REQUEST FOR BID

FOR

GRAVITY SEWER PACKAGE B CONSTRUCTION

Bid No. 421848.71.0420

March 4, 2025

City of Memphis, Tennessee

Black & Veatch and Overland Contracting Inc. (OCI), a subsidiary of Black & Veatch, are the Program Manager and Construction Manager respectively, for the SARP10 Program for the City of Memphis.

Overland Contracting Inc.
845 Crossover Lane, Suite 120, Memphis, TN 38117

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00170 - Request for Bid

00170.1 Introduction

Sealed bids will be received at the Office of the City of Memphis Environmental Administration, Room 620, City Hall, 125 N. Main, Memphis, TN 38103, until **2:00 p.m. local time, April 15, 2025** furnishing the City of Memphis with the following:

FOR THE DIVISION OF: PUBLIC WORKS FOR THE CONSTRUCTION OF:
SARP10 Program **Gravity Sewer Package B Construction**

The Sealed Bid envelope must be labeled with the project name, bidder's name, license bidder number, license expiration date, license classification. The Sealed Bid envelope must contain one (1) hardcopy of the bid and one (1) electronic CD copy of the bid.

Sealed Bids sent through the mail or other such delivery service shall be sent in such a manner so as to allow the opening of the "Mailing Container" and still have intact the sealed Bid. On the Mailing Container the sender shall state the words that a "**SEALED RESPONSE IS ENCLOSED**" and the Bid number.

Subcontractors intending to bid on this project must follow the instructions for Registration as stated in the Advertisement Legal Notice Request for Bid No. **421848.71.0420** (dated March 4, 2025). Registration information must be submitted by **March 27, 2025**.

00170.2 Program Overview

The Program consists of the management of the capital program needed to bring the City's wastewater and sewer system into compliance with federal and state regulations per the City of Memphis Wastewater Collection and Transmission System (WCTS) Condition Assessment and Rehabilitation Program Consent Decree signed on September 21, 2012, including the procurement of studies, design and construction services associated with the City of Memphis SARP10 Program.

00170.3 Scope of Work

This project involves the installation of new sewer pipelines at four designated locations in Memphis, including associated infrastructure improvements. The scope includes the construction of new sewer lines, installation of manholes, post-construction CCTV inspections, and abandonment of existing pipelines as required.

00170.4 Bid Guarantee Requirements

Guarantee Requirements:

a) Bidder will not withdraw bid for one hundred eighty (180) calendar days after opening of bids without Purchaser's written consent.

b) If bid is accepted, bidder will enter into formal Subcontract with Purchaser, within five (5) calendar days after receipt of Subcontract documents for execution.

c) If bid is accepted, bidder will execute required 100% Performance/Payment Bond in accordance with Article 00571.4 and will obtain required insurance coverage in accordance with Article 00572.21 within ten (10) calendar days after receipt of Subcontract.

d) All bids will require a bidder's bond or certified or cashier check made payable to the Purchaser on a solvent bank in the amount of 5% of the bid. Said instrument to remain in effect and will be returned only after the Subcontract has been fully executed and secured. Additionally, the successful bidder shall execute a performance bond in an amount equal to 100% of the Subcontract sum as security for the faithful performance of the Subcontract and for the payment of labor and material furnished and incorporated into the Work. The only acceptable form of instrument for this bid bond is bound herein, Article 00672.7.

Bidder shall be liable to the Purchaser for full amount of proposal guarantee as representing damage to the Purchaser on account of default of bidder if:

a) Bid is withdrawn within one hundred eighty (180) calendar days after receipt of bids without approval by Purchaser.

b) Bidder fails to enter into contract with Purchaser and execute required Performance Bond and provide required insurance coverage within ten (10) calendar days subsequent to notice of award of the Subcontract.

