.

- A. Provide protection necessary to prevent damage to existing improvements, trees, or vegetation indicated on the Contract Documents to remain.
- B. Protect improvements on adjoining properties and on Owner's property.
- C. Restore damaged improvements to original condition as acceptable to parties having jurisdiction.
- D. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Streets and roadways shall be thoroughly cleaned and/or swept on a daily basis or more frequently as required by the governing authority.
- E. Provide traffic control as required, in accordance with the US Department of Transportation "Manual on Uniform Traffic Control Devices" and the State Highway Department requirements.

### PART 2 - PRODUCTS (This Part Not Used.)

### PART 3 - EXECUTION

- 3.01 Unless otherwise indicated on the Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation

of new construction. Removal includes digging out stumps and roots. Do not remove items elsewhere on site or premises unless specifically indicated.

- 3.02 Strip topsoil to whatever depths encountered to prevent intermingling with underlying subsoil or other objectionable material. Cut heavy growths of grass from areas before stripping. Topsoil shall consist of sandy loam surficial soil found in depth of not less than four (4) inches. Topsoil shall be reasonably free of subsoil, clay lumps, stones and other objects over two (2) inches in diameter, weeds, roots, and other objectionable material. Contractor shall be responsible to excavate up to one (1) foot below existing grade to remove topsoil included in the base Contract. Additional excavation beyond this point shall be at additional payment to be negotiated. Extra excavation shall only be performed after a written Change Order is executed. If excavation is on a slope, benching of the existing site will be required. Benching shall be performed as part of the excavation at no addition cost regardless of the depth. See Excavation Specifications for specifics.
- 3.03 Stockpile topsoil in storage piles in areas shown or where directed by the Engineer. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable as specified for waste material, unless otherwise specified by Engineer. Excess topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.
- 3.04 Completely remove stumps, roots, and other debris below proposed sub-grade elevation. Fill depressions caused by clearing and grubbing operation with satisfactory soil material, unless further excavation or earthwork is required. Place fill material in horizontal layers not exceeding eight (8") inches loose depth, and thoroughly compacted per fill requirements of this Section and Section 02200.
- 3.05 Remove existing above grade and below grade improvements and abandoned underground piping or conduit necessary to permit construction and other work.
- 3.06 Contractor shall remove from site and dispose of or if permitted burn on site all vegetative matter including trees, brush stumps, and leaves. Material removed from site shall be brought to a location acceptable to the Engineer. Burning on site must be approved by the Engineer, land owner, and proper authorities.

**END OF SECTION**

SECTION 02150  
ABANDONMENT IN-PLACE OF EXISTING WATER MAIN  
PIPING STRUCTURES

PART 1: GENERAL

1.01 SCOPE

- A. The existing potable water system includes all water mains, lines, connections, service laterals, hydrants, gate valves and other piping related to the water distribution system.
- B. Abandonment in place, by cutting, breaking, grouting, and capping existing water mains, water lines and service lines. Reference Plan Sheets C-1 to C-9 and detail sheet C-12.
- C. Abandonment in place of water mains using flowable grout fill. Flowable fill will be utilized when abandoning water mains underneath State highways as required by MODOT, or at the direction of the Engineer as field conditions dictate, or as specified on the Drawings.

1.02 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittals.
- B. Submit product data for proposed plugs, caps, and clamps for approval. Submit a proposed plan and schedule for dewatering (depressurized) and capping the existing water system lines in place.
- C. Technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.
- D. At least 15 days prior to commencing flowable grout fill abandonment activities, submit plan for abandonment, describing proposed grouting sequence and other information pertinent to completion of Work.

PART 2: PRODUCTS

2.01 GENERAL MATERIALS

- A. Concrete for reaction blocks: Minimum of 3,000 psi concrete conforming to requirements of Section 03200.
- B. Plugs, caps, and clamps: Applicable for type and diameter of pipe to be plugged.

2.02 FLOWABLE FILL GROUT REQUIREMENTS

- A. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
- B. Placement characteristics: self-leveling.
- C. Shrinkage characteristics: non-shrink.

- C. Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C940.
- D. Minimum wet density: 90 pounds per cubic foot.

### 2.03 BALLAST

- A. Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.
- B. Ballast Composition: Free of regulated waste material.

## PART 3: EXECUTION

### 3.01 DEMOLITION OF FIRE HYDRANTS, VALVES, AND PIPELINE STRUCTURES PRIOR TO ABANDONMENT

- A. Remove all watermain appurtenances, such as water meters, hydrants, valves, and valve boxes. Appurtenances shall be returned to PWSD No. 3 for future use.
- B. Demolish and remove precast concrete adjustment rings, concrete vaults and covers, or other pipeline structures, to a minimum depth of 4 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned water main. Poke holes in floor prior to filling.
- C. Until a fire hydrant is physically removed, any hydrant that becomes non - usable during abandonment procedures shall have a heavy-duty plastic wrap cover placed over it and secured and marked "Abandoned" so that fire department personnel know its status.

### 3.02 CUTTING AND CAPPING OF WATER DISTRIBUTION SYSTEM (Water Main and Waterlines)

- A. Do not begin cut, plug, and abandonment operations until replacement water system has been constructed and tested, all service connections have been installed, and replacement main is approved for use by the Engineer.
- B. Install plug, cap, clamp, and make cut at the water main and/or at the location shown on Plan Sheets.
- C. Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on Plan Sheets, unless approved by the Engineer.
- D. After the main to be abandoned has been cut and capped, check for other sources feeding abandoned water main. When sources are found, notify the Engineer and PWSD No. 3 immediately. Cut and cap abandoned main at point of other feed as directed by Engineer.
- E. Plug or cap ends or opening in abandoned main in manner approved by the Engineer. May install concrete around pipe end to ensure it is not penetrable by groundwater, one 50 lb bag.

- F. Backfill excavations in accordance with Section 02222, Excavation, backfilling and compaction, and Backfill for Utilities.
- G. Repair street surfaces in accordance with the Contract Documents.
- H. Mark location of abandoned water mains and waterlines on plans and provide to field Project Manager.

### 3.03 CUTTING AND CAPPING OF WATER SERVICE LATERALS

- A. Do not begin cut, plug, and abandonment operations until replacement service, if necessary, has been constructed and tested, and all service connections have been installed.
- B. Service lines shall be cut and capped at the water main and/or as directed by field Project Manager.
- C. Before backfilling of a capped service line is started, the capping must be observed by a construction representative.
- D. After service to be abandoned has been cut and capped, check for any other sources feeding abandoned water service. When sources are found, notify Project Manager immediately. Cut and cap abandoned main at point of other feed as directed by Project Manager.
- E. Plug or cap ends or opening in abandoned service in manner approved by Project Manager. May install concrete around pipe end to ensure its not penetrable by groundwater, one 50lb bag.
- F. Remove all water service surface identifications and appurtenances such as valves and valve boxes, meters, and backflow devices. Return appurtenances to PWSD No. 3.
- G. Backfill excavations in accordance with Section 02222.
- H. Repair paved surfaces in accordance with Technical Specifications.
- I. Mark location of abandoned water services on plans and provide to Project Manager.

### 3.04 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

- A. Have fill mix design reports and other submittals required by Paragraph 1.02 accepted by the Project Manager prior to start of placement. Notify the Project Manager at least 24 hours in advance of grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- C. Perform demolition work prior to starting fill placement. Clean placement areas of water mains of debris that may hinder fill placement. Remove excessive amounts of tuberculations and other substances that may degrade performance of fill. Do not leave debris in place if filling more than 2 percent of placement volume.
- D. Remove free water prior to starting fill placement.

### 3.05 EQUIPMENT FOR ABANDONMENT VIA FLOWABLE GROUT FILL

- A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
- B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

### 3.06 INSTALLATION OF FLOWABLE GROUT FILL

- A. Abandon existing water lines underneath roadways, paved areas and other required locations by completely filling water mains with flowable fill.
- B. Place flowable fill to fill volume between abandonment points. Continuously place flowable fill with no intermediate pour points, but not exceeding 500 feet in length.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.
- D. Pump flowable fill through bulkheads constructed for placement of two 2 -inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- E. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill water main from downstream end, to discharge at upstream end.
- F. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- G. Remediate placement of flowable fill which does not fill voids in water main or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside watermain or from surface.
- H. Plug each end of the water main being abandoned.
- I. Backfill to surface, above pipe left in place. Place and compact backfill in compliance with Section -02222 Excavation, Backfilling and Compactions for Utilities.
- J. Collect and dispose of excess flowable fill material and other debris in accordance with waste material disposal or as directed by the Project Manager.

### 3.07 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions as required by OSHA and applicable State and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

3.08 ASBESTOS CONCRETE PIPE

- A. Any work involving or impacting asbestos concrete pipe must be in accordance with the EPA's document titled "Demolition Practices Under the Asbestos NESHAP".

END OF SECTION 02150

SECTION 02200  
EARTHWORK, BACKFILL, AND COMPACTION

PART I - GENERAL

1.01 SECTION INCLUDES:

- A. Installation, protection, and/or modification of utilities during site work construction including any necessary staging of work.
- B. Scarifying, compaction, and testing of previously graded sites to ensure proper preparation and acceptability.
- C. Excavation and embankment placement to required lines, dimensions, and Subgrade elevations.
- D. Preparation of existing low areas for placing of fill, including disposal of muck, topsoil, silt, and wet or unsuitable material.

1.02 RELATED REQUIREMENTS

- A. SITE PREPARATION. Section 02110
- B. CONSTRUCTION DRAWINGS. Refer to Plans and Specifications for specific requirements regarding the earthwork beneath the building. Where the detailed plans earthwork requirements for the building subgrade pad are more stringent than those stated herein, the Architectural plans and specifications shall govern.

1.03 REFERENCE STANDARDS

The following most current publications form part of this specification to the extent indicated by references thereto and shall be followed for all construction testing:

- A. American Society for Testing and Materials (ASTM)
  - 1. D 422 Method for Particle Size Analysis of Soils
  - 2. D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Hammer and twelve (12) inch (304.8mm) Drop (Standard Proctor)
  - 3. D 1556 Test for Density of Soil in Place by the Sand Cone Method
  - 4. D 1557 Test for Moisture-Density Relations of Soils Using 10 pound (4.5 kg) Hammer and 18 inch (457mm) Drop (Modified Proctor)
  - 5. D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - 6. D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - 7. D 2216 Laboratory Determination of Moisture Content of Soil

8. D 2487 Classification of Soils for Engineering Purposes
9. D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
10. D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
11. D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
12. C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime
13. C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
14. C 618 Specification for Fly Ash and Raw or Calcified Natural Pozzolan for Use as a Material in Portland Cement Concrete
15. C 977 Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO)

1. T 88 Mechanical Analysis of Soils

PART 2 - PRODUCTS

2.01 MATERIALS

A. ACCEPTABLE STABILIZATION FABRICS AND GEOGRIDS.

1. Mirafi 500X or 600X
2. Phillips 66 Supac 6WS
3. Dupont Typar 3401 and 3601
4. Trevira S1114 and S1120
5. Tensar SS-1 and SS-2
6. Exxon GTF-200 or 350

B. FILTER / DRAINAGE FABRICS

1. Mirafi 160NS
2. Trevira 1120
3. ADS 6600 needle punched

C. SILT FENCING FABRICS

1. Phillips 66 Supac 5 NP (UV)
2. Mirafi 100X
3. ADA 3301 WE

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. On Site Vegetative Material. The top layer of friable loamy vegetative soil that will be stripped from all areas to be excavated or to receive fill prior to starting excavation. The Contractor will be responsible to sort the soil as it is stripped to that which would not be suitable and to stockpile the materials in separate locations.
- B. Remove from site material encountered in grading operations that, in opinion of Owner or Engineer, is unsuitable or undesirable for back filling, subgrade or foundation purposes. Dispose of in a manner satisfactory to Owner or Engineer. Back fill areas with layers of suitable material and compact as specified.
- C. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
  - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
  - 2. After drainage of low area is complete, remove muck, mud, debris and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
  - 3. If proposed for fill, all muck, mud and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by Owner or Owner's representative. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of perimeter of building or paving subgrade. If, after observation by Owner or Owner's representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

### 3.02 EXCAVATION FOR FILLING AND GRADING

- A. Classification of Excavation. Contractor by submitting bid acknowledges that he has investigated site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation. (No extra payment will be made for rock excavation.)
- B. Perform excavation using capable, well-maintained equipment and methods acceptable to the Owner, Engineer and governing agencies.

- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.
- D. When placing fill on slopes greater than eight (8) percent contractor shall be responsible to prepare the existing ground to receive fill material by excavating the slopes to grades that are less than five (5) percent by cutting benches with the contours of the slope. The "Benches" shall be a minimum width of 12 feet each and shall be stair stepped up the slope until existing grades are less than eight (8) percent.
- E. Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.
- F. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges, and boulders that might dislodge.
- G. Use suitable material to replace rock over blast in building area and in expansion area to facilitate placement of utilities and future footings.
- H. Break or crush rock obtained from blasting to allow use for fill in parking area as follows:
  - 1. Rock six (6) Inches or greater in largest dimension is unacceptable as fill within proposed building and paving area.
  - 2. Rock less than six (6) inches in largest dimension is acceptable as fill to within 24 inches of surface of proposed subgrade when mixed with suitable material.
  - 3. Rock fragments less than two (2) inches in largest dimension and mixed with suitable material is acceptable as fill within the upper two (2) feet of proposed subgrade.
  - 4. Provides grade and elevations for all improvements at intervals appropriate to the grading being done. All grades slopes and stakes shall be set by a registered engineer or registered land surveyor.

### 3.03 USE OF EXPLOSIVES

- A. Blasting will be allowed if written permission is given by the Owner. Contractor should seek permission prior to preparing his bid and shall not be allowed extra payment if blasting is not allowed.
- B. Comply with all laws, rules, and regulations of federal, state, and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take

special precautions for proper use of explosives to prevent harm of human life and damage to surface structures, all utility lines, or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.

- C. Contractor shall save harmless Owner and Engineer from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such manner and such time as to avoid damage affecting integrity of design to avoid damage to any new or existing structure included in or adjacent to work. It shall be Contractor's responsibility to determine method operation to ensure desired results and integrity of completed work.

### 3.04 FILLING AND SUBGRADE PREPARATION

#### A. BUILDING, ROAD, DRIVE, AND PARKING SUBGRADE AREAS

1. Building and road subgrade pad shall be that portion of site directly beneath and ten (10) feet beyond the building and appurtenance limits.
2. The building, roads, drives, and parking areas subgrade shall be prepared in strict accordance with the Drawings.
3. Unless specifically indicated otherwise on the Drawings, areas exposed by excavation or stripping and on which building or road subgrade preparations are to be performed shall be scarified to a minimum depth of eight (8) inches and compacted to a minimum of 95 percent of the optimum density in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than one (1) percent below and not more than three (3) percent above the optimum moisture content.

These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

4. Unless specifically indicated otherwise on the Drawings, fill materials used in preparation of subgrades (if applicable) shall be placed in lifts of layers not to exceed eight (8) inches loose measure and compacted to a minimum density of 95 percent of optimum density, in accordance with ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557), at a moisture content of not less than one (1) percent below and not more than three (3) percent above the optimum moisture content. Unless specifically stated otherwise in the

"foundation subsurface preparation" on the Drawings, the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable materials to be used as fill in the specified areas.

Location	PI	LL
Building Area, Below Upper Four Feet	20	50
Building Area, Upper Four Feet	20	40

**B. AREAS OF CONSTRUCTION EXCLUSIVE OF THE AREAS MENTIONED ABOVE**

(NOTE: Unless specifically indicated otherwise on the Drawings, all other areas shall be considered to be "Areas of Construction Exclusive of the AREAS MENTIONED IN 3.4.1" and therefore, subject to the specifications regarding same.

1. Unless specifically stated otherwise on the Drawings, areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of eight (8) inches and compacted to minimum of 95 percent of optimum density, in accordance with ASTM D 698 (or 92% optimum density, in accordance with ASTM D 1557), at a moisture content of not less than optimum and not more than four (4) percent above the optimum moisture content. These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two (2) perpendicular directions under the supervision and direction of the Engineer. Areas of failure shall be excavated and re-compacted as stated above.
  
2. Unless specifically stated otherwise on the Drawings, fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed eight (8) inches loose measure and compacted to a minimum density of 95 percent of optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than optimum and not more than four (4) percent above the optimum moisture content.

### 3.05 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified by Contractor to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.
- D. Grading of building, road subgrade, and paving areas shall be checked by referencing grade stakes set at not more than 50-foot centers or other appropriate means. Tolerance of plus or minus 0.06 feet will be permitted.
- E. Maintain subgrade for area to be paved and building pad subgrade, whether previously graded by others and accepted by Contractor or constructed by Contractor. Make adjustments that may be required in accordance with Specifications at no additional expense to Owner.

### 3.06 FINISH GRADING

- A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.06 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential. For topsoil application, refer to Section 02900 (Landscaping, Seeding, and Sodding).
- B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to Owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

### 3.07 SUBGRADE STABILIZATION (If Applicable)

- A. **LIME STABILIZED SUBGRADE.** Where indicated on Drawings, treat prepared subgrade with hydrated lime in accordance with applicable state highway specification. Compact to not less than 95 percent of optimum

density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).

- B. CEMENT STABILIZED SUBGRADE. Where indicated on Drawings, treat prepared subgrade with Portland cement in accordance with applicable state highway specification. Compact to not less than 95 percent of optimum density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).
- C. FLY ASH STABILIZED SUBGRADE. Where indicated on Drawings, treat prepared subgrade with fly ash in accordance with applicable state highway specification. Compact to not less than 95 percent of optimum density as determined by ASTM D 698 (or 92% of the optimum density, in accordance with ASTM D 1557).

### 3.08 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory selected and paid for by owner and under the Supervision of a Registered Engineer, shall be retained to perform construction testing on site based on the following:
  - 1. Parking and Road Subgrade Areas, Parking Lots, Roadway Subgrades and Driving Lanes, not less than one compaction test for every 1,000 square feet. In fill areas, same rate of testing for each eight (8) inch lift (measured loose).
  - 2. Areas of Construction exclusive of Building Subgrade and areas mentioned above. In cut areas not less than one compaction test for every 2,000 square feet. In fill areas, same rate of testing for each eight (8) inch lift (measured loose).
- B. If compaction requirements are not complied with at any time during construction process, remove and re-compact deficient areas until proper compaction is obtained at no additional expense to Owner.
- C. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
  - 1. MOISTURE AND DENSITY RELATIONSHIP. ASTM D 698 or ASTM D 1557.
  - 2. MECHANICAL ANALYSIS. AASHTO T 88
  - 3. PLASTICITY INDEX. ASTM D 4318
- D. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
  - 1. SAND-CONE METHOD. ASTM D 1556

2. BALLOON METHOD. ASTM D 2167
3. NUCLEAR METHOD. ASTM D 2992 (Method B-Direct Transmission)
4. GEOGAUGE METHOD:

#### A. Scope

This method covers the measurement by the GeoGauge of compaction quality via the in-place stiffness of soil or soil-aggregate mixtures. The GeoGauge and method provide a rapid means of testing so as to minimize interference and delay of construction. The method is intended for evaluating the compaction of materials used in earthworks and roadways. Results obtained from this method are applicable to the evaluation of granular cohesionless materials. They are also applicable to the evaluation of silty and clayey materials with more than 20% fines that are not subject to a change in moisture content. If the silty and clayey material experiences a change in moisture content, then moisture content needs to be taken into account if the results of this method are to be applicable. The stiffness measured with this method is influenced by boundary conditions, specifically the support offered by underlying layers as well as the thickness and modulus of the layer being tested.

#### B. Applicability

This method is useful as a non-destructive technique for monitoring compaction so as to avoid under-compaction, over-compaction or wasted effort. Through an understanding of how stiffness relates to density for a particular material and compaction procedure, the stiffness achieved may be related to percent compaction in connection with density based compaction control or specifications, e.g. to meet the requirements of ASTM D 698 using standard effort or D 1657 using modified effort. This technique is useful in the construction of road bases or earthworks, including the installation of buried pipe.

#### C. QC/QA Method

1. Establish GeoGauge Precision (once per material on a job)
  - a. Scrape a location of prepared ground approximately smooth.
  - b. If the surface is smooth & hard or rough & irregular, pat in-place ~ 1/4" of moist mortar sand.

- c. Place the GeoGauge on the surface & turn it ~ 1/4 revolution if on sand or ~ 1/2 revolution if not on sand.
  - d. Make three (3) measurements.
  - e. Raise the gauge, smooth away its footprint & turn the gauge as before once replaced between measurements.
  - f. GeoGauge precision is sufficient if the Coefficient of Variation of the 4 measurements is < 8%.
2. Establish Roller Pattern & Target Stiffness (once per material on a job).
- a. Apply sufficient material over a prepared area and layout a 40' x 10' control strip (optimum).
  - b. Assure that the material's moisture content is within + 2% of optimum.
  - c. Begin compaction.
  - d. Measure stiffness with the Geogauge after every compactor pass at an optimum of Five (5) and a minimum of Three (3) well spaced locations.
  - e. The GeoGauge will be seated as described above.
  - f. Measure density and moisture content after every Two (2) passes near Two (2) of the GeoGauge test locations.
  - g. Stop compaction when the optimum compaction (maximum dry density) and maximum stiffness is reached.
  - h. Record stiffness, density and moisture content vs. compactor passes.
  - i. Calculate the average stiffness and standard deviation over locations within the control strip for the pass number that is coincident with the maximum density.
  - j. The resulting mean stiffness will define a target stiffness at optimum moisture content.
  - k. A tolerance on this target will be defined by 2 times the standard deviation.