**Firms desiring to submit a Bid should carefully review these instructions.
Compliance with all requirements will be solely the responsibility of the Respondent.**

00170.5 Request for Bid Definitions

Terms used in this Request for Bid documents are defined and have the meanings assigned to them as follows. The term "OCI", “Purchaser” or “Program Manager” means Overland Contracting Inc. The term "Respondent", “Firm”, “Company”, “Subcontractor” or “Bidder” means one who submits a Response for the purpose stated in this Solicitation Request for Bid documents. The terms “BID”, “Response” or “Respondent's Response” mean all submittal documents provided by the Respondent as required by this Request for Bid. The terms “Request for Bid” or “Bid Documents” mean the documents included in this Request for Bid.

Every effort has been made to use industry-accepted terminology in this Request for Bid. Any statement in this document, which uses words such as "must", "shall", "should", "provide for" or "have/provide the capability of/for", means that compliance with the intent of the statement is mandatory and that failure by the Respondent to satisfy that intent may be cause for the Response to be rejected.

00170.6 Minority / Women Business Enterprise (M/WBE) Requirements

This section shall set forth the respondent's M/WBE Participation Plan that must be submitted and include: (1) the level and dollar amount of participation your firm anticipates to achieve in the performance of the Subcontract resulting from this RFB; (2) the type of Work to be performed by the M/WBE firms participating; and (3) the names of the M/WBE firms the Respondent plans to utilize in the performance of the Subcontract resulting from this RFB.

SARP10 DBE Participation Goal:
DBE minimum **20%**
(Vendors from the City of Memphis EBO list only)

00170.7 Clarification of Bid

Purchaser reserves the right to obtain clarification of any point in a Response or to obtain additional information as necessary to properly evaluate a particular Response. Failure to respond to such request for additional information or clarification in a timely manner may result in rejection of the Response.

00170.8 Not Used

00170.9 Responsiveness

Respondents should respond to all requirements of the Bid to the maximum extent possible and are required to clearly identify any limitations.

00170.10 Examination of Request for Bid Documents

Before submitting a Response, each Respondent must:

- Study and carefully correlate the Respondent’s observations and responses with the Bid Documents.
- Notify Purchaser of all conflicts, errors and discrepancies, if any; in the Bid Document submitted.
- Review the Loss Control Manual.

Respondents by and through the submission of their Response, agree that they shall be held responsible for having therefore familiarized themselves with the nature and extent of the requirements in the Bid Documents.

00170.11 Interpretations and Addenda

If any prospective Firm is in doubt as to the true meaning of any part of the Requirements for Preparing and Submitting Bid Submittal for the requested services, they may submit a written request (verbal requests will not be accepted) for an interpretation before the Last Date for Bidder Questions; as stated in 00170.16. The person submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addendum transmitted to each party receiving a set of such documents. Purchaser will not be responsible for any other explanations or interpretations of the proposed documents. Any requests not submitted within this time period will be deemed waived.

SUBMIT ALL QUESTIONS BY E-MAIL TO:

Attn: Josh Grabowski
jgrabowski@allworldmail.com
Cc: Ginny Dorsey
DorseyV@bv.com
Cc: Jerry Caldwell
CaldwellJ@bv.com
(Reference: *SARP10 Program* ***Gravity Sewer Package B Construction****, BID No.* ***421848.71.0420***)

All requests or questions should be clearly marked and must be received by Last Date for Bidder Questions, as stated in 00170.16. A response will be returned via addendum to all Firms along with the original question(s).

There shall be no communication between the Firm, their employees or subcontractors concerning this Bid to anyone within Black & Veatch, Overland Contracting, Allen & Hoshall, Allworld Project Management, Gresham Smith, Carter-Malone Group, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above except through Bently Green – Program Director or Jerry Caldwell – Project Manager. **Failure to comply with this requirement will be grounds for disqualification.**

00170.12 Modification or Withdrawal of Bid Submittals

Responses may be modified or withdrawn by an appropriate document duly executed (in the same manner that a Response must be executed) and delivered to the place where Responses are to be submitted at any time prior to the submission deadline. A request for withdrawal or a modification must be in writing and signed by an authorized person. Evidence of such authority must accompany the request for withdrawal or modification. Withdrawal of a Response will not prejudice the rights of a Responder to submit a new Response prior to the Response deadline. After expiration of the period for receiving Responses, only Purchaser may request clarifications or additional information.

00170.13 Rejection of Responses

To the extent permitted by applicable local, state and federal laws and regulations, Purchaser reserves the right to reject any and all Responses, to waive any and all informalities not involving price, time, or changes in the Work with the successful Respondent, and the right to disregard all non-conforming, non-responsive, unbalanced or conditional Responses. Also, Purchaser reserves the right to reject a Response, in its sole discretion, if the City of Memphis believes that it would not be in its best interest to make an award to that Respondent.

Purchaser reserves the right to reject any Response if the evidence submitted by the Responder or if the investigation of such Respondent fails to satisfy Purchaser that such Respondent is properly qualified to carry out the obligations and to complete the Work contemplated therein. All Responses will be rejected if there is reason to believe that collusion exists among Respondents. Responses will be considered irregular and may be rejected if they show serious omissions, alterations in form, additions not called for, conditions or unauthorized alterations, or irregularities of any kind.

00170.14 Other Items

This Bid does not commit Purchaser to enter into a Subcontract, nor does it obligate Purchaser to pay for any costs incurred in the preparation and submission of Responses or in anticipation of a Subcontract. Costs of preparing the Bid in response to this request are solely the responsibility of the Respondent.

By responding to this solicitation, the respondent attests that no employee of Black & Veatch, Overland Contracting, Allen & Hoshall, Allworld Project Management, Gresham Smith, Carter-Malone Group, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above, has an existing or pending, direct or indirect, financial interest in the respondent's business.

No Respondents to this solicitation shall discriminate against any employee or applicant for employment because of race, religion, color, sex, age, or national origin.

00170.15 Selection Process

Purchaser intends to select one Firm based on price and successful completion and approval of the OCI Registration process.

00170.16 Selection Schedule

The following schedule will be adhered to during the selection process. It is subject to change at the sole discretion of OCI.

Event	Completed By
Advertising Date	March 4, 2025
Pre-Bid Meeting	March 20, 2025
Registration Information submitted per 421848.71.0420 Advertisement	March 27, 2025
Last Date for Bidder Questions	March 27, 2025
Issue Addendum for answers to questions	April 8, 2025
Receive all Bids	April 15, 2025 by 2:00 pm local time
Public Opening	April 15, 2025 immediately following receipt of bids
Public Notice of Intent to Award	April 29, 2025
Preconstruction Meeting with Subcontractor	May 6, 2025
Tentative Notice to Proceed	May 6, 2025

00170.17 Mandatory Pre-Bid Meeting

A mandatory pre-bid meeting will be held at **9:30 A.M** (local time) at the **Environmental Maintenance Office, 2865 Frayser Boulevard, Memphis, TN 38127** on **March 20, 2025**. Bidders are required to attend at their own cost.

00270 - Instructions to Bidders

00270.1 Bidder's Compliance with Request for Bid

Provide the information requested and any supporting information necessary to permit a complete analysis of your bid. You acknowledge that preparation and submission of a bid will be at your sole cost and that you will treat this RFB and any resulting discussions as confidential. If you do not agree to treat this RFB and associated discussions as confidential, return the complete RFB to Purchaser and delete or destroy any copies you made.

00270.2 General Bid Parameters

Provide the information requested in Section 00270 and Section 00370 in the appropriate fields of Section 00370. Complete each line of Section 00370 in its entirety and submit it with your bid in accordance with Section 00170. Do not alter Section 00370 forms in any way or deviate from the terminology used or the unit of measure indicated when completing Section 00370. Submit Section 00370 forms in their original core application software, with no embedded programming and no permissive encoding restricting access to the data provided.

00270.2.1 Bidder's Contact Information

Include contact information for your representative in Article 00370.2.1. Your representative must have the appropriate expertise and authority to negotiate on behalf of your company.

00270.2.2 Addenda to Request for Bid

In Article 00370.2.2, list all addenda received from Purchaser and indicate "Yes" to show your receipt of and incorporation of the listed addenda into the proposal.