## SECTION 02221 WATERMAIN EXCAVATION

### 1.01 LOCATION

- A. Water lines shall be located as shown on the drawings or as staked by the Engineer.
- B. Whenever obstructions or utilities not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to change the plans and order a deviation from the line or grade, or arrange with the Owners of the structures for the removal, relocation, or reconstruction of the obstructions. If the change of plans results in a change in the amount of work by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra work, or credit to the Owner for less work.
- C. The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part. Structures broken or damaged shall be repaired the same day.

### 2.01 TRENCHING, EXCAVATION, ALIGNMENT AND GRADE

- A. Excavation can be either by hand or by machinery. Excavation shall be extended to a point that is a minimum of six (6") inches below the bottom of the pipe, or to a point 1/8 the diameter of the pipe, whichever is greater. If over-excavation of the water trench bottom occurs, it shall be corrected by the addition of properly compacted granular backfill. There shall be no extra compensation for the extra backfill unless it is specifically ordered by the Engineer. Open no more trench in advance of pipe laying than is necessary to expedite the work. Excavate trenches to a width that will provide adequate working space, but no less than the outside diameter of the bells plus twelve (12) inches. Do not undercut trench walls.
- B. In the event it is necessary to place the excavated materials on any sidewalks, the Contractor shall keep the excavated materials at a minimum of four (4) feet from the front of all buildings and from the inner portion of the sidewalk.
- C. All sidewalks are to be cleaned thoroughly and open to pedestrian traffic when work is not in progress. Barricades and flares shall be provided at each end, and at such other locations as required by the Engineer to provide safety for the general public. Where the excavated material has been deposited on grass plots, the Contractor shall remove the excavated material carefully when backfilling so as not to destroy the grass.

### 3.01 SHEETING AND BRACING

- A. Where necessary to prevent caving, trench excavation in sand, gravel, sandy soil, or other unsuitable materials shall be adequately sheeted and braced. Where sheeting and bracing are used, the clear trench width shall not be less than that specified for non-sheet pile trenches. As backfill is placed, the sheeting shall be withdrawn in sections for proper compaction of the fill materials.

### 4.01 PIPE CLEARANCE IN ROCK

- A. A minimum clearance to rock at least six (6) inches shall be provided below and on each side of all pipe, bells, and fittings. All rock, boulders, ledge rock and other large stones shall be removed to provide a minimum of six (6) inches clearance.
- B. This minimum specified clearance is a minimum clear distance, also being minimum limits of measurement, which will be permitted between any part of the pipe, or appurtenances being laid to a point of projection of such rock, boulder, or stone. Before the pipe is installed, all irregularities of the rock shall be filled with earth, or sand that has been well rammed into place and the bottom of the trench brought to the proper grade and shape.
- C. When payment for rock excavation is specifically outlined in the Proposal Form, the six (6) inch clearance on each side of the pipe, plus the outside pipe diameter shall constitute the trench width for the basis of payment for rock excavation. Depth of rock shall be measured from the top of the rock to six (6) inches below the bottom of the pipe. No extra payment will be made for rock removed below this level.

### 5.01 ROCK

- A. Trench excavation is classified as to "rock" and "earth" only if trench excavation is specifically called out as classified. If trenching is called out as unclassified, there shall be no extra payment for rock. The word "rock" is defined as being sandstone, limestone, chert, granite, siltstone, quartzite, slate, shale, occurring in its natural undisturbed state, hard and unweathered, or similar material in masses more than one and one-half cubic yard in volume, in ledges six (6) inches or more in thickness. No soft or disintegrated rock that can be removed with a hand pick, or power-operated excavator, or shovel and no loose, shaken, or previously blasted rock or broken stone in rock fillings, or elsewhere, and no rock which may fall into the excavation, will be measured or allowed. "Earth" is any excavation not classified as "rock."
- B. For the purposes of classified excavation, trench rock shall be defined as material encountered in trench excavation that cannot be dislodged by a Caterpillar Model No. 215D-LC track-type hydraulic excavator, equipped with a 24 -inch wide short-tip radius rock bucket, rated at not less than 120 hp

flywheel power with a bucket-curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,000 lbs. Trench rock excavation includes up to 6 inches over-excavation below the pipe. Rock shall be quantified by measuring the extent of rock in the trench, not by measuring the volume of removed rock. Trench rock does not include materials such as hardpan, loose rock, or other materials that can be removed by means other than drilling and blasting, but which for reasons of economy in excavation, the Contractor chooses to remove by drilling and blasting.

Rock excavation will be measured by the Engineer or his representative in its original position, after which the rock shall be excavated to the depth specified and then measured by the cubic yard. Rock excavation shall consist of the removal and satisfactory disposal of all materials, which are classified as rock. No payment shall be made for rock removal by ripping.

Rock excavation will be paid for at the contract unit price per cubic yard for rock excavation and shall include all labor, materials, and equipment to excavate and dispose of rock.

- C. Rock excavation and payment shall be in accordance with the current Missouri Standard Specific-MHTC, including sections 203.2 Classification of Excavation, 203.3.3 Excavating in Rock, 206.3.3 Basis of Payment, 206.4.13 Excavation Classification, 206.5.2, Method of Payment, and 109.16 Fixed Cost Items.

#### 6.01 BLASTING

- A. The use of dynamite or other blasting materials will be permitted upon the approval of the Engineer, and then only after adequate safety precautions have been taken. The hours of blasting shall be fixed by the Engineer. Any damage resulting from the necessary blasting shall be paid by the Contractor at his own expense. The Contractor's methods and procedures for blasting shall conform to all local and state ordinances.

#### 7.01 DEWATERING TRENCHES

- A. Adequate provisions shall be made by the Contractor for the removal and disposal of all water entering the excavation and for the maintenance of the same in a dry condition until the pipe lines and other parts of the work have been satisfactorily installed.

#### 8.01 TRAFFIC CONTROL

- A. Where traffic must cross open trenches the Contractor shall suitable bridges, or bypass as required for the proper handling of traffic. Barricades and flares shall be provided at such locations and as required by the Engineer to provide safety for the general public.

## 9.01 BACKFILLING

### A. Materials

1. Unless other protection work is directed, backfill trenches immediately after the pipe is laid. In the case of concrete cradle bedding, encasement or anchor supports, delay backfilling until the concrete has set sufficiently, a minimum of 24 hours, to support the backfill load. Except for unusual circumstances (such as subaqueous installation) permit no water to rise in unbackfilled trenches after the pipe is in place. Finely divided earth, free from debris and stones shall be hand placed to a point twelve (12) inches above the top of the pipe bedding. Backfill material to be placed above pipe bedding shall be free of brush and debris. Unless specifically authorized, place no rock or rock excavation detritus in the upper 18 inches of the trench. Place no rock or stones having a dimension larger than six (6) inches within three (3) feet of the top of the pipe. Large stones may be placed in the remainder of the trench backfill, only if well separated and arranged so that no interference with backfill settlement will result. Use paddling, jetting, or water flooding for consolidating backfill material only when approved by the Engineer. Particularly prone to water damage are watermains laid in heavy clay soils or during cold winter months. Water flooding, or jetting in porous sand or gravel during warm periods may be recommended. In general, limit the addition of water during backfill to provide optimum moisture content for tamping procedures. Unless otherwise required, the backfill beneath streets, pavements, drives, curbs, walks, and other surface construction shall be Type 1 base rock material. The Contractor shall be required to obtain 98% compaction of the backfill material under all roadways and the materials shall be compacted in one (1) foot or less lifts. In less critical areas, a more moderate degree of compaction would be acceptable. Special care should be taken to provide an adequately compacted trench in order to minimize the possibility of soil erosion on steep slopes.
2. See pipe bedding gradation Section 02222.

### B. Cleanup

All excess excavation materials, if any, shall be moved from the alignment of the trench and disposed in a location obtained by the Contractor and approved by the Engineer. If extra trench fill is needed, approved material shall be provided by the Contractor at no additional cost to the Owner.

### C. Backfill in Unsuitable Material

1. Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic material that in the judgment of the Engineer should be removed, the Contractor shall excavate any such unsuitable material to the width

and depth ordered by the Engineer. Before the pipe is laid the subgrade shall be made by backfilling with an approved material in six (6) inch layers. These layers shall be thoroughly tamped to provide uniform and continuous bearing for the pipe. The Contractor will be allowed extra compensation for the additional work only after authorization by the Engineer, and as allowed for under bid item "Bedding Material" in the Bid Proposal.

2. Where the bottom of the trench at subgrade is found to consist of material that is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling timbers or other materials, in accordance with plans prepared by the Engineer. Extra compensation will be allowed for additional work under bid item "Bedding Material" in the Bid Proposal, only after authorization by the Engineer.

#### D. Restoration of Original Surfaces

1. All surplus materials, excavated and not required for backfill in the excavations, shall be removed from the area by the Contractor and deposited and graded at accessible points as directed by the Engineer. The cost of hauling, depositing and grading of the waste materials shall be done at the expense of the Contractor. Upon completion of the backfill of the trench, the trench shall be maintained in a safe condition relative to transportation and maintenance. If extra trench fill or cover is needed, approved material shall be provided by the Contractor at no additional cost to the Owner. The ditches shall be maintained for a period of twelve (12) months in such a manner that no standing water or settlement will occur over the trenches. Road resurfacing shall consist of the placement and compaction of a minimum of eight (8") inches of base material meeting Missouri Highway Department standard specifications for Type I aggregate. The surface coating shall equal thickness and quality of the surfacing removed during excavation.

#### E. Horizontal Separation of Water Mains and Sewers

1. Whenever possible the watermains shall be laid ten (10) feet, horizontally, from any existing or proposed sewer lines. Should local conditions prevent a lateral separation often (10) feet, watermains may be laid closer than ten (10) feet to a sewer line, provided that the water main is laid in a separate trench, or on an undisturbed earth located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. When it is impossible to obtain the proper horizontal or vertical clearance as stipulated above, both the water main and the sewer shall be

constructed of a slip-on or mechanical joint cast iron pipe and shall be pressure tested to assure water-tightness before backfilling.

F. Vertical Separation of Water Mains and Sewers

1. Whenever sewer lines must cross house water lines or water mains, the water main must be laid at such an elevation that the bottom of the water main is 18 inches above the top of the sewer line. The vertical separation shall be maintained for that portion of the water main located within ten (10) feet horizontally of any sewer line it crosses. Said ten (10) feet is to be measured as the normal distance from the water main to the sewer. Where conditions prevent this minimum vertical separation from being maintained, or where it is necessary for the water main to pass under a sewer line, the water main shall be laid with slip-on or mechanical joint cast iron pipe and the pipe shall extend on each side of the crossing until the normal distance from the water main to the sewer line is at least ten (10) feet. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main must cross under a sewer, a vertical separation of 18 inches between the bottom of the sewer and the top of the water main shall be maintained, with adequate support for the larger-sized sewer lines to prevent them from settling on and breaking the water main.

G. Separation of Water Mains and Sewer Manholes

1. No water pipe shall pass through, or come into contact with, any part of a sewer manhole, but must have a horizontal distance of 10 feet. No water or sewer line shall come into contact with any public or private well. A fifty (50') horizontal separation is required.

H. Crossings

1. Highway Crossings Where watermains are to be constructed along and/or across Township, County, State or Federal highways, before commencing any work within the limits of these rights-of-way, the Contractor shall have a permit from the governing highway department to construct the proposed watermains. The Owner will obtain necessary permits for the Contractor, but it shall be the Contractor's responsibility to give the Engineer adequate notice of his need for the permit. Costs of any necessary permits shall be paid for by the Contractor. Unless special permission is given otherwise by the governing highway department, the Contractor shall install all watermains crossing highways by boring and jacking methods so that the watermains will be installed to the lines and grades established in the plans. Casing pipe, if required, will be of the size and type as shown on the plans and/or specified by the Engineer, or otherwise a minimum wall thickness of 0.25 inches. The methods of jacking shall be subject to the Engineer's approval. The pipe or casing, if required,

shall be jacked into the fill as the boring auger drills out the gravel. The ends of the casing pipe shall be sealed with cement grout after installation of the core pipe. If ductile iron pipe is used, a suitable bracket approved by the Engineer, must be welded to the pipe in front of each joint to keep the pipe from floating where installed in a casing pipe. If an open cut is allowed for watermain replacement, the Contractor is to replace the highway crossing according to State Highway specifications. The existing pavement is to be saw cut to give a square surface to match the asphalt overlay into the existing pavement. Six (6) inches of bedding material is needed to cover the pipe. Then Type I aggregate is to extend from the bedding material to the highway surface. Finally three (3) inches of asphalt overlay is to cover the cut and match into the existing pavement. The Contractor is to maintain the road surface for a minimum of twelve (12) months against ruts, potholes, settlement and standing water holes.

2. Railroad Crossings. Where watermains are to be constructed along and/or across railroad rights-of-way, before commencing any work within the limits of these rights-of-way, the Contractor shall have a permit from the railroad to construct the proposed watermains. The Owner will obtain the necessary permits for the Contractor, but it shall be the Contractor's responsibility to give the Engineer adequate notice of his need for the permit. Costs of any necessary permits shall be paid for by the Contractor. Unless special permission is given otherwise by the railroad, the Contractor shall install all watermain crossing railroad tracks by boring and jacking methods so that the watermains will be installed to the lines and grades established in the plans. Casing pipe, if required, will be of the size and type as shown on the plans and/or specified by the Engineer. The methods of jacking shall be subject to the Engineer's approval. The pipe or casing, if required, shall be jacked into the fill as the boring auger drills out the gravel. The ends of the casing pipe shall be sealed with cement grout after installation of the core pipe. Once the boring and jacking operations commence, they shall be carried on in successive shifts until the boring and jacking operations have been completed.
3. Pipeline Crossings. Where watermains are to be constructed along and/or across pipeline rights-of-way, before commencing any work within the limits of these rights-of-way, the Contractor shall have a permit from the pipeline company to construct the proposed watermains. The Owner shall obtain necessary permits for the Contractor, but it shall be the Contractor's responsibility to give the Engineer adequate notice of his need for the permit. Costs of any necessary permits shall be paid for by the Contractor. The locations and method of crossing shall be as shown on the plans. Adequate notice of the crossing shall be given to the Engineer and the pipeline company so that the required representative can be present during the crossing.

4. Stream Crossings. All stream crossings are shown on the plans as concrete encased and shall be constructed in accordance with the detailed drawings and these specifications. The length of the encasement is subject to manipulation to meet field conditions and if additional length is required the Contractor will be entitled to additional compensation. The concrete encasement shall extend into the stream banks until a minimum of 24" of cover is obtained over the watermain pipe or as directed by the engineer. The crossing is to be backfilled, cleaned-up, and seeded immediately. All work is to be completed within 7 days. The crossing shall not be left unprotected for any longer period than these 7 days. The concrete must cure for a minimum of 24 hours.
5. River Crossings. All river crossings are shown on the plans as concrete encased and shall be constructed in accordance with the detailed drawings and these specifications. The length of the encasement is subject to manipulation to meet field conditions. The river crossing line shall be concrete encased from manhole to manhole as shown on the plans and installed to the grades and elevations given.

I. Carrier Pipe

1. To be used on State Highways and Railroads that are bored and cased for watermain Crossings. Carrier pipe shall be Ductile Iron Pipe or Steel Casing Pipe.
2. Ductile Iron Pipe

D.I.P. Nominal Diameter	D.I.P. Wall Thickness	Thickness Class
8"	0.33"	52
10"	0.35"	52
12"	0.37"	52
14"	0.39"	52
16"	0.40"	52
18"	0.41"	52
20"	0.42"	52
24"	0.44"	52

Steel Casing Size	Casing Thickness
8"	0.250

10"	0.250
16"	0.281
20	0.344
36	0.532

J. Electric Cable Crossings

1. The Contractor shall have representatives locate the electrical cables. The Contractor shall give the electric company a minimum of 48 hours notice to come and locate the electrical cables in the area he is about to excavate.
2. Even though the cables will be located within a small distance, the Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location may be determined, both known and unknown. The Contractor will be held solely responsible for the repair of such lines broken or otherwise damaged because of carelessness on his part.
3. When backfilling the excavated lines in the location of electrical cables, the Contractor shall carefully backfill around and underneath the cable so as to give sufficient support under the cable. The electrical cables are to be fully supported by backfill before any cover is to be put over the electrical cables. The Contractor shall notify the electric company of his intention to backfill around the electrical cables and allow them the opportunity to observe the backfilling process.

**END OF SECTION**

SECTION 02222  
EXCAVATING, BACKFILLING AND  
COMPACTING FOR UTILITIES

PART 1 - GENERAL

- 1.01 Not in contract system description from 10200
- 1.02 SUMMARY: This Section includes the excavation, bedding, and backfilling of utilities necessary to perform work indicated on Drawings and Contract Documents.
- 1.03 RELATED REQUIREMENTS:
  - A. Construction Drawings
  - B. SITE PREPARATION: Section 02110
  - C. EARTHWORK, BACKFILL, AND COMPACTION: Section 02200
- 1.04 SUBMITTALS:
  - A. Shop Drawings and details pertaining to Site Utilities are required Do not perform work until required Shop Drawings have been accepted by Engineer.

PART 2 - PRODUCTS

- 2.01 GRANULAR BEDDING MATERIAL:
  - A. Processed sand and gravel free from clay lumps, organic, or other deleterious material, and complying with following gradation requirements:

<u>U.S. Sieve Size</u>	<u>Percent Passing (by weight)</u>
1 Inch	100
3/4 Inch	95 - 100
No. 4	0 - 5

- 2.02 STEEL CASING PIPE:
  - A. Comply with AWWA C 201 or C 202, minimum Grade B, size and wall thickness as indicated on Drawings.

## PART 3 - EXECUTION

### 3.01 SUMMARY:

- A. Set all lines, elevations, and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments, or other reference points.
- B. Maintain in operating condition existing utilities, active utilities, drainage systems encountered in utility installation. Repair any surface or subsurface improvements shown on Drawings.
- C. Verify location, size, elevation, and other pertinent data required to make connections to existing utilities and drainage systems as indicated on Drawings. Contractor shall comply with local codes and regulations.

### 3.02 EXCAVATION, TRENCHING, AND BACKFILLING:

- A. Contractor shall strip all topsoil minimum (6") from field areas and stockpile this material separate from other earth. Contractor shall use stockpiled topsoil for restoration of the surface of the trenches.
- B. Perform excavation as indicated for specified depths. During excavation stockpile materials suitable for backfilling in an orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
  - 1. Remove excavated materials not required or not suitable for backfill of embankments and waste as specified. Any structures discovered during excavation(s) shall be disposed of as specified.
  - 2. Prevent surface water from flowing into trenches or other excavations temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.
  - 3. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.

### 3.03 TRENCH EXCAVATION:

- A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks as nearly vertical as practical and remove stones as necessary to avoid point bearing. Over excavate wet or unstable soil, if

encountered, from trench bottom as necessary to prove suitable base for continuous and uniform bedding.

- B. All trench excavation side walls greater than five feet (5') in depth shall be sloped, shored, sheeted, braced or otherwise supported by means of the sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than twenty-five feet (25') in trenches four feet (4') or deeper.
- C. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- D. For utilities receiving select earth bedding trench width requirements below the top of the pipe shall not be less than twelve inches (12") nor more than eighteen inches (18") wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- E. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances:
  - 1. WATER MAINS: Forty-two inches (42") to top of pipe barrel.
  - 2. SANITARY SEWER: Elevations and grades as indicated on Drawings.
  - 3. STORM SEWER: Depth, elevations, and grades as shown on Drawings.
  - 4. ELECTRICAL CONDUITS: Twenty-four inches (24") minimum to top of conduit or as required by the NEW 300- 5, NEW 710-36 codes, or the local utility company requirements, whichever is deeper.
  - 5. TV CONDUITS: Eighteen inches (18") minimum to top of conduit, or as required by the local utility company, whichever is deeper.

- 6 TELEPHONE CONDUITS: Eighteen inches (18") minimum to top of conduit, or as required by the local utility company, whichever is deeper.
7. GAS MAINS AND SERVICE: Thirty inches (30") minimum to top of pipe, or as required by the local utility company, whichever is deeper.

#### 3.04 SHEETING AND BRACING:

- A. Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

#### 3.05 PIPE BEDDING (GRANULAR):

- A. Accurately cut trenches for pipe or conduit that is to be installed to designated elevations and grades to line and grade from six inches (6") below bottom of pipe and to width as specified. Place four inches (4") of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel. After pipe installation, place granular backfill and compact in maximum six-inch (6") layers measured loose to 6" above top of pipe. Place select earth materials in 6" lifts compacted to top of trench.

#### 3.06 TRENCH BACKFILLING:

- A. CRITERIA: Trenches shall not be backfilled until required tests are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner. When PVC or polyethylene pipe is used, follow requirements in storm & sanitary sewer sections of the specifications.
- B. BACKFILLING WITH 1" MINUS LIMESTONE (REQUIRED IN PARKING & ROADWAY AREAS and as shown on the drawings): After pipe or conduit has been installed, bedded, and tested as specified, backfill trench or structure excavation with 1" minus crushed limestone material placed in eight inch (8") maximum loose lifts. Compact to minimum density of ninety-five percent (95%) of optimum density in accordance with ASTM D 698 (or 92% of optimum density in accordance with ASTM D 1557), under all parking, drive or paved areas. Exercise proper caution when compacting immediately over top of pipes or conduits

- C. **COMPACTION IN OTHER AREAS:** All other areas shall be sufficiently compacted to eliminate settlement. Water jetting or flooding is not permitted as method of compaction.
- 3.07 **BORINGS AND CASINGS UNDER ROADS, HIGHWAYS AND RAILROAD CROSSINGS:**
- A. When indicated by Drawings and Specifications, make certain street, road, highway, or railroad crossings for utility mains by jacking and boring method, and install utility pipe in accordance with AREA specifications.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than six inches (6") thick for entire length and depth of trench or pit. Compact backfill to ninety-five percent (95%) of maximum density as determined by ASTM D 698 (or 92% as determined by ASTM D 1557). Mechanical tampers may be used after cover of six inches (6") has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig and bored hole to proper alignment and grade and of a diameter no less than two inches (2") larger than the largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made, and in no instance shall hole be left open while unattended.
- D. In event subsurface operations result in failure or damage to pavement within one year of construction, Contractor to make necessary repairs to pavement at no additional cost to Owner. In event paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area without further compensation.
- E. Clean and prime interior and exterior of casing pipe; and line with two (2) coats of asphalt in accordance with AREA specifications.
- F. **BUTT WELD STEEL CASING:** Welds shall be full penetration single butt-welds in accordance with AWWA C 205 and AWS D 7- 0-62.
- G. Install casing and utility pipe with end seals, vent pipe, and in accordance with other special requirements of AREA specifications and governing authorities.

**END OF SECTION**

SECTION 02305  
BORING AND JACKING

Scope:

The work covered by this Section includes furnishing all labor, materials and equipment required to bore and jack casings, install casings by horizontal directional boring or horizontal directional drilling and to properly complete pipeline construction as shown on the Drawings and described herein.

Submittals:

- A. Materials submittals shall include shop drawings for casing pipe showing sizes and connection details and details on any casing spacers that will be used.
- B. Experience submittals shall be required as boring and jacking casings is considered specialty work. If the Contractor elects to perform the work, the Contractor shall provide evidence of a minimum of five continuous years of experience in steel casing construction.
- C. Contractor shall submit allowable tensile loads ATLS for various pipe sizes and lengths and a proposed "weak-link" or breakaway device in accordance with those ATLS for approval by the Owner prior to any pull-in installation including directional drilling. ATLS shall be determined using manufacturer's recommendations and be in accordance with ASTM F 1804 Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation.

Safety:

Perform all excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226.

Products:

- A. Steel Pipe Casing: Smooth steel pipe casing shall be manufactured from steel conforming to ASTM A-139 Grade B and ASTM A252 Grade 2 as amended to date, with a minimum yield strength of 35,000 psi before cold forming.

(1) Pipe may be straight seam or spiral welded with bituminous protective coating. Spacers for installation of the carrier pipe shall be installed by the Contractor.

(2) The diameter and wall thickness of the steel piping shall be as listed in the following Table.

(3) The thicknesses of casing shown are minimum thicknesses. Actual thicknesses shall be determined by the casing installer based on an evaluation of the required

jacking forces. Any buckling of the casing due to jacking forces shall be repaired at no additional cost to the Owner.

Gravity Carrier Pipe (in.)	Press. Carrier Pipe (in.)	Outside Bell Diam. (in.)	Steel Casing (in.)	Casing Thickness (in.)
NA	2 or 3		6	0.280
NA	4	4.215	8	0.322
4	6	6.28	12	0.375
6	8	8.4	14	0.375
8	10	10.5	16	0.375
10	10	10.5	18	0.375
12	12	12.5	20	0.375
14	14	14.28	24	0.375
15	15	15.3	28	0.375
18	18	18.7	32	0.375
21	21	22.05	36	0.375
24	24	24.8	36	0.375
27	27	27.95	44	0.375
30	30	32.0	44	0.375
36	36	38.3	48	0.500
42	42	44.5	60	0.500
48	48	50.8	72	0.625

- B. Casing Spacers: Casing spacers shall be flanged, bolt-on style with a two-section stainless steel shell lined with a PVC liner, minimum 0.09-inch thick, also having a hardness of 85-90 durometer. Runners shall be attached to stainless steel risers which shall be properly welded to the shell. The height of the runners and risers shall be manufactured such that the pipe does not float in the casing. Casing spacers shall be Cascade Waterworks Manufacturing Company or Advanced Products and Systems, Inc., or equal.
- C. HDPE Casing: The casing pipe shall be either iron pipe size or ductile iron pipe size with an SDR of 17 or less. Casing pipe shall be supplied by the same supplier approved for water mains. The pipe shall be produced by Performance Pipe, or equal.

Implementation:

- A. Installation of Steel Pipe Casing by Boring: Installation of steel pipe casing shall be by the dry bore method at locations requested by the Owner. Installation of steel pipe casing shall be in accordance with the applicable regulations of the Department of Transportation (DOT), Detail Drawings, these specifications, and any permits acquired with respect to the particular boring. All excavation for the pit and bore shall be unclassified. Steel casing pipe shall be required when the carrier pipe is ductile iron and for all DOT crossings.

- (1) Boring pit: The boring pit shall be solid sheeted, braced, and shored as necessary to provide a safe operation. The Contractor shall take all precautions and comply with all requirements as may be necessary to protect private or public property.
- (2) Line and Grade: The Contractor shall set the boring rig so that after the casing is complete, and the water or sewer pipe is installed, the invert of the pipe shall conform to grade and alignment as shown on the Contract Drawings. As the casing is installed, Contractor shall check the horizontal and vertical alignment frequently. Contractor shall install the boring at a 90-degree angle to the crossing unless Engineer approves a different crossing angle.
- (3) Boring: Boring and jacking of the casing pipe shall be accomplished by the dry auger boring method without jetting, sluicing, or wet boring. The hole shall be bored and cased through the soil by a cutting head on a continuous auger mounted inside the casing pipe. The boring of the hole and installation of the casing pipe shall be simultaneous. Lengths of the casing pipe shall be fully welded to the preceding section in accordance with AWS recommended procedure.
- (4) Diameter of Hole: Bored installations shall have a bored hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
- (5) Casing Pipe Length: Lengths of casing pipe shall be as long as practical for site conditions. Joints between sections shall be completely welded in accordance with AWS recommended procedures. Prior to welding joints, the Contractor shall ensure that both ends of the casing sections being welded are square.
- (6) The Contractor shall plan to use a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.
- (7) Once the jacking procedure has begun, it should be continued without stopping until completed.
- (8) Installation of the Carrier Pipe: The carrier pipe for the water line shall be as shown on the Detail Sheet. Spacers for installation of the carrier pipe shall be furnished and installed by the Contractor.
- (9) The ends of the casing pipe shall have a wrap-around type end seal thick synthetic rubber boot secured with stainless steel bands to the casing and carrier pipe. Wrap-around end seal shall be as per Model AW manufactured by Advanced Products & Systems, Inc. or approved equal.
- (10) 2,000 psi concrete cradles shall be installed under the casing/carrier pipe transition and boot seal. Cradle shall extend a minimum of two (2) feet beyond boot seal on each end and have a depth of ten (10) inches below the casing and carrier pipes. Cradle shall be reinforced with #4 rebar 12 inches on center each way.
- (11) Payment: The price bid for the steel casing shall include all necessary excavation

and sheeting for the pit, protective service, and all other miscellaneous materials and work required for complete installation. Payment for steel casing shall be for total number of feet installed. Payment for the carrier pipe shall be by the unit price bid for the water line. The spacers shall be furnished and installed by the Contractor.

B. HDPE Casing by the Boring Method: HDPE casing pipe shall be installed by the Directional Bore Method in accordance with manufacturer's recommendations and where requested by the Owner. HDPE casing shall be installed where requested by the Owner and where the carrier pipe is also HDPE. Directional bores will be used for crossing creeks, rivers, and County Roads where approved by the Engineer.

(1) Boring pit: The boring pit shall be solid sheeted, braced, and shored as necessary to provide a safe operation. The Contractor shall take all precautions and comply with all requirements as may be necessary to protect private or public property.

(2) Line and Grade: The Contractor shall set the boring rig so that after the casing is complete, and the water or sewer carrier pipe is installed, the invert of the pipe shall conform to grade and alignment as shown on the Contract Drawings. As the casing is installed, Contractor shall check the horizontal and vertical alignment frequently. Contractor shall install the boring at a 90° angle to the crossing unless Engineer approves a different crossing angle.

(3) Centering spacers shall not be used for HDPE pipe installed in HDPE casing.

(4) The annulus between the casing and the pipe shall not be grouted.

(5) Contractor will join leading end of carrier pipe using a restrained mechanical joint or a flange adapter with a split backup ring.

(6) Diameter of Hole: Bored installations shall have a bored hole diameter essentially the same as the outside diameter of the casing pipe to be installed.

(7) Casing Pipe Length: Lengths of casing pipe shall be as long as practical for site conditions. Joints between sections shall be completely fused in accordance with the manufacturer's recommendations.

C. HDPE Casing by Horizontal Directional Drilling: HDPE casing pipe shall be installed by the Directional Drilling Method in accordance with manufacturer's recommendations, ASTM F 1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacle, Including River Crossings, Plastic Pipe Institute Polyethylene Pipe for Horizontal Directional Drilling. Directional drilling will be used only where requested by the Owner. HDPE casing shall be installed the carrier pipe is also HDPE. Directional drilling techniques may be used for crossing creeks, rivers, and County Roads where approved by the Engineer.

(1) The movement of the pipe string and the pulling load on the polyethylene pipe shall

be monitored and a weak link device shall be used to ensure that the pipe is not damaged during installation.

(2) Contractor shall allow a 24-hour relaxation period for pipe installed by directional drilling before fusing additional pipe to the pulled in pipe.

**END OF SECTION**

## SECTION 02511 ROAD CONSTRUCTION AND/OR RESURFACING

A. GENERAL : The Contractor shall reconstruct the existing access roadways and driveways at the location and grade shown on the plans. It shall have a four-inch layer of 2-1/2" clean crushed stone and 4" of 1" minus base rock spread 12' wide. It shall be ditched in the cut areas and shall have 2:1 in-slopes to the 24" deep ditch point, then 1:1 slopes to existing ground in the cuts and fills. The crushed stone shall be the thickness after the rock has been compacted to a minimum of 95% compaction (ASTM 1557). Construction of aggregate course shall conform to the typical sections, lines, grades, and thickness as shown on the drawings. Aggregate shall be crushed stone, and shall be of the angular fragments resulting from crushing by mechanical means of calcareous or dolomitic limestone from undisturbed, consolidated deposits.

### 1. Barricades and Lights

- a. Open trenches and other excavations shall be provided with suitable barriers, signs, and lights to the extent that adequate protection is provided to the public against accident by reason of such open construction. Obstructions such as material piles and equipment, shall be provided with similar warning signs and lights.
- b. Barricades and obstructions shall be illuminated by means of acceptable warning lights at night and all lights used for this purpose shall be kept burning from sunset to sunrise. Materials stored upon or alongside the public streets, roads and highways shall be so placed, and the work at all times shall be so conducted, as to cause the minimum obstruction and inconvenience to the traveling public.
- c. Barricades, signs, warning lights and other protective devices shall be installed and maintained in conformance with applicable statutory requirements and, where within highway rights-of-way, as required by the authority having jurisdiction thereover.

### 2. Responsibility of Contractor for Backfill Settlement

- a. The Contractor shall be responsible, financially and otherwise, for: (a). any and all settlement of trench and other backfill which may occur from the time of the original backfilling until the expiration of a period of one (1) year from and after the date of final acceptance of the entire contract under which the backfilling work was performed, (b). the refilling and repair of all backfill settlement and the repair or replacement to the original or a better condition of all pavement, top surfacing, driveways, curbs, gutters, walks, surface structures, utilities, and drainage facilities, sod and shrubbery, which have been damaged as a result of said backfill settlement or which have been removed or destroyed in connection with backfill replacement operations, and (c). any and all damage claims filed with or court actions brought against the Owner for and on account of

any damage or damages directly or indirectly caused by said backfill settlement.

- b. The Contractor shall make, or cause to be made, all necessary backfill replacements) and repairs or replacements appurtenant thereto, immediately from and after due notification by the Engineer or Owner of backfill settlement and resulting damage at any designated location or locations. If the Contractor does not make the necessary repairs and the Owner deems it necessary, the Owner may make the necessary repairs at the Contractor's expense.

3. Maintenance of Traffic and Road Bed

- a. Through traffic is that traffic which has neither its origin nor its destination within the limits of the project.
- b. Local traffic is that traffic which has its origin or its destination at some point within the limits of the project. Local traffic shall also include that traffic on all side roads that lead into the project where such traffic does not have satisfactory outlet over a passable road or street.
- c. Provision for local traffic shall be made by the Contractor, at his expense, at all times during construction.
- d. When the Contractor is required to maintain traffic, he shall maintain the road bed substantially free of ruts, holes, and detrimental surface deformations and provide and maintain, in a safe condition, approaches, crossings, and intersections with trails, roads and streets. Such maintenance shall be performed as necessary from the day the Contractor starts working any equipment on the project or from the first day which would qualify as a working day, whichever is earlier, until the acceptance of the work, regardless of whether the contract time for completion is on a working day or calendar day basis. Snow removal will not be required of the Contractor.

4. Opening Sections of Roads, Streets or Highways

- a. Notwithstanding any other requirements of the maintenance requirements, and when it is to the advantage of the Owner, projects involving pavement may be opened to traffic as soon as the surface has been sufficiently cured, even though the shoulders and other items of work may not be completed. Such projects or portions of projects will be accepted as to the work completed and the Contractor will be required to complete any remaining construction items under traffic prior to final acceptance. when stated in the Engineers acceptance, the Contractor will be relieved from any further responsibility, except for required liability insurance coverage, under the contract for the portion accepted. No extra compensation will be allowed the Contractor for any maintenance, inconvenience, or extra work caused by traffic using the roadbed while such shouldering and other finishing work is being done.

5. Surfacing for Temporary Use

- a. Surfacing for the temporary use of traffic shall, when directed by the Engineer, be applied to areas necessary to provide satisfactory ingress and egress to private property, across the project or along the roadway. Such surfacing will be authorized if traffic cannot be handled satisfactorily by the Contractor maintaining a reasonably smooth and drainable earth surface in accordance with the Maintenance Requirements. The quantity, quality, and type of surfacing will be designated by the Engineer. Acceptance of the material will be based on visual examination.
- 1) No measurement will be made of the material furnished as surfacing for temporary use.
  - 2) No payment will be made for preparing a subgrade, spreading or laying the surfacing and materials, maintaining the surfacing, or future removal or scarifying if necessary, but shall all be considered as incidental to the road construction.

6. Signs and Markers

- a. Signs and markers within the limits of operations shall be removed by the Contractor before work is begun. Signs and markers required for safe control and guidance of traffic shall be temporarily reset where they are readily visible to traffic, and shall be maintained in a satisfactory condition. If the nature of the work makes temporary relocation impractical, the signs shall be placed on movable supports and maintained properly. Stop and yield signs at intersecting roadways shall be maintained where they are readily visible to traffic at all times. Other individual signs may be moved aside only when they interfere with actual operations. Required signs and markers must be properly located to control traffic during the hours of darkness. Final removal of signs and markers will be permitted only when permanent signs and markers have been installed. Signs and markers remain the property of the Owner or Governing Authority and shall, after final removal, be delivered without damage to one or more locations within the project limits as directed by the Engineer. No direct payment will be made for removal, relocation, temporary supports, maintenance, or final removal and delivery of signs and markers.

7. Access Road

- a. The Contractor shall construct the access road at the location and grade shown on the detailed plans. It shall have a four (4") inch layer of 2-1/2" clean crushed stone and a four (4") inch layer of 1" minus base rock spread 12' wide. It shall be ditched in the cut areas and shall have 2:1 in slopes to two (2) foot deep ditch points, then 1:1 slopes to existing ground in the cuts and fills. The crushed stone shall be the thickness after the rock has been compacted to a minimum of 95% compaction

(ASTM 1557). Construction of aggregate course shall conform to the typical sections, lines, grades, and thickness as shown on the drawings. Aggregate shall be crushed stone, and shall be of the angular fragments resulting from crushing by mechanical means of calcareous or dolomitic limestone from undisturbed, consolidated deposits.

- b. The crushed stone shall contain not more than 15% deleterious rock and shale. Sand may be added to the crushed stone only for the purpose of reducing the plasticity index of the fraction passing the No.40 sieve in the finished product. Any sand, silt, and clay, and any deleterious rock and shale shall be uniformly distributed throughout the mass. The aggregates shall conform to the gradation requirements listed in 02511.2.
- c. The aggregate base material shall be from an approved source. The fraction passing the No.40 sieve shall have a plasticity index not greater than six (6). All materials shall contain moisture sufficient to ensure that the design density requirements will be obtained when the materials are compacted. The Contractor shall examine the areas and conditions under which the aggregate base course is to be placed for conditions detrimental to the proper and timely completion of the work. The Contractor will not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner to the Engineer.
- d. The subgrade and base course shall be compacted, graded and cut to proper lines, grades and cross-sections to the satisfaction of the Engineer before placing of the surface course. Immediately before spreading the aggregate, the subgrade shall be wetted as directed by the Engineer. The material shall be delivered to the site for placement with the material thoroughly mixed with water to approximate moisture content for desired compaction. Maintain optimum moisture content for compacting base course material during placement shaping and compaction operations. Required compaction shall be accomplished by a self-propelled smooth-wheeled roller, weighing no less than five tons, or other approved methods.
- e. Contractor shall allow the Owner's testing service to inspect and test base course layer before further construction work is performed. Base course material after compaction shall be cut to proper lines, grades, sections and cross-slopes as shown on the drawings. Tolerances shall be  $\pm 0.1$  of a foot. For compacted areas that are below 0.1 of a foot of grade, additional material shall be brought in place, shaped and compacted to attain the proper thickness and subbase elevation.
- f. The access roads shall have the ditches graded to the typical section shown on the plans at the locations indicated. The contractor shall construct ditch blocks and culvert drainage across the existing roadway where so indicated on the plans.

8. Paved Road Resurfacing

- a. Paved road resurfacing shall include a minimum of twelve (12) inches of 98% compacted crushed stone, as specified below, and a minimum of three (3) inches asphalt overlay, or greater to replace existing asphalt thickness. Resurface work shall be accomplished only after all backfill is properly compacted. The backfill compaction shall be 98% for Type I base rock. Disturbed road surfaces involving high strength designs, such as concrete or a combination of concrete and asphalt shall require resurfacing materials and procedure that will result in an equal or better design. Future maintenance, as well as initial strength, shall be considered.

9. Gravel Road Resurfacing

- a. Gravel road resurfacing shall include a minimum of twelve (12) inches of 98% compacted crushed stone (Type I aggregate) as specified below. Resurface work shall be accomplished only after all backfill is properly compacted.

10. Crushed Stone for Resurfacing Roads

- a. The crushed limestone to be used for resurfacing will conform to the following gradation requirements:

(Type I Aggregate)

Passing 1" sieve	100%
Passing 1/2" sieve	60% - 90%
Passing No.4 sieve	40% - 60%
Passing No.40 sieve	10% - 35%

- b. The twelve (12) inch minimum layer of base rock and crushed stone shall be the thickness after the rock has been compacted to a minimum of 98% compaction.

11. FULL DEPTH GRANULAR BEDDING

- a. In street, road or traffic areas, full depth granular bedding shall be placed over pipe to within (12) inches of final surface subgrade. Gradation shall be clean rock and meet the following requirements:

(1" Clean Aggregate)

Passing 1" sieve	100%
Passing 1/2" sieve	30 - 42%
Passing No.4 sieve	0% - 5%
Passing No.40 sieve	0% - 5%

B. AGGREGATE BASE COURSE

1. Description

This work shall consist of furnishing and placing one 4" lift of 2 1/2" oversize material and a 4" lift of Type I aggregate on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

2. Materials - Two and one half (2 1/2)- inch Oversize Material

- a. Two and one half (2 1/2)-inch stone base shall be essentially limestone, dolomite or creek run. The portion of the material passing the No.4 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6. The maximum amount of material finer than 0.02 mm. in diameter shall be less than 3%. The aggregates shall conform to the following gradation requirements:

	<u>Percent</u>
Passing 2 1/2-inch sieve	100 %
Passing 1 1/2-inch sieve	40 – 20%
Passing No.4 sieve	0 – 5%
Passing No.200 sieve	0 – 5%

- b. Type I aggregate (1" minus) for paving course shall be essentially limestone, dolomite or creek washed gravel. The stone shall contain not more than 15% deleterious rock and shale. Sand may be added to the crushed stone only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt, clay and any deleterious rock and shale shall be uniformly distributed throughout the mass. The aggregates shall conform to the following gradation requirements:

	<u>Percent</u>
Passing 1-inch sieve	100%
Passing 1/2-inch sieve	60-90%
Passing No. 4 sieve	40-60%
Passing No. 40 sieve	10-35%

The fraction passing the No. 40 sieve shall have a plasticity index not greater than 6.

C. CONSTRUCTION REQUIREMENTS FOR CRUSHED STONE PAVING

1. Subgrade

- a. Work on that portion of the subgrade on which the base is to be constructed shall be completed in accordance with the requirements of bedding preparation prior to the placing of any base material on that portion.

2. Mixing

- a. Unless otherwise specified, base material, any additional material required, and sufficient water to obtain the desired compaction shall be thoroughly mixed and delivered to the road as a combined product.

3. Placing

- a. The maximum compacted thickness of any one layer shall not exceed six (6) inches. When the specified compacted depth of the base course exceeds six (6) inches, the base shall be constructed in two or more layers.
- b. The Contractor shall be responsible for placing the correct quantity of base material to construct a base conforming with the contract. Excess material shall be hauled ahead and reused, or loaded into trucks and measured or weighed over scales furnished by the Contractor. Payment will be made on the basis of lineal foot of the road crossing.
- c. Aggregates shall not be deposited on the pavement and bladed or dozed into place.

4. Shaping and Compacting

- a. The mixture shall be uniformly spread in successive layers of such depth that when compacted, the base will have the approximate thickness specified. Each layer shall be compacted to the specified density before another layer is placed.
- b. Shaping and compacting shall be performed until a true, even, and uniform surface of proper grade, cross-section, and density is obtained. Types 1 aggregate shall be compacted to not less than 98 percent of standard maximum density. The standard compaction test will be made in accordance with AASHTO T 99-74, Method C, replacing any material retained on the 3/4 inch sieve, as provided therein. Field density will be determined in accordance with AASHTO T 191-61(1974), using the total material for wet density. When nuclear density test methods are used, moisture content will be determined in accordance with AASHTO T 239-73. The volume of the test hole may be reduced as necessary to accommodate available testing equipment. Rolling shall be continued until there is no visible evidence of further consolidation. During shaping and compacting operations the moisture content of the base shall be maintained at the level necessary for compaction by wetting or drying as required. Final rolling shall be accomplished by a self-propelled smooth-wheeled roller weighing not less than 5 tons. Two (2) inch base course shall be rolled until there is no visible evidence of further consolidation.
- c. Shaping of the completed surface of the aggregate base for flexible type surfacing shall be continued until the deviation from the required elevation does not exceed a roughly compensating maximum of 1/2 inch.

- d. The surface of the aggregate base shall be well drained at all times. If at any time the compacted aggregate base or subgrade becomes unstable, it shall be the Contractor's responsibility to restore, at his expense, the aggregate base to the required grade, cross-section, and density.
  - e. Materials shall contain moisture sufficient to ensure that the design density requirements will be obtained when the materials are compacted. The Contractor shall examine the areas and conditions under which the aggregate base course is to be placed for conditions detrimental to the proper and timely completion of the work. The Contractor will not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner to the Engineer.
  - f. The subgrade and base course shall be compacted, graded and cut to proper lines, grades and cross-sections to the satisfaction of the Engineer before placing of the surface course. Immediately before spreading the aggregate, the subgrade shall be wetted as directed by the Engineer. The material shall be delivered to the site for placement with the material thoroughly mixed with water to approximate moisture content for desired compaction. Maintain optimum moisture content for compacting base course material during placement, shaping and compaction operations. Required compaction shall be accomplished by a self-propelled smooth-wheeled roller, weighing no less than five tons, or other approved methods.
  - g. Contractor shall allow the Owner's testing service to inspect and test base course layer before further construction work is performed. Base course material after compaction shall be cut to proper lines, grades, sections and cross-slopes as shown on the drawings. Tolerances shall be  $\pm 0.1$  of a foot. For compacted areas that are below 0.1 of a foot of grade, additional material shall be brought in place, shaped and compacted to attain the proper thickness and sub-base elevation.
5. Maintenance
- a. When the pavement is to be constructed in more than one layer, the Contractor shall maintain each layer by wetting or drying, blading, and rolling in a manner satisfactory to the Engineer, until it is covered by the next layer. This maintenance, including the necessary water, shall be entirely at the Contractor's expense. The Contractor shall maintain the required density and surface condition of any portion of the completed base until either the prime or a succeeding course or pavement is placed.

**END OF SECTION**

## SECTION 02512 ASPHALT CONCRETE PAVING

### PART 1 - GENERAL

#### A. RELATED REQUIREMENTS:

All construction and materials shall meet or exceed the requirements of this Section and any state highway department specifications sections referred to or noted on the Drawings that pertain to asphaltic concrete paving design, materials, preparation, and/or execution of this product. All materials shall be as indicated on Drawings and shall comply with applicable state highway specifications regarding source, quality, gradation, and mix design proportioning.

#### B. SUBMITTALS:

1. **DESIGN MIX:** Before any asphaltic concrete paving is constructed, submit actual design mix to the Engineer for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual AS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, asphalt cement grade used, Marshall Stability (pounds), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. Design shall be for a mixture listed in the most recent edition of roadway specifications of the Missouri State Highway Department. In no case shall a mix design over one (1) year old be submitted.
2. **MATERIAL CERTIFICATES:** Submit materials certificate to on site Independent Testing Laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

#### C. JOB CONDITIONS:

##### 1. WEATHER LIMITATIONS:

- a. Apply prime and tack coats when ambient temperature is above forty degrees Fahrenheit (40°F), and when temperature has been above thirty-five degrees Fahrenheit (35°F) for twelve (12) hours immediately prior to application. Do not apply when base is wet or contains excess moisture.
- b. Construct asphaltic concrete paving when atmospheric temperature is above forty degrees Fahrenheit (40°F).

### PART 2 - PRODUCTS

#### A. MATERIALS:

1. Provide a plant mix Bituminous Base Course asphaltic concrete mixture for surface courses in accordance with Missouri State Highway Department specifications Section 403 (current edition). Use locally available materials and gradations that meet state highway specifications and exhibit satisfactory record on previous installation.

2. Provide a "BP-1" Type asphaltic concrete mixture for surface courses in accordance with Missouri State Highway Department specifications Section 403 (1999 edition). Use locally available materials and gradations which meet state highway specifications and exhibit satisfactory record on previous installation.
3. ASPHALT CEMENT: Comply with AASHTO M 226/ASTM D 3381; Table 1 AC-10, AC-20, or AC-30, AR-80, viscosity grade, depending on local mean annual air temperature. (See chart below):

<u>Temperature Condition</u>	<u>Asphalt Grades</u>
Cold, mean annual air temperature ≤ 7° C (45° F)	AC-10 85/100 pen.
Warm, mean annual air temperature between 7° C (45° F) and 24° C (75° F)	AC-20 60/70 pen.
Hot, mean annual air temperature ≥ 24° C (75° F)	AC-30

Final acceptance of the proper grade of A.C. shall be made by the Engineer.

4. PRIME COAT: A medium curing cut-back asphalt or an asphalt penetrating prime coat consisting of MC-30.
5. TACK COAT: On pavement to receive paving fabric; AASHTO M 226/ASTM D 3381, Table 1 AC-2.5.
6. MINERAL FILLER: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M 17/ASTM D 242, if recommended by applicable state highway standards.
7. ASPHALT-AGGREGATE MIXTURE: Unless otherwise noted on the Drawings, the Design Mix shall have a minimum stability based on a 50-blow AASHTO T167 Test of 300 pounds. The Design Mix shall be within sieve analysis and bitumen ranges below:

SIEVE ANALYSIS OF MIX ( BP-1)

<u>Square Sieve</u>	<u>Total Percent Passing</u>
¾"	100%
½"	80% - 100%
No. 4	40% - 65%
No. 8	30% - 55%
No. 30	10% - 30%
No. 200	4% - 12%

Percent bitumen by weight of total mix: 4.5% - 8.5%  
Air voids: 3% - 6%

SIEVE ANALYSIS OF MIX (Black Base)

<u>Square Sieve</u>	<u>Total Percent Passing</u>
1"	100%
1/2"	60% - 90%
No. 4	35% - 65%
No. 8	25% - 50%
No. 30	10% - 35%
No. 200	5% - 12%

Percent bitumen by weight of total mix: 4.0% - 7.0%  
Air voids: 3% - 6%

- B. **EQUIPMENT:** Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

PART 3 - EXECUTION

A. **PREPARATION:**

1. **ROCK SUBGRADE:** Remove loose material from compacted base material surface immediately before applying prime coat.
2. Compact prepared base material surface with a 10 ton vibratory roller a minimum of four (4) passes on all areas to receive asphalt.
3. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.
4. **ASPHALT OVERLAY:** Sweep all areas that are to receive an overlay so surfaces are totally free of debris or dust.

B. **APPLICATIONS:**

1. **PRIME COAT:**

- a. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.
- b. Apply bituminous prime coat in accordance with MHTD Section 408.
- c. Apply at minimum rate of 0.30 gallon per square yard over compacted base material. Apply to penetrate and seal, but not flood surface.
- d. Make necessary precautions to protect adjacent areas from overspray.
- e. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

2. **TACK COAT:**

- a. Apply to contact surfaces of previously constructed asphaltic concrete base courses or Portland cement concrete and surfaces abutting or

projecting into asphalt concrete and surfaces abutting or projecting into asphalt concrete pavement.

- b. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply asphalt tack coat on the surface of all such bases where asphaltic concrete paving will be constructed.
- c. Apply asphalt tack coat in accordance with MHTD Section 409 and applicable state highway specifications.
- d. Apply at minimum rate of 0.25 gallon per square yard of surface to all areas that receive paving fabric.
- e. Allow to dry until at proper condition to receive paving.

C ASPHALTIC CONCRETE PLACEMENT:

1. Place asphalt concrete mixture on completed compacted sub grade surface, spread, and struck off. All placement shall comply with MHTD standard specifications Section 403 (1996 edition). All of this section shall be incorporated in these specifications by reference, and it shall be the Contractor's responsibility to comply with all provisions of this section. Spread mixture at following minimum temperature.
  - a. When ambient temperature is between forty degrees Fahrenheit (40°F) and fifty degrees Fahrenheit (50°F): Two hundred eighty-five degrees Fahrenheit (285°F).
  - b. When ambient temperature is between fifty degrees Fahrenheit (50°F) and sixty degrees Fahrenheit (60°F): Two hundred eighty degrees Fahrenheit (280°F).
  - c. When ambient temperature is higher than sixty degrees Fahrenheit (60°F): Two hundred seventy-five degrees Fahrenheit (275°F).
2. All pavement shall be spread by a self propelled finishing machine with a mechanically vibrating screed. Inaccessible or irregular areas, pavement may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated coarse aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster than they can be properly spread. Workers shall not stand on the loose mixture while spreading.
3. PAVING MACHINE PLACEMENT: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than ten feet (10'-0") wide.
4. JOINTS: Make joints between old and new pavements, or between successive day's work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

D. ROLLING AND COMPACTION:

1. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. Mixture shall be compacted to a minimum of ninety-eight percent (98%) of the laboratory specimen made in proportions of the job mix formula in accordance with AASHTO T 167. Pay factors shall be according to MHTD specifications for densities below 98%. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.
2. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
3. BREAKDOWN ROLLING: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
4. SECOND ROLLING: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted. This shall be performed by a vibratory or rubber tired roller.
5. FINISH ROLLING: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
6. PATCHING: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
7. PROTECTION: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

E FIELD QUALITY CONTROL:

1. An Independent Testing Laboratory under the supervision of a registered professional engineer, employed by the contractor, shall be on site during paving to assure compaction and thickness requirements. Engineer shall also have the right to require Contractor to core asphalt at appropriate intervals to assure thickness. Contractor shall perform coring and replace cored areas with new asphalt at no additional cost to the Owner.
2. GRADE CONTROL: Establish and maintain required lines and elevations.
3. THICKNESS: In-place compacted thickness shall not be less than thickness specified on the Drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum one inch (1") overlay; or shall be removed and replaced to the proper thickness, at the discretion of Engineer; until specified thickness of the course is met or exceeded at no additional expense to Owner.
4. SURFACE SMOOTHNESS: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using ten foot (10'-0") straightedge applied parallel with, and at right angles to centerline of paved area.

The results of these tests shall be made available to the Owner upon request. Surfaces will not be acceptable if exceeding following tolerances for smoothness:

Base Course Surface:	3/8"
Wearing Course Surface:	1/4"

5. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving areas or provide diamond grinding (sec. 403.20.6.6) to meet specifications. Ground areas will also receive a slurry seal for protection.
6. **COMPACTION:** Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the Specifications at no expense to the Owner.

**END OF SECTION**

## SECTION 02615 DUCTILE IRON PIPE

### A PIPECLASS

1. Ductile Iron Pipe shall be installed according to the manufacturer's recommendations and these specifications. Pipe from 4" to 54" shall be manufactured in accordance with Federal Specifications WW-P-421 D in nominal lengths of 18 to 20 feet. Pipe design shall be in accordance with AWWA Specifications C151, ANSI A21.50, class 50 - 4" to 18", class 52 - 20" to 30" and larger unless specified elsewhere, 2-15 foot cover, trench condition "B" or Type 2 flat bottom, no blocks, tamped, backfill to center-line of pipe, except higher strength inch modules of pounds per square inch tensile - 45,000 pounds per square inch modules of rupture may be used to compute design. Pipe to be manufactured in accordance with AWWA Specification C151 (metal molds).
2. Pipe and fillings shall be lined with an approved thin cement lining, sealed with an approved bituminous seal coat in accordance with ANSI A21 .40, wherever applicable, and as further specified herein. All pipe sizes, slope, and location shall be as shown on plans and profiles. All ductile iron pipe shall be tested by the air pressure test.

### B. JOINTS AND FITTINGS

1. Joints for ductile iron shall conform to either Type II (push-on joints) or Type III (mechanical joint) furnished with complete accessories and shall be ductile iron. Ductile iron fittings shall conform to ANSI/AWWA C110/A21.10 and C111/A21.11. All fittings shall be lined with an approved thin cement lining and have a bituminous coating inside and outside. Metal thickness, class, net weight of pipe without lining, length of pipe and name of manufacturer shall be clearly marked on each length of pipe. Gaskets shall be styrene-butadiene.

### C. ANSI/AWWA STANDARDS

1. The ANSI/AWWA Standards referenced above are given in detail in the following publications:
  - a. Handbook of Ductile Iron Pipe  
Ductile Iron Pipe Research Association  
245 Riverchase Parkway East  
Birmingham, Alabama 35244  
Telephone (205) 988-9870
  - b. American Water Works Association  
6666 West Quincy Avenue  
Denver, Colorado 80235

**END OF SECTION**

Section 02618  
POLYETHYLENE PLASTIC PIPE, TUBING AND  
FITTINGS FOR WATER MAINS AND DISTRIBUTION

**INTRODUCTION**

1. AWWA C901-02: Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2" (13 mm) through 3" (76 mm) for Water Service.
2. AWWA C 906-99: Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4" (100 mm) through 63" (1,575 mm) for Water Distribution and Transmission.
3. ASTM D 2657-97: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
4. ASTM D 2683-98: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
5. ASTM D 2837-04: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
6. ASTM D 3261-03: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
7. ASTM D 3350-02a: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
8. ASTM F 1055-98e1: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
9. PPI TR-3 /2004: Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for thermoplastic Piping Materials or Pipe.
10. PPI TR-4/2004: PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe.
11. NSF/ANSI-61-2003e: Standard for Drinking Water Systems Components Health Effects.
12. CSA B137.1-2002: Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
13. PPI TR-33/2003: Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe.
14. PPI TR-41/2002: Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping.
15. AWWA M55 (expected 2005): Manual for the Design and Installation of Polyethylene Pipe in water Applications.

16. PPI TR-14/2000: Water Flow Characteristics of Thermoplastic Pipe.
17. PPI TR-34/2001: Disinfection of Newly Constructed Polyethylene Water Mains.
18. PPI Handbook of Polyethylene Pipe available at [www.plasticpipe.org](http://www.plasticpipe.org).
19. AWWA publication, "Design and Installation of PE Pipe Made in Accordance with AWWA C906".

## **I. General**

All polyethylene pipe, tubing and fittings furnished under this specification shall conform to all applicable provisions and requirements of the latest revision of AWWA C901, C906 or CSA B137.1 and, by inclusion, all appropriate standards referenced therein.

## **II. Materials**

Polyethylene compounds utilized in the manufacture of products furnished under this specification shall be listed in PPI TR-4, have a grade of PE34 with a minimum cell classification of PE 345444[C, D, or E] for PE3408 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1600 psi (PE3408) at a temperature of 73.4°F (23°C).

All materials which come in contact with water, including lubricants, shall be evaluated, tested and certified for conformance with NSF/ANSI Standard 61, if required by the production standard or requested by the end user.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing and fittings produced meet all the requirements of AWWA C901, AWWA C906, or CSA B137.1.

## **III. Pipe and Tubing**

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above. Dimensional and performance characteristics shall conform to the requirements of AWWA C901, AWWA C906, or CSA B137.1.

The pipe's DR (Dimension Ratio) and Working Pressure Rating (WPR) shall be

as specified by the project design engineer.

#### **IV. Fittings**

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of Section II above, and all appropriate requirements of AWWA C901, AWWA C906, or CSA B137.1. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Fabricated fittings shall be designed in accordance with the requirements of Section V and manufactured to be as strong or stronger than the pipe to which the fittings will be joined. Mechanical fittings produced from material not listed in Section II shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements for the fittings supplied shall comply with the appropriate sections of AWWA C901, AWWA C906, or CSA B137.1.

#### **V. Pressure Class**

The Pressure Class of the PE pipe and PE fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

**For PE 3408, the net pressure capability shall be the working pressure rating (WPR) @ 73°F as follows:**

DR	WPR (psi)	WPR + Surge (psi)	Hydrotest (psi)	Nominal 60 sec. Burst (psi)
32.5	51	76	76	200
26.0	64	96	96	256
21.0	80	120	120	320
17.0	100	150	150	400
15.5	110	165	165	440
13.5	128	192	192	512
11.0	160	240	240	640
9.0	200	300	300	800
7.0	266	400	400	1064

## VI. Marking

Pipe and tubing shall be marked in accordance with either AWWA C901, AWWA C906, or CSA B137.1 which ever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided (1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, (2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and (3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261, AWWA C906 or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

## VII. Workmanship

Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

## **VIII. Quality Control**

Pipe, tubing and fittings furnished under this specification shall comply with AWWA C901, AWWA C906, or CSA B137.1 which ever applies.

## **IX. Fusion Qualification**

The manufacturer of pipe, tubing and fittings supplied under this specification shall establish and qualify heat fusion procedures for the joining of the materials supplied if required. Qualified fusion procedures, with appropriate supporting data, shall be furnished to the purchaser upon request.

PPI Technical Report TR-33 is this generic butt fusion procedure for field fusion of polyethylene pipe. This report is also listed in ASTM D2657 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings. A list of pipe manufacturers, who have tested and approve this procedure, is shown in appendix B of that document.

## **X. Resolution of Conflicts**

The use of ASTM standard specification references without a year designation implies the most current applicable specification. In the event this specification conflicts with the specification referenced in AWWA C901, AWWA C906, CSA B137.1 or local regulations, the requirements of AWWA C901, AWWA C906, CSA B137.1 or local regulations shall apply.

SECTION 02622  
WATER MAIN  
POLYVINYL CHLORIDE (PVC)

1.01 WATER MAIN PIPE

A. GENERAL

1. This specification designates the general requirements and installation of polyvinyl chloride (PVC) pipe and fittings used for conveying water under pressure.

B. MATERIAL SPECIFICATIONS

1. All plastic pipe shall meet the requirements of AWWA. Each length of pipe must also show the diameter and the ASTM standard, which is applicable to the type of pipe specified. Plastic pipe shall be polyvinyl chloride ASTM 2241, type 1, grade 1 (normal impact). The minimum wall thickness shall conform to SDR 21.

C. MANUFACTURER'S REQUIREMENTS

1. The pipe manufacturer shall furnish three copies of a certification that the pipe furnished is in full compliance with the commercial standards applicable to the pipe specified. The manufacturer shall furnish the Engineer three copies of data showing the physical properties of the pipe furnished. Properties should include normal bursting pressure, manufacturer's name, maximum working pressure, physical dimensions, and tolerances. Pipe shall not be purchased until approved by the Engineer. The manufacturer shall also provide a factory representative skilled in the installation of the type of pipe purchased to instruct the Contractor's personnel in the proper procedures for connecting and laying the pipe.

D. MARKING

1. Pipe shall be clearly marked at intervals of five (5) feet or less with the manufacturer's name or trademark and code, nominal pipe size, PVC Type cell classification, SDR or pipe stiffness as appropriate, ASTM designation. The manufacturer's code shall include the year, month, day, shift, plant, and material.

E. PIPE JOINTING

1. All joints should be of the rubber ring seal type, such as "Ring-Tite" supplied by Johns-Manville, or "Fluid-Tite" supplied by CertainTeed, or equal. No "snaking" of pipe will be required with gasket joint pipe. All pipe shall be installed to meet manufacturer's specifications and according to these plans and specifications.

F. CONTRACTOR'S GUARANTEE

1. Pipe furnished by Contractor shall be guaranteed against rot, electrolytic corrosion, and production defects. Contractor shall maintain the pipelines for a period of one year from day of acceptance by the Owner. Such remedial

measures as required to correct leaks and similar troubles will be done by the Contractor at his own expense.

#### G. PRESSURE AND LEAKAGE TESTS

1. Scope of Work. The work to be performed under this section of the specifications shall include the furnishing of all labor, materials and equipment necessary for the completion of pressure and leakage tests of all water mains that are to be installed as shown on the plans and/or as herein specified.
2. Material Required. The Contractor shall furnish all the necessary materials to make the pressure and leakage tests and to perform any work incidental thereto. The Contractor shall also provide a pump to raise the pressure to the required amount above the normal operating pressures. In addition to a suitable pump, the Contractor shall provide pressure gauges, water meters and other appliances necessary for measuring the amount of water pumped in the mains that are being tested. These instruments shall be tested for accuracy and calibration as frequently as directed by the Engineer.
3. Test Pressure. Pressure tests shall be conducted in sections as long as possible up to 5,000 feet and as directed by the Engineer. All laid pipe shall be subjected to a hydrostatic pressure of 100 percent above normal operating pressure but shall not exceed 150 pounds per square inch or be less than 50 psi. The normal operating pressure shall be defined as a total hydrostatic pressure caused by the static head between the water reservoir and the lowest point in the new water lines. The pressure shall be maintained for a period of not less than two hours for uncovered pipe joints. Where the pipe has been completely backfilled before the tests are conducted, the pressure shall remain on these pipes for not less than twenty-four hours.
4. Leakage Tests. Care shall be taken to expel all air from the water lines as they are being filled with water to make the necessary pressure tests. The quantity of water forced into the mains during the time of the pressure test shall be determined, and this amount shall be taken as a basis to compute the leakage for a twenty-four hour period.
5. Permissible Overall Leakage. No pipe or installation shall be accepted unless, or until the leakage, determined under the test pressure, is less than 0.16 gallon per inch of pipe diameter per joint in the twenty-four-hour period.
6. Correction of Leakage Defects. All pipe, fittings, valves, hydrants and joints shall be carefully examined for leakage defects. Leaking joints shall be remade and re-tested. The Contractor shall, at his own expense, continue to locate and repair the defective joints until the leakage is within the permitted allowance, and until all obvious leaks are repaired.

#### H. THRUST BLOCKS

1. Thrust blocks of adequate size shall be placed at all bends greater than 22-1/2 degrees. Backing shall be of concrete and shall be placed between solid ground and the pipe to be anchored. The backing shall be placed so that the pipe will be accessible for repairs unless otherwise directed by the Engineer.

I. PIPE BEDDING

1. Pipe bedding shall conform to ASTM 0-2321 for Class I materials.
2. Clean ¾" graded crushed or creek run shall be used for pipe bedding.
3. Bedding shall be as depicted on the plan sheet details and shall meet AWWA and manufactures requirements.

J. BACKFILLING

Backfill of Trench

Backfilling shall follow close behind completed installation of pressure mains. The pipe will be covered and placed by hand or approved mechanical methods with selected backfill containing no stone larger than one (1) inch to a depth of six (6) inches above the top of the pipe and couplings. The materials shall be worked around and beneath the pipe in a suitable manner to ensure complete bedding and stabilization of the pipe before the remaining backfill shall be deposited. After the select backfill has reached a point six (6) inches, or more above the top of the pipe, a variation in the procedure and manner of placing the backfill will be allowed, depending upon the location of work and the danger from subsequent settlement as follows:

1. METHOD I: For backfilling in unimproved areas the backfill shall contain no rock, stone, or boulders larger than eight (8) inches in diameter and shall be free from brush and other objectionable mailer that will prevent proper consolidation. The backfill may be deposited by dragline, bulldozer, or other suitable equipment. Depositing of the fill in layers or tamping will not be required. Surface excavated materials equal to the volume of the displaced pipe, or other structures shall be disposed of as directed by the Engineer. The remaining excavated material shall be neatly mounded over the trench by using a bulldozer, or other similar equipment.
2. METHOD II: For backfilling across non-rigid, or rigid type of surfacing, all backfill materials above the select earth backfill shall be an approved granular material of high density and high weight. Granular materials shall be placed in six (6) inch layers, loose measure, and compacted to the satisfaction of the Engineer. All paving shall be replaced to a condition equal to, or better than, when construction commenced.

**END OF SECTION**

SECTION 02625  
RESTRAINED-JOINT PVC PIPE

1.0 SCOPE

This specification covers thrust-restrained Polyvinyl Chloride (PVC) Pipe, ASTM-2241, with SDR21 outside diameters. Pipe is intended for use in pressure-rated water main delivery systems.

2.0 REFERENCE DOCUMENTS

American Society for Testing and Materials (ASTM)

ASTM D1784	Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

3.0 REQUIREMENTS

3.1 GENERAL

The restrained joint pipe system shall also meet all short and long term pressure test requirements. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

3.2 MATERIALS

Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837.

3.3 APPROVALS

Restrained joint PVC pipe products shall have been tested and approved by Underwriters Laboratories and Factory Mutual Research for continuous use at a rated pressure of 200 psi.

### 3.4 DIMENSIONS

Nominal outside diameters and wall thicknesses of thrust-restrained pipe shall conform to the requirements of SDR21 pipe. Thrust-restrained pipe shall be furnished in Class 160 and Class 200. Pipe shall be furnished in standard lengths of 20 feet.

### 3.5 JOINTS

Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading. Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

### 3.6 WORKMANSHIP

Pipe and couplings shall be homogeneous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.

### 3.7 QUALITY CONTROL

Every pipe and machined coupling shall pass hydrostatic proof test requirements of 4 times the pressure class for 5 seconds.

### 3.8 MARKING

Pipe and couplings shall be legibly and permanently marked in ink with the following minimum information:

PIPE: Nominal size (for example, 4 In.), PVC, Dimension ratio (for example, DR18) Pressure class (for example, Class 160) Designation number, Manufacture's name or trademark and production record code, Seal of the testing agency verifying the suitability of the pipe material, Seal of the certifying agencies which have tested and approved the pipe

COUPLINGS: Nominal size (for example, 4 In.), PVC, Pressure class (for example, Class 200), Designation number, Manufacture's name or trademark, Seal of the testing agency verifying the suitability of the pipe material, Seal of the certifying agencies which have tested and approved the pipe.

### 3.9 APPROVED MANUFACTURERS

PVC restrained-joint pipe from CertainTeed Corporation, or approved equal.

- 3.10 Restrained joint PVC shall connect to regular SDR21 PVC pipe using the Certa-Lok Yelomine X IPS Expansion Coupling or approved equal.

END OF SECTION

SECTION 02632  
INSTALLATION OF TRACE WIRE ON WATER MAINS

General

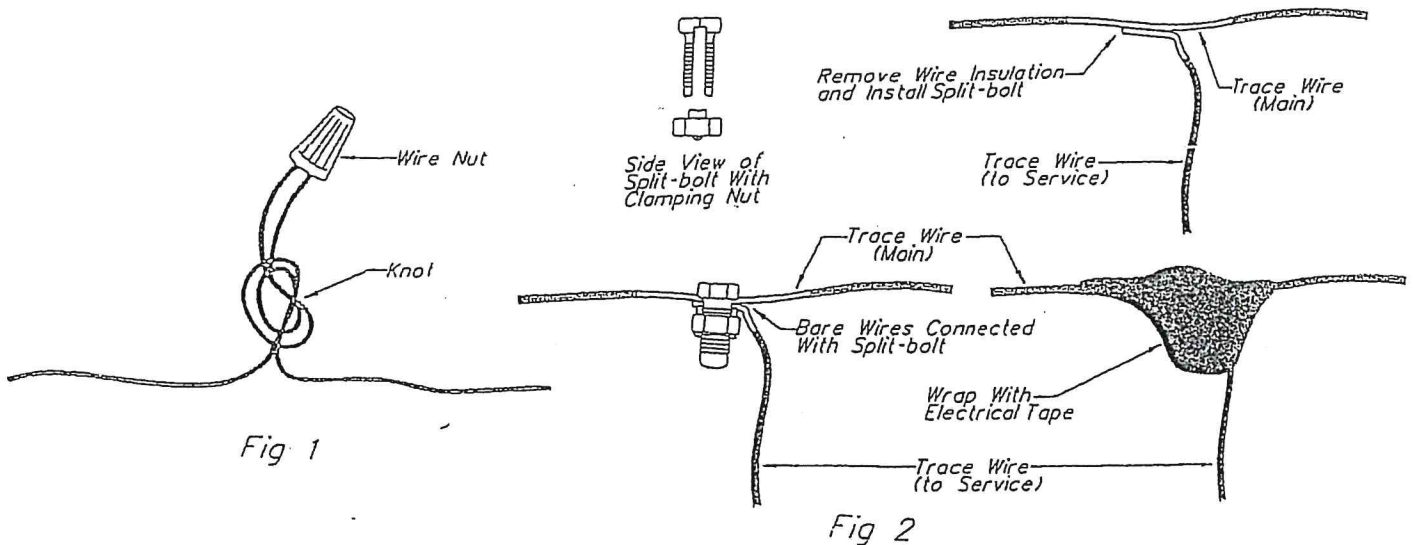
This Construction Standard governs trace wire installation on water mains. Trace wire shall be installed on all 2" mains and larger and where called for on project drawings.

Extra Trace Wire Material

- Trace wire shall be #12 TW solid, coated copper wire
- Green tri-view plastic markers by Rhino w/Test Screws
- 4 ft U-channel posts
- Valve Box Top Sections
- Plastic test box
- Wire Nuts or Split-Bolts

Approved Trace Wire Connections

When tying trace wire together,  $\frac{3}{4}$  to 1" of insulation should be removed and the bare copper wires twisted together with a wire nut. Fig. 1 shows a typical splice using a plastic wire nut and tying the wire in a knot to strengthen the connection. When connecting a lead to the main run, a split-bolt may be used as shown in Fig. 2. Always protect the connection with electrical tape when using the split-bolt.



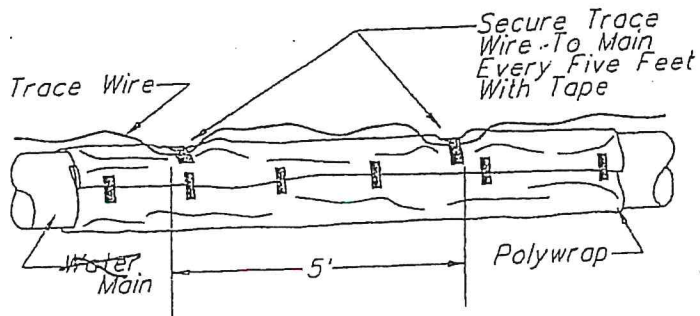


Fig 3

Installation

Install trace wire on top of water main and secure to main every five (5) feet with tape as shown in Fig. 3. Polywrap is not required.

Bring trace wire to surface at a maximum spacing of one thousand (1,000) feet. The trace wire shall be brought to the surface in a vault, green plastic marker, air release valve, gate valve, valve box top section, or in test box. Take care not to damage the wire coating. Repair damaged coating with electrical tape. Splice wire when necessary using wire nuts or split bolts. Terminate old wire runs and begin new ones at an approved access point.

Trace Wire in a Vault

When using a vault, bring the trace wire to the surface according to Fig. 4. Do not wrap the trace wire around the steps or any other place where a person entering the vault could trip. Approved alternatives may be utilized for bringing the trace wire to the surface.

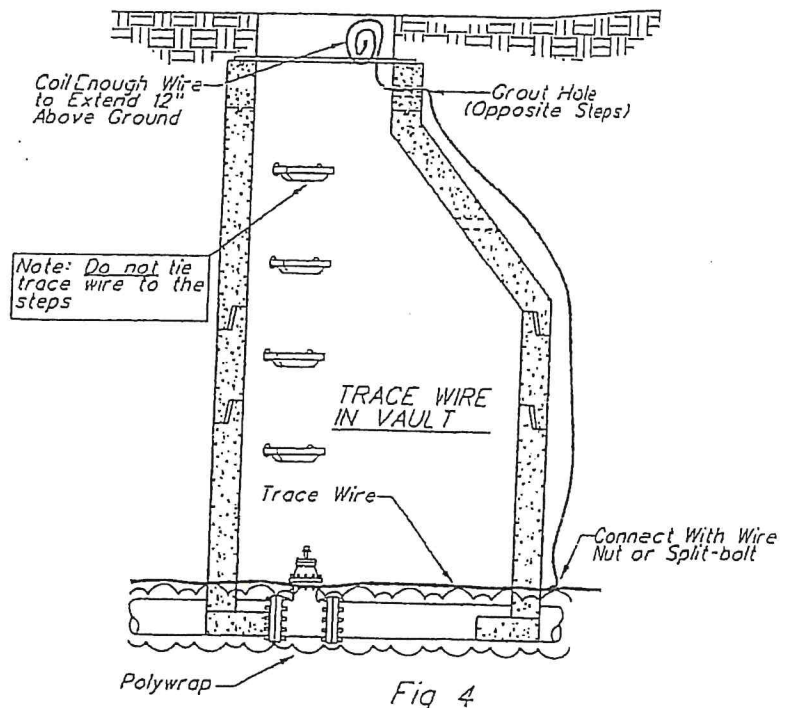
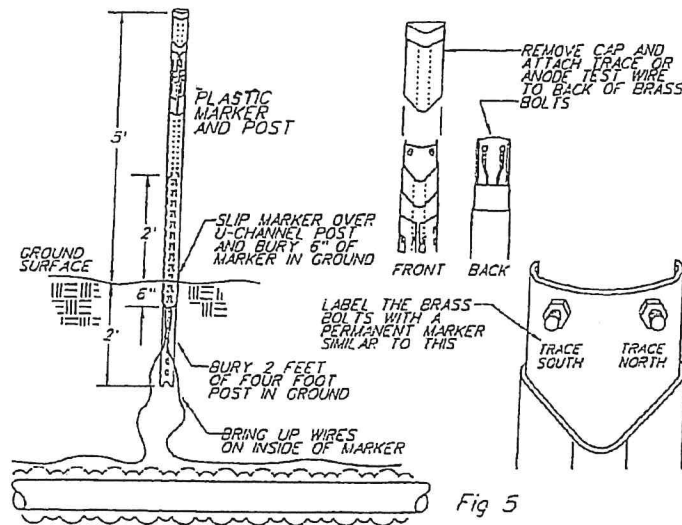


Fig 4

## Trace Wire in Green Plastic Marker

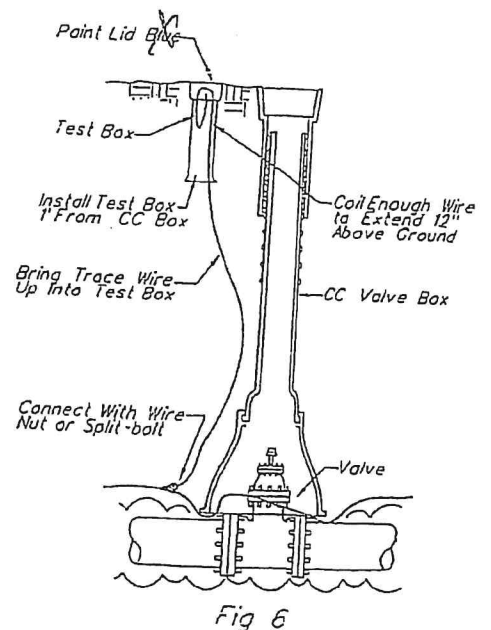
When bringing the trace wire up in a green plastic marker, install the trace wire according to Fig. 5. Bury a 4 foot u-channel post 2 feet in the ground. Run the trace wire up through the marker and slide the green plastic marker over the post. Bury the bottom six inches of the marker. Connect the trace wire to the brass connecting screws and label the screws with a permanent marker as shown in Fig. 5. Note location of trace wire marker on as-built drawings.

Note: If a marker is used only to mark the main location and not bring up the trace wire, use the green markers without the test point connectors.



## Trace Wire in a Test Box at CC Valve Box

When bringing the trace wire at a valve box, install the trace wire in a test box about a foot from the valve box according to Fig. 6. Make sure there is enough coiled wire to extend a foot above ground. Paint the lid green. Note location of test box on as-built drawings.



### Trace Wire in a Valve Box Top Section

When trace wire is to be brought to the surface in an area where a marker is not practical, valve box top section may be used as shown in Fig. 7. Coil enough wire to extend a foot above the surface of the ground. Fill with sand to a foot from the top. Spray paint the lid green. Note location of trace wire box on as-built drawings.

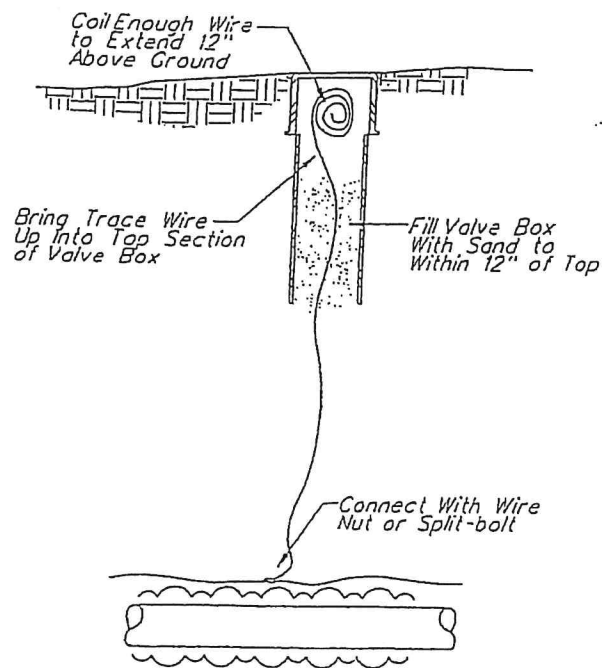


Fig 7

## SECTION 02640 PIPE, FITTINGS, AND JOINTS

### A. INSPECTION AND REJECTION OF PIPE

1. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, or on the job-site after delivery, or at both places, and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture. The Engineer shall have the right to cut cores from such pieces of the finished pipe as he desires for such inspection and tests as he may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the Manufacturer of the pipe. The cores not meeting the specifications will be rejected and the pipe replaced at the Manufacturers expense, and the cores meeting the specifications shall be repaired by the Manufacturer and an equitable adjustment shall be made to the contract price. Any pipe that has been damaged after delivery shall be rejected and if such pipe is already laid in the conduit line, it shall be acceptably repaired, if permitted, or removed and replaced, or made good solely at the Contractor's expense. The pipe Manufacturer shall warrant that pipe materials supplied are manufactured in accordance with the specifications as outlined in the following sections, and that all material shall be free from defects.

### B. GENERAL ACCEPTANCE

1. The Contractor shall furnish the Owner with every reasonable facility for ascertaining whether or not the work performed was in accordance with the requirements and intent of the plans and specifications. Any work done (except excavation) or material used without suitable supervision or inspection by the Engineer may be ordered removed and replaced at the Contractor's expense.
2. After the completion of the work, or from time to time as the work progresses, the Contractor shall, under the direction of the Engineer, make such tests of the entire work or any part thereof as may be required to demonstrate the efficiency of the sewer and appurtenances. If required, the Contractor shall make such openings as the Engineer may direct and shall restore the part of the work so disturbed to the satisfaction of the Engineer. Should any part of the work be found faulty in any respect, the Contractor shall repair such defects or replace them with new work as may be directed by the Engineer. The Contractor shall provide facilities to the Engineer to make a visual observation test of the straightness of each section of sewer between two adjacent manholes. The Engineer shall obtain a full-bore vision of the entire pipeline from one manhole to the next.

**END OF SECTION**

## SECTION 02700 WATER SYSTEM

### PART 1 - GENERAL

#### 1.01 PIPE TRENCH EXCAVATION:

- A. Clearing and Care of Surface Materials: The Contractor shall furnish all the labor, materials, and equipment necessary to complete all clearing of brush, trees or other obstructions required to complete all Work under this heading.

Where existing roads are cut or disturbed by the installation of the water lines, or otherwise damaged by the Contractor's equipment, the roads and streets shall be replaced and repaired with surface materials matching the existing paving materials in such a manner satisfactory to the Engineer. Fences, power poles, and other property shall be protected by the Contractor, unless their removal is authorized. All property shall be satisfactorily restored by the Contractor at his expense and to the approval of the Engineer.

- B. Trenching and Excavation: Excavation for water mains may be either by hand or machinery, but in no case shall such excavations extend below the finished grade. The last few inches of the finished grade shall be removed by pick or shovel, or crumbed out by hand and shall be trimmed to the shape and grade required before the placement of the pipe. Excavations carried below the grade at the Contractor's expense with earth, sand, gravel, or concrete as directed by the Engineer, and thoroughly compacted. The sides of all trenches shall be as nearly as possible vertical, or as shown on the plans. The minimum widths of trenches will not be allowed on each side of the bells of the pipes. These minimum widths of trenches shall be at least six (6) inches above the finished grade to the finished grade line, the excavation shall conform as nearly as possible to the size and shape of the pipe so that the pipe may rest on undisturbed soil. Bell holes shall be excavated accurately to the shape of the pipe by hand.

The trenches shall be of such depth that there shall be a minimum of forty-two (42) inches of cover measured from the final ground surface to the top of the pipe unless otherwise noted. Greater depths will be required to make smooth transitions at points of abrupt changes in the ground surface, or under railroads, streams, county roads and highways.

The bottom of the trench shall provide continuous and uniform bearing for the pipe except at the bell or joints at which a hole shall be dug to prevent the end from bearing.

- C. Sheet piling and Bracing: Where necessary to prevent caving, trench excavation in sand, gravel, sandy soils or other unsuitable materials shall be adequately sheeted and braced. Where sheeting and bracing are used, the clear trench width shall not be less than that specified for

unsheeted trenches. As back fill is placed, the sheeting shall be withdrawn in sections for proper compaction of the fill materials.

- D. Pipe Clearance in Rock: A minimum clearance to rock of at least six (6) inches shall be provided below and on each side of all pipe, valves, and fittings. All rock, boulders, ledge rock and other large stones shall be removed to provide a minimum of six (6) inches clearance.
- E. Dewatering Trenches: Adequate provisions shall be made by the Contractor for the removal and disposal of all water entering the excavation and for the maintenance of the same in a dry condition until the pipe lines and other parts of the work have been satisfactorily installed.

#### 1.02 PIPE LINE INSTALLATION:

- A. Water Main Laying: All pipes, special castings, valves, and other appurtenances shall be carefully examined for defects, and no pipe, or other fittings shall be installed which is known to be defective. In the event such pipe, or other appurtenances shall be discovered to be defective after being installed, they shall be removed and replaced with sound material at the Contractor's expense. Every pipe shall be cleared of all debris, dirt, etc., before being laid. Care shall be taken to preserve a good alignment and to give the pipe a firm bearing throughout its entire length. Pipe shall be laid in a satisfactory manner, true to line and depth. Pipes shall not be laid in water. The methods of laying pipe shall be in accordance with the recommendations of the manufacturer and as approved by the Engineer.
- B. Tracer Wire: All water main piping shall be installed with tracer wire. Wire shall be 12 gauge, THNN, solid copper wire with blue insulation, or equal as approved by the engineer. All wire splice joints shall be joined by use of a wire clamp. These connections shall be sealed and taped to create watertight connections. All material shall be normally used for direct underground burial.
- C. Temporary Plugs and Trench Water: When pipe laying is not in progress the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. The open ends of the pipe shall be closed by temporary water tight plugs, or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed. Enough back fill shall be placed on the pipe to prevent flotation. Any pipe that has floated shall be relayed as directed by the Engineer.
- D. Thrust Blocks: Thrust blocks shall be provided for all valves, bends, and tees as directed by the Engineer, or as shown on the plans. Backing shall be of concrete, as specified, and shall be placed between solid ground and the fittings to be anchored. The backing shall be placed so that the pipe and fittings will be accessible for repairs unless otherwise directed by the Engineer.

### 1.03 BACK FILLING:

- A. **Backfill of Trench:** Backfilling shall follow close behind completed installation of water mains. The pipe will be covered and placed by hand, or approved mechanical methods with selected backfill containing no stone larger than one (1) inch to a depth of six (6) inches above the top of the pipe and couplings. The balance of the backfill shall contain no rock, stone, or boulders larger than (8) inches in diameter and shall be free from brush and other objectionable matter that will prevent proper consolidation. After the backfill has reached a point six (6) inches, or more above the top of the pipe, the backfill may be deposited by drag line, bulldozer, or other suitable equipment.
- B. **Backfill in Unsuitable Material:** Where the bottom of the trench at sub grade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic material that in the judgment of the Engineer should be removed, the Contractor shall excavate any such unsuitable material to the width and depth ordered by the Engineer. Before the pipe is laid, the sub grade shall be made by backfilling with an approved material in six (6) inch layers. These layers shall be thoroughly tamped to provide uniform and continuous bearing for the pipe. The Contractor will be allowed extra compensation for the additional work.

Where the bottom of the trench at sub grade is found to consist of material that is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling timbers or other materials, in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the additional work.

- C. **Horizontal Separation of Water Mains and Sewers:** Water mains shall be laid ten (10) feet or greater, horizontally, from any existing or proposed drain or sewer line. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.
- D. **Vertical Separation of Water Mains and Sewers:** Whenever water mains must cross house sewers, storm drains or sanitary sewers, the water main shall be laid at such an elevation that the bottom of the water main is eighteen (18) inches or greater above the top of the drain or sewer. The vertical separation shall be maintained for that portion of the water main located within ten (10) feet horizontally of any sewer or drain it crosses, said ten (10) feet to be measured as the normal distance from the water main to the drain or sewer.
- E. **Separation of Water Mains and Sewer Manholes:** Water mains shall be laid ten (10) feet or greater, horizontally, from any existing or proposed sewer manhole.

- F. Highway Crossings: Where water mains are to be constructed along and/or across State or Federal highway, before commencing any work within the limits of these rights-of-way, the Contractor shall have a permit from the governing highway department to construct the proposed water mains. The Owner will obtain the necessary permits for the Contractor, but it shall be the Contractor's responsibility to give the Engineer adequate notice of his need for the permit. Costs of any necessary permits shall be paid for by the Contractor. Unless special permission is given otherwise by the governing highway department, the Contractor shall install all water mains crossing highways by boring and jacking methods so that the water mains will be installed to the lines and grades established in the plans. Casing pipe, if required, will be of the size and type as shown on the plans and/or specified by the Engineer. The methods of jacking shall be subject to the Engineer's approval. The pipe or casing, if required, shall be jacked into the fill as the boring augur drills out the earth or rock. Once boring and jacking operations commence, they shall be carried on in successive shifts until the boring and jacking operations have been completed.
- G. Railroad Crossings: Where water mains are to be constructed along and/or across railroad right-of-way, before commencing any work within the limits of these rights-of-ways, the Contractor shall have a permit from the railroad to construct the proposed water mains. The Owner will obtain the necessary permits for the Contractor, but it shall be the Contractor's responsibility to give the Engineer adequate notice of his need for the permit. Costs of any necessary permits shall be paid for by the Contractor. Unless special permission is given otherwise by the railroad, the Contractor shall install all water mains crossing railroad tracks by boring and jacking methods so that the water mains will be installed to the lines and grades established in the plans. Casing pipe, if required, will be of the size and type as shown on the plans and/or specified by the Engineer. The methods of jacking shall be subject to the Engineer's approval. The pipe or casing, if required, shall be jacked into the fill as the boring augur drills out the earth or rock. Once the boring and jacking operations commence, they shall be carried on in successive shifts until the boring and jacking operations have been completed.

#### 1.04 PIPE, FITTINGS AND JOINTS:

- A. Inspection and Rejection of Pipe: The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places, and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements even though sample pipes may have been accepted as satisfactory at the place manufactured.

The Engineer shall have the right to cut cores from such pieces of the finished pipe as he desires for such inspection and tests as he may wish to apply.

Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.

Any pipe which has been damaged after delivery will be rejected, and if such pipe is already laid in the conduit line, it shall be acceptably repaired, if permitted, or removed and replaced, or made good solely at the Contractor's expense.

B. PVC Plastic Pipe:

1. General: This specification designates the general requirements and installation of Polyvinyl Chloride (PVC) pipe and fittings used for conveying potable water under pressure. All PVC shall be rubber gasket o-ring joint pipe.
2. Pipe: All plastic pipe shall meet the requirements of the National Sanitation Foundation. Each length of pipe must also show the diameter and the commercial standard which is applicable to the type of pipe specified. Plastic pipe shall be polyvinyl chloride ASTM Type 1, Grade 1 (normal impact), conforming to commercial standards of CS 256-63. Class 200 PVC pipe shall meet the requirements of AWWA C900 and shall be furnished in cast iron pipe equivalent outside diameters with rubber gasketed separate couplings as listed in that standard. PVC SDR-21 pipe shall conform to ASTM D-2241 standards. The pipe is to bear the seal of NSF.
3. Manufacturer's Requirements: The pipe manufacturer shall furnish three copies of a certification that the pipe furnished is in full compliance with the commercial standards applicable to the pipe specified. The manufacturer shall furnish the Engineer three copies of data showing the physical properties of the pipe furnished. Properties should include normal bursting pressure, manufacturer's maximum working pressure, physical dimensions, and tolerances. Pipe shall not be purchased until approved by the Engineer. The manufacturer shall also provide a factory representative skilled in the installation of the type of pipe purchased to instruct the Contractor's personnel in the proper procedure for connecting and laying the pipe.
4. Fittings: All fittings, couplings and adapters shall be manufactured out of materials conforming to the same standards as the pipe and having a design strength equal to or better than the adjacent pipe. Fittings shall conform to ASTM D 3139.
5. Mechanical Joint Adapters: It is contemplated that valves two (2) inches and larger may be specified mechanical joint, AWWA, and in such event Mechanical Joint Adapters shall be furnished. They are to be made of cast iron. One end shall be built up to an OD equal to that required by the MJ fitting. Adapters shall screw into PVC pipe to make a secured joint. Adapters shall be Mega-Lug or approved equal.
6. Rubber Gasket Joint Pipe: Gasket joint pipe and couplings shall conform to the specifications previously outlined. The rubber o-ring joints for plastic pressure pipe shall conform with the latest requirements of ASTM D 3139 and ASTM 1869. The joint shall

have been tested and approved by the National Sanitation Foundation and certification of said approval shall be submitted.

7. Contractor's Guarantee: Pipe furnished by the Contractor shall be guaranteed against rot, electrolytic corrosion, and production defects.

Contractor shall maintain the pipe lines for a period of one year from date of acceptance by the Owner. Such remedial measures as required to correct leaks and similar troubles will be done by the Contractor at his own expense.

#### 1.05 APPURTENANCES AND ADDITIONAL MATERIALS:

##### A. Gate Valves:

1. Gate Valves Three Inches and Larger: Gate valves three (3) inches or larger shall be iron body, bronze mounted gate valves, No. A-2370-20 as manufactured by Mueller Company, Decatur, Illinois, or approved equal, suitable for cold water, non shock, working pressure of two hundred (200) pounds per square inch, except as other wise specified. Valves shall have mechanical joint ends and shall conform to AWWA Specification C-500-61. Gate valve bolts shall be of steel and the nuts shall be of bronze; the valve stems shall be of bronze.

All buried valves shall be resilient seat, non-rising stem type conforming in all other respects with the above specifications.

Buried valves shall have cast iron wrench nuts two (2) inches square. They shall be of such design as to maintain the full area of the pipe through the valve when open and shall be designed to take the full pressure on either face and shall be opened by turning counterclockwise. The operating nut shall have an arrow cast in the metal indicating the direction of opening. All valves shall have the manufacturer's name or initials and the pressure rating cast on the body. All necessary gaskets shall be furnished. Buried valves shall be provided with valve boxes.

2. Gate Valves Two and One-half Inches and Smaller: Unless otherwise specified, gate valves two and one-half (2½) inches and smaller in size shall be standard, bronze, solid-wedge, rising stem type gate valves with screwed ends, suitable for 125 pound working steam pressure and conforming to Federal Specification WW-V-54, Amendment 1, Class B, for Valves, Bronze, Gate 125 and 150 pounds Screwed and Flanged (for land use).
3. Valve Boxes: Valve boxes shall be provided for all gate valves on the system. Boxes shall be tough, close grained, gray cast iron free from defects, and shall be coated as specified for cast iron pipe. They shall have suitable bases to fit around the valve bodies without bearing on them. Barrels shall be made telescopic for adjustment and shall have a minimum inside diameter of five (5) inches. They shall be designed for the depth of trench specified.

Top section shall have a flange for holding it in position. Covers shall be recessed flush with top, and marked "Water" in raised letters.

- a. Installation - Gate Valves and Pipeline Accessories: Care shall be taken to prevent damage or injury to valves and appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings, etc., all operating mechanisms operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment that do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense. All fire hydrants, bends, tees, caps, plugs, etc., shall be provided with thrust blocks. Valves and valve boxes shall be firmly set on a foundation or footing of concrete. The volume of the concrete base shall be not less than one (1) cubic foot. The heights conform to the height of the connecting pipe.
- b. Data: For valves, gates and appurtenances, the Contractor will furnish submittals for approval, which will include illustrations, descriptive matter and complete manufacturer's specifications of the equipment he proposed to furnish. Such material shall be sufficiently detailed to enable the Engineer to determine that the proposed equipment will conform to the specifications.
- c. Painting and Protection: Ferrous parts of valves and appurtenances installed in the exposed piping shall be given two coats of an asphaltum varnish on the inside and one shop coat of Tnemec No. 66-1211 Hi-Build Epoxoline primer, Koppers, or approved equal suitable for field coats, on the outside, applied in accordance with the instructions of the manufacturer.

Valve boxes shall be given two shop coats of asphaltum varnish or coal-tar coating.

All finished parts shall be coated with grease to prevent corrosion during shipment and installation. Flanges shall be protected during shipment by wooden covers.

#### B. Fire Hydrants:

1. Fire Hydrants Conforming: Fire hydrants shall conform to AWWA Specifications C-502-54, with compression type shutoff valve, two 2½ inch and one 4½ inch hose nozzles, bury equal to adjacent pipe, national standard threads to open left, painted red, nozzle caps securely chained to the barrel, and two (2) hydrant wrenches shall be furnished. Fire hydrants shall be Mueller A-421 with auxiliary gate valves and mechanical joint shoe or approved equal.

2. Placing Hydrants: Hydrants shall be installed with nozzles facing the street unless otherwise specified. The base of the hydrant shall be set in a concrete foundation, minimum two and one half (2.5 ft<sup>2</sup>) square foot, as shown on the plan details.

The trench space around each hydrant shall be back filled with at least seven (7) cubic feet of coarse gravel or broken stone up to the level of the drain valve, except where natural drainage is provided. The excavation shall be so made as to receive this material. In addition, the space around the hydrant barrel for a thickness of at least six (6) inches shall be back filled with coarse gravel or broken stone to the full depth of the trench.

C. Post Hydrant:

1. Post hydrants shall be equivalent to an eclipse #2 post hydrant as manufactured by Kupferle Foundary Company, St. Louis, MO, or approved equal. Hydrant shall be compression type shut off valve, one 2 1/2" hose nozzle, 42" bury, painted red, nozzle caps securely chained to the barrel and one hydrant wrench furnished. Units shall be installed with mechanical joint shoe (4") and a 4" gate valve.
2. Placing Hydrants: Hydrants shall be installed with nozzles facing the street unless otherwise specified. The base of the hydrant shall be set in a concrete foundation, minimum two and one half (2.5 ft<sup>2</sup>) square foot, as shown on the plan details.

The trench space around each hydrant shall be back filled with at least seven (7) cubic feet of coarse gravel or broken stone up to the level of the drain valve, except where natural drainage is provided. The excavation shall be so made as to receive this material. In addition, the space around the hydrant barrel for a thickness of at least six (6) inches shall be back filled with coarse gravel or broken stone to the full depth of the trench.

D. Meter Service Connections:

1. General: Service connections shall be placed when ordered by the Engineer. These connections shall consist of the following: Tap; corporation stop; flexible connections; and tie to the existing service line as shown on the plans.  
✓ The Contractor shall furnish, install, test, flush and disinfect all service connections and service pipes.
2. Corporation Stops: Corporation stops shall be three- fourths (3/4) inch size unless otherwise directed by the Engineer, and shall be Ford F-1002, or approved equal for SDR-9 PVC CTS service.
3. ✓ Taps: All service connections shall be attached to the mains using Ford service clamps, or approved equal.

4. Service Pipe: Service pipe shall be SDR-9 CTS PVC installed at the locations indicated by the Plans. It shall be designed for not less than 150 pounds per square inch water working pressure unless a greater working pressure is specified in the plans and/or proposal. Polyethylene pipe shall also be allowed (DR-9 only).
5. Meter Yokes: Meter yokes shall be copper with a twelve (12) inch riser. Yokes shall be Ford V-172-12 with check valve, or equal for copper service (for  $\frac{3}{4}$  service).
6. Meter Boxes and Covers: Meter boxes shall be Sunoco ribbed, or equal, PVC material in thirty (30) inch lengths in stalled as indicated on the drawings. If ground water is found to be present, the Engineer shall be notified. Covers shall be a cast iron, twelve (12) inch opening, and labeled "Water".
7. Water Service Meters:
  - a. Residential Water Meters Conforming: Water meters shall conform to AWWA C700-61T and shall be three-fourths ( $\frac{3}{4}$ ) inch size unless specified otherwise in the plans. Water meters shall be the standard product of an American manufacturer approved by the Engineer. They shall be cold water meters reading directly in U.S. gallons. The meters shall be designed for a water working pressure of not less than 150 pounds per square inch. The meters shall be the frost- proof, displacement type, with magnetic drive and hermetically sealed register.
  - b. Installing Water Meters: Water meters shall be installed at the locations designated on the plans or by the Engineer. In general, the location shall be within one (1) to five (5) feet inside of the private property line; however, the meters shall be set at locations that are least likely to be disturbed. The Engineer's decision shall govern. Meters one (1) inch and smaller shall be set with the inlet and outlet connections approximately twenty four (24) inches below the ground surface. Larger meters shall be set with connections at the depths required for the connection pipes. The earth shall be excavated to the full depth of the bottom of the meter box, meters set and carefully adjusted with faces and dials up. All connections shall be screwed down watertight.
8. Installing Service Pipe: Service pipe shall be joined to the corporation stop by flanging tools and screwing the nut down tight. The service pipe shall extend from the corporation stop in the water main to the curb stop at the meter location. Where more than single length of pipe is used, the Contractor shall furnish and install the necessary brass unions as part of the pipe. All connections shall be made secure and watertight.

## 1.06 PRESSURE AND LEAKAGE TESTS:

### A. Conducting Tests:

1. **Scope of Work:** The work to be performed under this Section of the specifications shall include the furnishing of all labor, materials and equipment necessary for the completion of pressure and leakage tests of all water mains that are to be installed as shown on the plans and/or as herein specified.
2. **Materials Required:** The Contractor shall furnish all the necessary materials to make the pressure and leakage tests and to perform any work incidental thereto. The Contractor shall also provide a pump to raise the pressure to the required amount above the normal operating pressures. In addition to a suitable pump, the Contractor shall provide pressure gauges, water meters and other appliances necessary for measuring the amount of water pumped in the mains that are being tested.

The instruments shall be tested for accuracy and calibration as frequently as directed by the Engineer.

3. **Test Pressure:** Pressure tests shall be conducted between valves in sections as long as possible up to 5,000 feet and as directed by the Engineer. All laid pipe shall be subjected to a hydrostatic pressure of one hundred (100) percent above normal operating pressure, but shall not exceed 150 pounds per square inch or be less than sixty (60) PSI. The normal operating pressure shall be defined as a total hydrostatic pressure caused by the static head between the existing water reservoir and the lowest point in the new water mains. The pressure shall be maintained for a period of not less than two (2) hours for uncovered pipe joints. Where the pipe has been completely back filled before the tests are conducted, the pressure shall remain on these pipes for not less than twenty-four (24) hours.
4. **Leakage Tests:** Care shall be taken to expel all air from the water lines as they are being filled with water to make the necessary pressure tests. The quantity of water forced into the mains during the time of the pressure test shall be determined, and this amount shall be taken as a basis to compute the leakage for a twenty-four (24) hour period.
5. **Permissible Overall Leakage:** No pipe or installation shall be accepted unless, or until the leakage, determined under the tests pressure, is less than ten (10) gallons per inch of pipe diameter per mile in the twenty-four (24) hour period.
6. **Correction of Leakage Defects:** All pipe, fittings, valves, hydrants and joints shall be carefully examined for leakage defects. Leaking joints shall be remade and re-tested. The Contractor shall, at his own expense, continue to locate and repair the defective joints until the leakage is within the permitted allowance, and until all obvious leaks are repaired.

## 1.07 WATER LINE DISINFECTION:

### A. Disinfection Procedure:

1. General: Each unit of the water distribution system shall be sterilized in accordance with AWWA Standard C651 (latest version) with chlorine or chlorine-bearing compounds before acceptance for domestic operation.
2. Materials:
  - a. Liquid Chlorine: Liquid chlorine shall conform to AWWA Standard B301-57T.
  - b. Hypo chlorite: Hypo chlorite shall conform to AWWA Standard B300-55.
3. Laying Pipe: Every precaution shall be used to protect pipe against the entrance of foreign material before the pipe is placed in the new line. At the close of the day's work, or whenever the workmen are absent from the job, the end of the last laid section of pipe shall be plugged, capped, or otherwise tightly closed to prevent the entry of the foreign material of any nature.

If the Contractor, or pipe-laying crew, cannot put the pipe into the trench, and in place without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe.
4. Preventing Trench Water from Entering Pipe: At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. Joints of pipe in the trench shall be poured before the work is stopped. If water is in the trench, the seal shall remain in place until the trench is pumped dry.
5. Flushing Completed Pipelines: The main shall be flushed, prior to chlorination, as thoroughly as possible with the water pressure and outlets available. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. If no hydrant is installed at the end of the main, a tap should be provided large enough to develop a velocity in the main of at least three and three (3) feet per second.
6. Requirement of Chlorination: Before being placed in service, all new mains and repaired portions of, or extensions to, existing mains shall be chlorinated so that a chlorine residual of not less than fifty (50) PPM remains in the water after twenty-four (24) hours standing in the pipe.

7. **Liquid Chlorine:** A chlorine gas-water mixture shall be applied by means of a solution-fed chlorinating device, or if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating device for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing back flow of water into the chlorine cylinder.
8. **Point of Application and Retention Period:** The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension, or any valved section of it and through a corporation stop inserted by the Owner (except in new distribution systems) in the top of the newly laid pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. In a new system, application of chlorine may be made advantageously at the pumping station, the elevated tank, the stand pipe, or the reservoir.

Water from the existing distribution system or other source of supply shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least fifty (50) PPM after twenty-four (24) hours standing. This may be expected with an application of one hundred (100) PPM, although some conditions may require more.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves may be used, if desired.

Treated water shall be retained in the pipe long enough to destroy all non spore-forming bacteria. This period should be at least twenty-four (24) hours and should produce no less than fifty (50) PPM at the extreme end of the line at the end of the retention period.

**NOTE:** If the circumstances are such that a shorter retention period must be used, the chlorine concentration shall be increased accordingly. For instance, for a contact period of two (2) hours, a one hundred (100) PPM chlorine concentration is required. Under these conditions, special care should be taken to avoid attack on pipe, valves, hydrants, and other appurtenances.

In the process of chlorinating newly laid pipe, all valves, or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

9. **Final Flushing and Test:** Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at its

extremities until the replacement water throughout its length shall, upon test, be proved comparable in quality to the water served the public from the existing water supply system and approved by the State Department of Natural Resources. This satisfactory quality of water delivered by the new main should continue for a period of at least two (2) full days as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination.

If the test samples show unsatisfactory quality of water, the process of sterilization shall be repeated until satisfactory samples are obtained. The Contractor shall receive no extra payment for laboratory tests or sampling.

#### 1.08 WATER MAIN/LINE SEPARATION

- A. General Requirements: Separation of Water Mains, Sanitary Sewers and Combined Sewers are specified in Section 8.6 of the Minimum Design Standards for Missouri Community Water Systems, Missouri DNR.
- B. Procedure: When buried water mains or water lines are in close proximity to non-potable pipelines, the water mains/lines are vulnerable to contamination that can pose a risk of waterborne disease outbreaks and public health hazards.
- C. General: The following factors should be considered in providing adequate separation between water mains/lines and non-potable pipe lines:
  - 1. Materials and type of joints for water and sewer pipes;
  - 2. Soil conditions;
  - 3. Service and branch connections into the water main and sewer line;
  - 4. Compensating variations in the horizontal and vertical separations;
  - 5. Space for repair and alterations of water and sewer pipes; and
  - 6. Off-setting of water mains around manholes.
- D. Parallel Installation:
  - 1. The water main shall be located at least ten feet horizontally from any existing or proposed line carrying non-potable fluids such as, but not limited to drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.

2. In cases where it is not practical to maintain a ten-foot separation, DNR may allow deviation on a case-by-case basis, if supported by data from the Design Engineer. Such deviation may allow installation of the water main closer to a non-potable fluid line, provided that the water main is laid in a separate trench located as far away from the non-potable line as feasible and meets other specific construction requirements. Locating a water main on an undisturbed earth shelf located on one side of the non-potable line is not recommended and requires justification by the Engineer and specific case-by-case approval of DNR. In either case, an elevation shall be maintained such that the bottom of the water main is at least 18 inches above the top of the non-potable line while meeting minimum cover requirements.
  3. In areas where the recommended separations cannot be obtained, either the water main/line or the non-potable line shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.
- E. Crossings: Water mains crossing sewers, or any other lines carrying non-potable fluids shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipeline. This shall be the case where the water main is either above or below the non-potable pipeline. An 18 inch separation is a structural protection measure to prevent the sewer or water main from settling and breaking the other pipe. At crossings, the full length of the water pipe shall be located so both joints will be as far from the non-potable pipeline as possible but in no case less than 10 feet or centered on a 20 foot pipe. In areas where the recommended separations cannot be obtained either the water main/line or the non-potable pipeline shall be constructed of a mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing that extends no less than 10 feet on both sides of the crossing. Special structural support for the water and sewer pipes may be required. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.
- F. Exception: Any exception from the specified distances in paragraphs D and E must be submitted to DNR for approval.
- G. Force Mains: There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches. In

areas where the recommended separations cannot be obtained, either the water main/line or the non-potable line shall be constructed of mechanical joint pipe or cased in a continuous casing, be constructed of mechanical joint pipe, or be jointless or fusion welded pipe. Where possible, the water main/line shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

- H. Sewer Manholes: No water line shall be located closer than 10 feet to any part of a sanitary or combined sewer manhole. Where the separation cannot be obtained, the water line shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than 10 feet or centered on a 20 foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.
- I. Disposal Facilities: No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.

**END OF SECTION**

SECTION 02900  
LANDSCAPING, SEEDING, AND SODDING

PART 1 - GENERAL

1.01 SUMMARY:

Furnish all labor, materials, services, equipment, and other necessary items required for establishing landscaped and grassed areas in all disturbed areas not covered by pavement, building, or other permanent construction. The contractor is to strip and stockpile the topsoil existing on a site to be disturbed. Only that amount of top soil that was existing at the site is required to be replaced prior to seeding except that a minimum of two (2") of top spoil is required in residential, golf course, and commercial areas. If an area had a greater depth of top soil prior to being disturbed by the Contractor, the Contractor must match the depth of topsoil and bring the area back to its original condition.

1.02 RELATED REQUIREMENTS:

Construction Drawings:

Erosion Control:

Section 02105

Excavating, Backfilling, and Compaction:

Section 02200

Excavating, Backfilling, and Compacting for Utilities:

Section 02222

1.03 SUBMITTALS:

Submit certification tags from trees, shrubs, flowers, and seed verifying type and purity. Supplier's invoices shall be provided to the Engineer for all quantities of fertilizer, lime, seed and straw applied in the project.

PART 2 - PRODUCTS

2.01 FERTILIZER:

Unless specifically indicated otherwise on the Drawings, spread Commercial 13-13-13, at the rate of one hundred fifty (150) pounds per acre.

2.02 LIME:

Ground limestone composed of not less than 65% calcium and magnesium carbonate with 90% passing a No. 10 sieve. Supplied in accordance with Section 801.2 of Missouri Standard Specifications for Highway Construction 1999 Edition (MSSHC). Lime shall be applied at a minimum rate of 400 pounds per acre.

2.03 SEED:

- A. Unless otherwise specified on the Drawings, Contractor shall provide seed as follows: Fresh, clean, new crop seed shall be purchased from a recognized distributor and shall be composed of the following varieties mixed in the proportions indicated. Seed shall test to minimum percentages of purity and germination specified.

2.04 SELECT VEGETATIVE TOPSOIL:

- A. Good quality fertile friable loamy soil, free of stones, over one-quarter (¼) inch in size and fines content passing the 200 size sieve between 30 and 50 percent capable of supporting a vegetative growth of grass.
- B. Free from clay lumps, stones, brush, objectionable stumps, roots, litter, toxic substances, and other material or substances which may be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.
- C. Vegetative top soil shall be placed on all residential, commercial and golf course areas disturbed by the Contractors' operations. In agricultural or wooded areas, the Engineer will determine the requirements and thickness of top soil to be placed.

2.05 GRASS SEED MIXTURE:

<u>Scientific Name</u>	<u>Common Name</u>	<u>Proportion by Weight</u>	<u>Percent Purity</u>	<u>Percent Germination</u>
KY-31 Tall Fescue	Tall Fescue	90%	99%	90%
Lolium Perenne "Regal"	Regal Perennial Rye Grass	10%	99%	90%

The above seed mixture shall be sown at the rate of five (5) pounds per one thousand (1,000) square feet on all disturbed areas, or at the rate of 218 pounds per acre. Contractor shall use a grass seed mixture of 90% turf type tall fescue with 10% rye on golf course disturbed areas. Submit proposed mixtures to the Engineer and PWSD No. 3 for final approval.

## 2.06 MULCH:

All mulch materials shall be air-dried and reasonably free of noxious weeds and seeds. Straw shall be stalks of rye, oats, or wheat. Straw shall be suitable for spreading with standard mulch blower equipment. Straw mulch shall be thoroughly fluffed and applied at a rate of two (2) tons per acre in residential and commercial areas, and one (1) ton per acre in agricultural, wooded and State Right-of-Way areas, unless otherwise directed by the Engineer.

## 2.07 SOD:

Install in areas designated as sod on the Drawings. Sod shall be allowed in lieu of seeded areas. Sod species shall be a type recommended by an experienced local A.A.N.- certified nursery. Sod to be strongly rooted, weed free, and a uniform thickness with not less than one inch (1") of vegetative top soil.

## PART 3 - EXECUTION

Contractor shall have completed and established all landscaping, seeding and sodding on or before the contract completion date, unless otherwise approved in writing by the Engineer. In addition, the Contractor shall guarantee all products and materials furnished and work performed for a period of one (1) year from the final acceptance date of the project.

### 3.01 VEGETATIVE SOIL AND TOP SOIL GRADING AND PLACEMENT:

Grade all disturbed areas to finish grade elevation. Graded areas shall be uniform and smooth, raked to remove all rocks equal to or greater than one (1) inch in diameter, free from debris, or irregular surface changes.

- A. The surface on which the topsoil is to be placed shall be free of all loose rock and foreign material greater in any dimension than  $\frac{1}{2}$  the depth of the topsoil to be added. It shall be raked or otherwise loosened just prior to being covered with topsoil. Topsoil shall be placed and spread over the designated areas to a depth sufficiently greater than 2" so that after settling, the completed work will conform to a minimum 2" thickness. After spreading, all dirt clods and foreign material shall be removed by the Contractor. All rock and gravel larger than 1" in size shall be removed from the surface of the topsoil prior to seeding.

### 3.02 PREPARATION:

- A. All Areas to be Seeded:
  - 1. Prepare the seedbed in accordance with Section 805.3 of the MSSHC and as specified herein.

2. Disk, harrow, drag with a chain or mat, blade, machine rake, or hand work as necessary to provide a reasonably firm but friable seedbed, without rocks.
  3. Meet the specified grades free of growth and debris.
  4. Take care to prevent the formation of low places and pockets where water will stand.
- B. Depth of Tillage: Shall be at least four (4) inches or as directed by the Engineer.
- C. Where a grass mixture has been planted for temporary erosion control and has not been eliminated prior to the completion of the work, disk at least 4 inches deep and seed with permanent grasses.
- D. Apply vegetation top soil as specified above in Paragraph 3.01 for residential and commercial areas disturbed by the Contractor.

### 3.03 APPLICATION:

- A. Fertilizer and Lime:
1. Apply to the vegetative layer of top soil by means of a mechanical spreader or other acceptable method which is capable of maintaining a uniform rate of application to soil which has been tilled to a depth of at least 4 inches.
  2. Conduct when the soil is in a moist condition and at least 24 hours before sowing the seed.
- B. Seeding:
1. Perform erosion control items of work such as seeding, mulching and installing excelsior blanket matting upon completion of a unit or portion of the project. Matting for erosion control is specified in Section 02105.
  2. When immediate protection of newly graded areas is necessary at a time which is outside of the normal seeding season, apply straw mulch with the seeding done at the same time or done later, or both, as ordered by the Engineer.
  3. When immediate seeding is required on areas of the project which are not to be regarded or disturbed, use specified seed mixture.
  4. Areas of the project which are to be left temporarily and which will be regraded or otherwise disturbed later during construction may be ordered by the Engineer to be seeded and strawed with either winter rye or wheat or another seed mixture for temporary erosion control and shall be sown at a rate of approximately three (3) pounds per 1,000 square feet or 128 pounds per acre.

5. The Engineer reserves the right to prohibit the use of any equipment that is unsuitable or inadequate for the proper performance of the work. The Contractor shall immediately remove all rejected equipment from the project.

C. Mulch: Apply mulch materials at a rate of two (2) tons per acre in residential/commercial areas and one (1) ton per acre in agriculture wooded and State Right-of-Way areas with standard mulch blowing equipment as specified in Section 02105.

#### 3.04 SEEDING SEASONS:

- A. Conduct normal seeding anytime except from May 15 -August 30.
- B. Do not seed during windy weather or when the ground is frozen, excessively wet, or otherwise untillable.
- C. The Engineer may require the Contractor to apply temporary erosion control and seeding as specified in Section 02105 at no additional cost to the Owner.

#### 3.05 SEEDING METHODS:

Fertilizer, lime, and mulch material if required, and seed of the type specified shall be placed at the locations shown on the Drawings, at all disturbed areas or directed by the Engineer by methods specified in Section 805.3 of the MSSHC and as specified herein by one of the following methods, provided an even distribution is obtained.

##### A. Dry Method:

- 1. Power Equipment: Use mechanical seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seeding equipment or attachments when seed, lime, and fertilizer are to be applied in dry form.
- 2. Manual Equipment: On areas which are inaccessible to power equipment, permission may be given to use hand-operated mechanical equipment when the materials are to be applied in dry form. The use of hand shovels to spread the materials will not be allowed.
- 3. Do not mix lime and fertilizer together prior to their application but work into the soil together to the specified depth.
- 4. Allow at least 24 hours between fertilizing and seeding.
- 5. Work seed approximately one-quarter ( $\frac{1}{4}$ ) inch into prepared soil and firm the seeded area by rolling.

6. Unless otherwise ordered, immediately mulch disturbed areas covered with seed.

B. Hydraulic Method:

1. The application of grass, seed fertilizer, lime, and a suitable mulch, if approved by the Engineer, may be accomplished in one operation by the use of an approved spraying machine.
2. Mix materials with water in the machine and keep in an agitated state in order that the materials may be uniformly suspended in the water.
3. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, and grass seed are equal in quantity to the required rates.
4. Prior to the start of work, furnish Engineer with a certified statement of approval as to the number of pounds of materials to be used per 100 gallons of water, and specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.
5. Flush and clean hydraulic seeding and fertilizing machine each day before seeding is to be started, and thoroughly flush of all residue after the completion of application on every 10 acres.
6. If the results of the spray operations are unsatisfactory, abandon this method and apply the materials by the dry method.
7. When inoculum is required, mix with the seed, and then spray.
8. Compaction or rolling is not required.
9. Unless mulch material required is applied during the seeding operation or within one-half (1/2) hour following the seeding operation, take measures to protect the seed from sunlight and heat such as the use of a light brush drag over the seeded areas to stir the seed into the soil, taking care not to carry the seed ahead.

### C. Hand Seeding:

1. May be permitted, if it is done by an experienced worker and if the seeding is done in several directions to insure uniform coverage.
2. Otherwise use a mechanical seeder.
3. After the seed has been sown, cover to an average depth of one quarter ( $\frac{1}{4}$ ) inch by means of a brush, harrow, spike tooth harrow, chain harrow, cultipacker or approved device.
4. Immediately after seeding, compact the entire area by a suitable roller, weighing 60 to 90 pounds per lineal foot.

### 1.06 CARE AFTER SEEDING:

- A. Protect and care for seeded areas until final acceptance of the work, and repair any damage to seeded areas caused by contractors pedestrian or vehicular traffic or other contractor causes, at no additional cost to the Owner.
- B. If necessary, place barricades of brush or other materials and suitable signs to protect the seeded areas.
- C. Apply water to maintain proper moisture to promote growth. Use approved water wagons or tanks or other approved devices to apply water in the form of a spray or sprinkle without erosive force. Apply water prior to 10:00 a.m. and after 4:00 p.m. to minimize losses due to evaporation. Contractor shall keep seed bed moist for 14 days after seeding.
- D. Cut back weeds growing in areas seeded to prevent them from dominating the desired grass plants.
- E. The Contractor shall reseed any part of the seeded areas which fail to show a uniform stand at the contractor's expense.
- F. Acceptable grass areas shall have a coverage of not less than 80 percent of permanent grass at the end of the one (1) year maintenance period. The maintenance period will start at the date of project final acceptance.

**END OF SECTION**

**SECTION 03200**  
**CONCRETE REINFORCING**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Section Includes specifications for concrete reinforcing.

**1.02 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI):
1. 301 Specifications for Structural Concrete for Buildings.
  2. 315 Details and Detailing of Concrete Reinforcement.
- B. ASTM International (ASTM):
1. A82 Specification for Steel Wire, Plain, for Concrete Reinforcement
  2. A185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  3. A497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
  4. A706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
  5. A767 Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
  6. A775 Specification for Epoxy-Coated Reinforcing Steel Bars
  7. A884 Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
  8. C1107 Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
  9. D3963 Specification for Epoxy-Coated Reinforcing Steel
- C. American Welding Society (AWS):
1. D1.4 Structural Welding Code – Reinforcing Steel
  2. QC1 Specification for AWS Certification of Welding Inspectors
- D. Concrete Research Standards Institute (CRSI):
1. Manual of Standard Practice

2. Placing Reinforcing Bars
- E. State of California, Department of Transportation, Standard Specifications (Caltrans):
1. Section 52 Reinforcement
  2. Section 83 Railings and Barriers
  3. Section 90 Portland Cement Concrete
- F. State of California, Department of Transportation, Test Methods (Caltrans):
1. 417 Soils and Water for Sulfate Content
  2. 422 Testing Soils and Water for Chloride Content

### 1.03 SUBMITTALS

- A. Reinforcing Steel Shop Drawings: Indicate sizes, spacing, bending and cutting schedules, splices and laps, supporting and spacing devices, and quantities. Coordinate drawings to prevent reinforcing steel from interfering with the placement of embedded items.
- B. Mill Test Reports: Submit certified mill test reports (tensile and bending) for each heat or melt of steel showing physical and chemical analyses before delivery of reinforcing material to the job site.
- C. Certificates of Compliance: Submit in accordance with Caltrans Standard Specifications Section 52-1.04, Inspection. For galvanized reinforcing bars, submit certificates of compliance with ASTM A 767.
- D. Submit manufacturer's product data and installation instructions for proprietary mechanical coupler systems when such splicing methods are permitted.
- E. When galvanized or epoxy-coated reinforcing bars are indicated, furnish two 12-inch long samples and two additional samples bent to minimum radius of the rebar from each lot shipped to the work site.
- F. Qualifications of welding operators, welding processes, and procedures. For welders, furnish welding certificates or affidavits attesting to the welders' qualifications to perform the indicated welding in accordance with applicable requirements of AWS D1.4.

### 1.04 DELIVERABLES

- A. Submit copies of inspection and test reports for welding as required in this Section.

## **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with the requirements of applicable building codes, CRSI Manual of Standard Practice, and CRSI Placing Reinforcing Bars.
- B. Perform work in accordance with the requirements of ACI 301 and ACI 315.
- C. Qualifications of Welding Inspector: Welds to be inspected by the Contractor shall be inspected and certified by a Contractor-employed AWS Certified Welding Inspector (CWI), certified in accordance with AWS QC 1.
- D. Qualification of Personnel Performing Nondestructive Testing: Personnel performing nondestructive testing, who are Contractor-employed, shall be qualified and certified in accordance with SNT-TC-1A. Only persons certified for NDT Level I and working under a NDT Level II person or persons certified for NDT Level II may perform nondestructive testing.

## **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Ship and store reinforcement with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings.
- B. Store reinforcement off the ground, protect from moisture, and keep free from dirt, oil, or other contaminants. Steel, which cannot be properly identified, will be rejected and shall be immediately removed from the work site.
- C. Handle and store galvanized and epoxy-coated reinforcement in a manner which will prevent damage to the coatings. For epoxy-coated reinforcement, comply with the requirements of ASTM D 3963.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Reinforcing Steel Bars: ASTM A706
- B. Reinforcing Steel Wire: ASTM A 82, cold drawn
- C. Welded Steel Wire Fabric – Plain Wire: ASTM A 185, uncoated finish
- D. Welded Steel Wire Fabric – Deformed Wire: ASTM A 497, uncoated finish
- E. Welded Steel Wire Fabric – Epoxy-Coated: ASTM A 884
- F. Epoxy-coated Reinforcing Bars: ASTM A 706 epoxy-coated in accordance with ASTM A 775 and ASTM D 3963. Coating material shall conform to ASTM A 775 and ASTM D 3963, Annex 1, green in color. Bars shall be cut and bent cold before applying coating material.
- G. Galvanized Reinforcing Bars: ASTM A 706 galvanized in accordance with ASTM A 767, Class I coating. Bars shall be cut and bent cold before galvanizing.

- H. Mechanical Splice Coupler: Provide bar splicing connections produced by threaded reinforcing bar ends and threaded coupler, or by sleeves hydraulically pressed or forged onto butt-ended reinforcing bars. Mechanical splice couplers shall be capable of being installed in the clear space indicated and to provide the required clearances. The strength of the splice in tension and compression shall be a minimum of 125 percent of the yield strength of the connected reinforcing bars.
- I. Welding Electrodes: E90 meeting the requirements of AWS D1.4.

## 2.02 ACCESSORIES

- A. Steel Tie Wire: No. 16 gage or heavier, black or galvanized, soft or commercial grade steel tie wire. For galvanized reinforcement, provide zinc-coated wire. For epoxy-coated reinforcement, provide nylon-, epoxy-, or plastic-coated wire.
- B. Chairs, bolsters, bar supports, and spacers:
  - 1. Metal, plastic tipped, in accordance with the requirements of CRSI Manual of Standard Practice for reinforced concrete construction.
  - 2. Sized and shaped for strength and support of reinforcement during installation and placement of concrete.
  - 3. For galvanized reinforcement, provide all galvanized accessories.
  - 4. For epoxy-coated reinforcement, provide accessories which are nylon-, epoxy-, or plastic-coated.

## 2.03 GROUT

- A. Bonding Material for Bonding Dowels: As specified in Caltrans Standard Specifications, Section 83-2.02D(1).
- B. Non-Shrink Grout: Grout shall be a premixed package blend of Portland cement, graded silica sand, and water reducing, plasticizing and time release expansion agents, which conforms to ASTM C1107, Grade B, and provides a minimum 5000 psi compressive strength at 28 days. Mix grout in accordance with the manufacturer's recommendations. Water shall comply with the provisions in Caltrans Standard Specifications, Section 90-2.03, Water.
  - 1. Admixtures shall not contain more than 0.05 percent soluble chlorides when tested in conformance with California Test 422 nor more than 0.25 percent soluble sulfates, as  $SO_4$ , when tested in conformance with California Test 417.

## 2.04 FABRICATION

- A. Fabricate in accordance with the requirements of ACI 315.

- B. Locate splices not indicated on the Contract Drawings at point of minimum stress.
- C. Repair of Damaged Coatings:
  - 1. Epoxy: Repair in accordance with the provisions in Caltrans Standard Specifications, Section 52, Reinforcement.
  - 2. Galvanized: Repair as specified in ACI 301, ASTM A 767, ASTM A 775, ASTM A 884, and ASTM D 3963, as applicable.
- D. Welding:
  - 1. Welding of reinforcement, where indicated and approved, including preparation of bars, shall conform with applicable requirements of AWS D1.4.
  - 2. Clean bars of oil, grease, dirt, and other foreign matter and flame-dry before welding. Preheat bars welding in accordance with AWS D1.4, Chapter 5.
  - 3. Butt Welded Splices: Use full penetration butt welds in accordance with the provisions in Caltrans Standard Specifications, Section 52, Reinforcement, unless another weld splice type is indicated or approved.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Before placing concrete, clean reinforcement of foreign particles, including mortar, oil, grease, dirt, loose mill scale, rust and any other coating that will prevent or reduce bond.
- B. Place in position, support, and secure reinforcement to prevent displacement during concrete placement. Do not deviate from alignment or spacing as shown on the Contract Drawings.

#### **3.02 CLEANING, BENDING, PLACING, AND SPLICES**

- A. Perform work in accordance with the provisions in Caltrans Standard Specifications, Section 52, Reinforcement, and as specified herein.
- B. Perform installation of mechanical coupler and tightening for joint assembly in accordance with the coupler manufacturer's installation instructions and recommendations.

#### **3.03 DRILLING AND BONDING DOWELS**

- A. Drilling and bonding dowels shall conform to the details shown on the Contract Drawings, the provisions in Caltrans Standard Specifications, Section 83-2.02D(1), and as specified herein.

- B. If reinforcement is encountered during drilling, before the specified depth is attained, notify the Engineer. Unless the Engineer approves coring through the reinforcement, the hole will be rejected. If hole is rejected, drill a new hole, in which reinforcement is not encountered, adjacent to the rejected hole to the depth shown on the Contract Drawings. Grout rejected hole.
- C. Dowels shall conform to the provisions for reinforcing steel bars specified herein.

#### **3.04 DRILLING AND GROUTING DOWELS**

- A. Drilling and grouting concrete shall consist of drilling through reinforced concrete bridge members, placing reinforcement and filling holes with non-shrink grout, and shall conform to the details shown on the Contract Drawings, the provisions in Caltrans Standard Specifications, Section 83-2.02D(1), and as specified herein.
- B. If reinforcement is encountered during drilling, before the specified depth is attained, notify Engineer. Unless the Engineer approves coring through the reinforcement, the hole will be rejected. If hole is rejected, drill new hole, in which reinforcement is not encountered, adjacent to the rejected hole to the depth shown on the Contract Drawings. Grout rejected hole.
- C. Dowels shall conform to the provisions for reinforcing steel bars specified herein.
- D. Clean concrete areas to be in contact with grout of all loose or foreign material that would in any way prevent bond between the concrete surfaces, flush flushed with water, and allow to dry to a surface dry condition immediately prior to grouting.
- E. After placement of reinforcement, seal ends of the drilled hole containing the reinforcement, with one vent tube and one injection feed tube. Place tubes in the hole in a manner which will allow the air to vent and the hole to be completely filled with grout. Achieve sufficient pressure to ensure that the hole is free of voids. Pump grout through the holes and continually waste grout until no visible slugs or other visible evidence of water or air are ejected and the efflux time of ejected grout is not less than 1.1 seconds.
- F. Prevent grout from falling into any waterway and on public traffic, from flowing across shoulders or lanes occupied by public traffic, and from flowing into gutters or other drainage facilities.

#### **3.05 FIELD QUALITY CONTROL**

- A. Inspection and testing of welds shall be performed by an approved Inspection and Testing Agency retained by the Contractor:
  - 1. Visually inspect reinforcing bar welds.
  - 2. Tension tests of welded butt joints shall be performed on sample welds produced by the Contractor in accordance with ASTM E8.
  - 3. Non destructive tests of installed welded butt joints shall be performed in accordance with ASTM E165.

4. Inspections and tests shall be performed in accordance with the applicable requirements of AWS D1.4, Chapters 6 and 7.

**END OF SECTION**

## SECTION 03250 CONCRETE ACCESSORIES

1. WATERSTOPS
  - 1.1 Waterstops shall be extruded from thermo-plastic material consisting of a base resin of polyvinyl chloride (PVC) which contains no reclaimed material. Waterstops are required where shown on the plans and as directed by the Engineer. In general, they shall be required at horizontal and vertical construction joints in below grade walls and floor slabs and in all water retaining structures. The type of waterstop shall be as shown on the plans or as directed by the Engineer.
  - 1.2.1 Care shall be taken in the correct positioning of the waterstops during installation. Splices in waterstops shall have a minimum lap of twelve (12) inches and shall be sealed to provide continuity.

END OF SECTION

SECTION 03300  
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cast-in-Place Concrete required to complete the work indicated on all the project construction drawings except for related sections.
- B. Related Sections
  - 1. None

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans.

1.3 SUBMITTALS

- A. Product Data: Submit preprinted data for each type of manufactured material and product demonstrating compliance requested by the Engineer.
- B. Design Mixes: Submit design mix for each concrete mix. Include field test data used to establish the required average strength in accordance with ACI 301. Review of design mixes and field test data will be for general information only. Production of concrete to comply with specified requirements is the responsibility of the Contractor. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until each mix has been reviewed and approved by the Engineer.
  - 1. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Shop Drawings:
  - 1. Steel Reinforcement Shop Drawings: Submit details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.  
Pour sequence layout: Submit plans and elevations showing quantity and sequence of pours, include waterstops and other joint sealants.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Testing Agency Qualifications: A materials testing company acceptable to authorities having jurisdiction, and under the direct supervision of a registered professional Engineer shall conduct the testing indicated in the specifications and submit for approval.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. Publications: Comply with the latest edition of the following, except as modified by the Contract Documents. Maintain a copy of the latest edition of ACI 301, 117, 318, and 347 at the project site at all times. Where provisions of the above codes and standards are in conflict with the building code in force for the Project, the building code shall govern.
  - 1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  - 2. ACI 301, "Standard Specification for Structural Concrete."
  - 3. ACI 302, "Guide for Concrete Floor and Slab Construction."
  - 4. ACI 305, "Hot Weather Concreting"
  - 5. ACI 306, "Cold Weather Concreting"
  - 6. ACI 308, "Standard Practice for Curing Concrete"
  - 7. ACI 318 "Building Code Requirements for Structural Concrete"
  - 8. ACI 347 "Recommended Practice for Concrete Formwork"
  - 9. ACI 350 – "Code Requirements For Environmental Engineering Concrete Structures"
  - 10. ASTM C494 Standard Specification for Chemical Admixtures for Concrete
  - 11. AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
  - 12. CRSI "Manual of Standard Practice."
- G. Concrete Testing Service: The Contractor will employ a testing laboratory to perform initial field quality control testing.
  - 1. Materials and installed Work may require testing and retesting, at anytime during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed Work, shall be done at the Contractor's expense.
- H. Pre-Concrete review of documents.
  - 1. The Contractor shall review the detailed requirements for preparing the concrete design mixes and review the drawings, specifications, and the details of the project.

2. Require responsible representatives of every party who is concerned with the concrete work to review these portions of the contract documents, including but not limited to the following:
  - a. Contractor's superintendent
  - b. Laboratory responsible for the concrete design mix
  - c. Laboratory responsible for the field quality control
  - d. Concrete subcontractor

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.
  1. Avoid damaging coatings on steel reinforcement.

#### 1.6 PROJECT CONDITIONS

- A. Before commencing work, examine all adjoining work on which this work is in any way dependent for proper installation and workmanship and report to the Contractor any condition which prevents performing first class work.
- B. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.
- C. Protect adjacent finish materials against spatter during concrete placement.
- D. Provide all barricades and safeguards at all pits, holes, shaft and stairway openings, and the like. Provide all safeguards as required by authorities having jurisdiction. Take full responsibility for safety precautions and methods.

### PART 2 - PRODUCTS

#### 2.1 FORM-FACING MATERIALS

- A. Formed Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Rust-free metal.
  2. Exterior-grade undamaged, unpatched plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
    - b. Structural 1, B-B, or better, mill oiled and edge sealed.
    - c. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist plastic concrete loads imposed by concrete without deformation.

- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 , deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Deformed-Steel Wire: ASTM A 496.
- D. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
  - 1. All welded wire shall be supported on non metallic chairs at 4' on center and tied in place to preserve proper placement in the slab. No lifting or pulling up of the welded wire will be allowed during the concrete placement.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
  - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
  - 4. Do not use wood, masonry, concrete or other similar supports.

- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
  - C. C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.
  - D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 755M.
- Mechanical Reinforcement Couplers: ASTM A-519, Minimum tensile strength 125% of Fy.

#### 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C150, Type I/II, supplied from a single manufacturer. **ASTM TYPE II CEMENT SHALL BE USED IN ALL STRUCTURES IN DIRECT CONTACT WITH SEWAGE OR INFLUENT.** Supplement with the following:
    - a. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
    - b. Fly Ash: ASTM C618, Class F or C.
    - c. Silica Fume: ASTM C 1240, amorphous silica.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
  - 1. Class: Severe weathering region, but not less than 3S.
  - 2. Nominal Maximum Aggregate Size: 3/4 inch unless otherwise indicated.

*NOTE: INCLUDE "C" BELOW IF APPLICABLE.*

- C. Water: Complying with ASTM C 94.

#### 2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride thiocyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F.

## FIBER REINFORCEMENT

Carbon-Steel Fiber: ASTM A 820, deformed, minimum 1.5 inches (60 mm) long, and of diameter or effective diameter indicated.

Fiber: Type 1, cold-drawn wire.

Products: Subject to compliance with requirements, provide one of the following:

Carbon-Steel Fibers:

Dramix; Bekaert Corporation.

Fibercon; Fibercon International.

Zorex; Novocon International Inc.

Provide admixtures as recommended by steel fiber manufacturer without increasing specified water-cementitious material ratio.

*NOTE: INCLUDE "WATERSTOPS" BELOW IF APPROPRIATE.*

### 2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections, and directional changes. Waterstops shown at interior wall construction joints and at the base of the structural wall are required.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or an approved equal.
    - a. Greenstreak
    - b. Multiurethanes, LTD
    - c. Williams Products, Inc.
  2. Profile: Flat, dumbbell with center bulb.
  3. Dimensions:
    - a. 9 inches by 3/8 inch thick
    - b. 6 inches by 1/4 inch thick
- B. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.
1. Products: Subject to compliance with requirements, provide one of the following, or an approved equal.
    - a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
    - b. Conseal CS-231; Concrete Sealants Inc.
    - c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
    - d. Hydrotite; Greenstreak.
    - e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.
    - f. Adeka Ultra Seal; Mitsubishi International Corporation.
    - g. Superstop; Progress Unlimited Inc.

## 2.7 VAPOR RETARDERS

- A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 8 mils (0.25 mm) thick. Use only materials which are resistant to decay when tested in accordance with ASTM E 154:
  - 1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.
  - 2. Three-ply, nylon- or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 7.8 mils (0.18 mm) thick.

## 2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Drinkable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

## 2.9 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 26 gage (0.0217-inch) thick galvanized steel sheet with 45 degree slot minimum 1" deep and 1/4" wide and formed with upper lip bent back to engage concrete. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dipped galvanized steel sheet not less than 0.0217 inch (0.55-mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

## 2.11 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Provide a minimum 28 day compressive strength of 3500 psi (27.7 MPa) and a maximum water-cementitious material ratio of 0.44, unless otherwise indicated.
- D. Building Footings and Building Foundation Walls: Proportion normal-weight concrete mix as follows unless otherwise indicated:
1. Compressive Strength (28 Days): 4000 psi with a maximum water cementitious material ratio of 0.44 (non air-entrained) (6 bag mix).
  2. Maximum Slump at point of placement: 4 inches .
  3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.
- E. Slab-on-Grade: Proportion normal-weight concrete mix as follows unless otherwise indicated:
1. Exterior Exposed Concrete - Compressive Strength (28 Days): 4500 psi with a maximum water-cementitious material ratio of 0.4 (air-entrained) 6 bag mix.
  2. Interior Concrete - Compressive Strength (28 Days): 4000 psi with a maximum water-cementitious material ratio of 0.44 (6 bag Mix).
- F. Basin Walls, Floors, Foundations, and all Liquid Containing Structures.
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum Water Cementitious Materials Ratio: 0.40

3. Slump limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. No admixtures containing calcium chloride.
5. Air content: 5.0% - 8.0%
6. Aggregates per ASTM C33, maximum aggregate size – 1 inch.

G. Cementitious Materials:

1. For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.
2. For all other concrete, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
  - a. Fly Ash: 15 percent by weight.

H. Air Content: Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content: 6 percent for 3/4-inch nominal maximum aggregate size.

I. Steel-Fiber Reinforcement: Add to concrete mix, according to manufacturer's written instructions at a rate indicated on the drawings but not less than 25 lb/cu. yd. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

J. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs.

## 2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." In the case of fabrication errors, do not rebend or straighten reinforcement.
- B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:
  1. Bar lengths, depths or bends exceeding specified fabrication tolerances.
  2. Bends or kinks not indicated on the Drawings or final Shop Drawings

3. Bars with reduced cross section due to excessive corrosion or other cause.
4. Bars with damaged corrosion resistive coating (if specified).

### 2.13 CONCRETE MIXING

- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information to the field inspector.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads within acceptable deflection limits.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, and inserts, and other features required.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  1. Class A, 1/8 inch for surfaces predominantly exposed to public view.
  2. Class B, 1/4 inch for course-textured concrete formed surfaces intended to receive plaster, stucco, or wainscoting.
  3. Class C, 1/2 inch for all other surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
  1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and

securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- H. Chamfer exterior corners and edges of permanently exposed concrete with  $\frac{3}{4}$ " x  $\frac{3}{4}$ " strips (unless otherwise indicated) accurately formed and surfaced to produce uniform straight lines and tight edges. Unexposed corners may be formed square or chamfered.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items, including those under separate prime contracts (if any).
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with non-staining, rust preventative form-release agent, according to manufacturer's written instructions, before placing reinforcement. Rust stained steel formwork is not acceptable.
- M. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces of accurate alignment, from irregularities and within allowable tolerances
- N. Elevate formwork as required for anticipated deflections due to weight and pressures of fresh concrete, shortening of formwork system, and construction loads.
- O. Carefully inspect falsework and formwork during and after concrete placement to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.
- P. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.
- Q. Forms for exposed Concrete:
  - 1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes.
  - 2. Do not use metal cover plates for patching holes or defects in forms.
  - 3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersection.
  - 4. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance of concrete. Do not use narrow strips of form material that will produce bow.
  - 5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required.
  - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50° F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.
  - 1. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

### 3.4 VAPOR RETARDERS

- A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions and as follows:
  - 1. Use sheets as large as practical. Overlap minimum 6" and tape. Tape to perimeter and to projections.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. At a spacing not to exceed 4'-0" on center in either direction. For slabs on grade, use supports not to exceed 4'-0" o.c. with sand plates or horizontal runners where base material will not support chair legs.
  - 2. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two mesh spacings. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 1. Expansion and construction joints plus joint filler materials shall be as shown on the Drawings. If not detailed, place contraction (control) joints at not more than twenty-five (25) feet each way in slabs or walls.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs, unless noted otherwise.
  - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in concrete walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls at not more than 35 feet in any horizontal direction, unless drawings show otherwise. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into 15-foot maximum perpendicular strips, and areas not exceeding 225 square feet. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete within 24-hours after initial floating, when cutting action will not tear, abrade, or otherwise damage surface, and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: Install joint-filler strips at all slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.7 CONCRETE PLACEMENT

- A. Pre-Placement Inspection:
1. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.
  2. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their Work; cooperate with other trades in setting such Work, as required.
  3. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.
  4. Soil at bottom of foundation systems are subject to testing for soil bearing value by the testing laboratory, as directed by the Engineer. Place concrete immediately after approval of foundation excavations.
  5. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
  6. Remove soil, debris, standing water, ice, snow, loose mill scale or coating and other foreign matter from formwork and metal deck.

- B. Do not add water to concrete during delivery, at Project site, or during placement, unless indicated on trip ticket.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- D. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
  - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete. Place concrete in accordance with the practices and recommendations of ACI 304, and as herein specified.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

- G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
  2. Do not apply rubbed finish to smooth-formed finish.
- C. Rubbed Finish: Apply the following to finished concrete exposed to view:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform surface.
  2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
1. F(F) defines the maximum floor curvature allowed over 24 in. Computed on the basis of successive 12 in. elevation differentials, F(F) is commonly referred to as the "Flatness F-Number".
  2. F(L) defines the relative conformity of the floor surface to a horizontal plane as measured over a 10 ft. distance, commonly referred to as the "Levelness F-Number".
  3. All floors shall be measured in accordance with ASTM E-1155 "Standard Test Method for Determining Floor Flatness and Levelness Using the "F Number" System.
  4. All slabs shall achieve the specified overall tolerance. The minimum local tolerance (1/2 bay) shall be 2/3 of the specified tolerances.
- B. Trowel Finish: Apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
1. Gymnasium Floors: Overall values of flatness, F(F) 50; and levelness, F(L) 35; with minimum local values of flatness, F(F) 35; and levelness, F(L) 24 for gymnasium floors and other specialty floor areas as required.
  2. Elevated slabs overall values of flatness, F(F) 25; with minimum local values of flatness, F(F) 17.
  3. All other slab on grade overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15 other.

### 3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Provide wire reinforcement. Cast-in inserts and accessories as shown on Drawings or required by manufacturer. Screed, tamp, and trowel-finish concrete surfaces.

### 3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301, ACI 306.1 for cold-weather protection, and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive resilient sheet floor coverings. Cure concrete surfaces to receive other floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.12 WATERPROOFING

- A. Waterstops:

1. PVC Waterstops shall be extruded from thermoplastic material consisting of a base resin of polyvinyl chloride (PVC), which contains no reclaimed material whatsoever. Waterstops are required where shown on the Plans and as directed by the Engineer. They shall be required at horizontal and vertical construction joints in below grade walls and floor slabs in all water retaining structures. The type of waterstop shall be as shown on the Plans or as directed by the Engineer.
2. Swellable Waterstops: Conformable, swellable polymer/butyl rubber water stops shall be used where indicated on drawings. Care shall be taken in the correct positioning of the waterstops during installation. Splices in waterstops shall have a minimum lap of twelve inches (12") and shall be sealed to provide continuity.

### 3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval. Comply with ACI 301.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
  8. Repair shrinkage cracks by filling cracks with pressure epoxy grout. Perform repairs with prior approval of method and materials from Engineer.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

#### 3.14 FIELD QUALITY CONTROL

- G. Testing Agency: Contractor will engage a qualified testing and inspecting company to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- H. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample (four 6" x 12" cylinders) for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd. plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from

at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
  7. Compressive-Strength Tests: ASTM C 39
    - a. Test two specimens at 7 days, two at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
  8. Floor Flatness and Levelness: ASTM E 1155
    - a. Test one sample area for each slab area required to have a floor flatness, F(F) or floor levelness F(L) greater than 25.
    - b. Perform tests elevated slabs within 72 hours of concrete placement.
- I. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- J. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- K. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- L. Additional Tests: Testing and inspecting company shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.

- M. Defective Work: Concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense without extension of time. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

END OF SECTION

SECTION 03610  
NON-SHRINK GROUT

PART 1 – MEASUREMENT AND PAYMENT

1.01 GENERAL

- A. All costs associated with providing and installing non-shrink grout materials shall be included in the respective unit prices bid for related Work items. The item will not be measured for payment.

PART 2 – GENERAL

2.01 SUMMARY

- A. Cement based grout for setting equipment base plates.

2.02 SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's literature.
- B. Submit in accordance with Section 01330.

PART 3 – PRODUCTS

3.01 MATERIALS

- A. Manufacturers (Grade B)
  - 1. Five Star Grout by Five Star Products, Inc.
  - 2. DuragROUT by L&M Construction Chemicals, Inc.
  - 3. SikaGrout 212 by Sika Corp.
  - 4. NBEC, Five Star Products, Inc.
  - 5. Masterflow 713 Grout by Master Builders
  - 6. Euco N-S Grout, Euclid Chemical Company
  - 7. Crystex, L&M Construction Materials, Inc.
- B. Grout:
  - 1. Preblended, cement based, nonmetallic, nongas forming, nonshrink and shall not bleed.
  - 2. Comply with ASTM C1107 and CRD C621, Grade B or C.
  - 3. Moderate fluidity.
  - 4. 5,000 psi minimum compressive strength.
- C. Water:
  - 1. Potable

END OF SECTION