00270.3 Bid Pricing

You must include numerical values in the applicable fields of Table 00370.3.1. Non-numerical values, such as "included" or "not applicable," are not acceptable. Purchaser will evaluate fields left blank or filled with a zero as scope included in your bid at no cost.

00270.3.1 Unit Pricing

Provide the unit prices to perform the Work in accordance with this RFB in Table 00370.3.1. A unit price is the total amount to be billed to Purchaser for a specific unit of work. Unit pricing includes all costs, overhead, profit and mark-up associated with delivering the complete unit.

00270.4 Supplemental Bid Information

00270.4.1 Company Status

In Article 00370.4.1, indicate the type of your organization’s legal entity and the state and country in which it is organized.

00270.4.2 Contractor License

If you are not licensed to perform the Work, indicate “No" in Article 00370.4.2.

00270.4.3 Not Used

00270.4.4 Bid Validity Period

Indicate "Yes" in Article 00370.4.4 if your proposal is valid for one hundred eighty calendar days after the Proposal Due Date (the "Proposal Validity Period"). Purchaser may reject your proposal without prior notice if your proposal is not valid for the full Bid Validity Period.

00270.4.5 Firm Non-Escalatable Pricing

Indicate "Yes" in Article 00370.4.5 if the proposal pricing is firm and not subject to escalation.

00270.4.6 Taxes
Tax requirements are identified in Article 00571.6. Indicate "Included" in Article 00370.4.6 if your proposal includes the tax requirements.

00270.4.7 Work at Jobsite
Identify the type of craft labor. If you plan to subcontract any of the Work, indicate “Yes” in the appropriate section of Article 00370.4.7 and complete Table 00370.4.7.

00270.5 Schedule Compliance
Indicate "Yes" in Article 00370.5 if you can meet the schedule dates included in Table 00370.5. If you indicate "No," submit an alternative summary level schedule with your proposal.

00270.6 Compliance with Request for Bid

00270.6.1 Not Used

00270.6.2 Not Used

00270.7 Bid Attachments
List any supplemental documents included in your bid in Article 00370.7.

00270.8 Declarations
Indicate "Yes" in Article 00370.8 to confirm you have familiarized yourself with the conditions affecting the Work.

00270.9 Nondiscrimination
All entities contracting with the Purchaser agree to abide by and to take affirmative action when necessary to ensure compliance with the nondiscrimination clauses set out below and agree to show proof of non-discrimination upon request and to post in conspicuous places available to all associate agents and their employees. In the event of non-compliance with nondiscrimination clauses, or with provisions of Executive Orders 11141 (age), 11246, 11375 (women), 12086 (Vietnam veterans), 11478 (federal employees), 11625 (minority business) 11701 (veterans), Title 41, Chapter 60 (handicapped) and specifically the handicapped affirmative action clause in Section 60-741.6.9 of OFCCP Rules, and any and all other federal laws prohibiting discrimination, contracts may be canceled, terminated, or suspended in whole or in part by the Purchaser.

The Bidder shall execute the specified Nondiscrimination Certificate (see Section 00672.3) agreeing that, if awarded the Subcontract, he/she shall not discriminate against any Sub-subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex, in accordance with the citations listed in the above paragraph; and shall require the execution of such a certificate for each Sub-subcontractor prior to award of any subcontract with the further requirement that each subcontractor shall include identical requirements in any lower tier subcontracts which might in turn be made. FAILURE TO EXECUTE AND SUBMIT SUCH CERTIFICATE WITH THE BID MAY CAUSE THE BID TO BE REJECTED AS NON-CONFORMING. The successful Bidder and all Sub-subcontractors under the general contract shall maintain copies of their payrolls and all subcontracts for each weekly payroll period for the life of the construction and for a period of **SEVEN (7) YEARS** after final release and payment is made by the Purchaser to the contractor.

00270.10 Equal Business Opportunity Program (EBO)
The Bidder must complete and return the Equal Business Opportunity Program Compliance Form included in Section 00672.4 of this RFB.

00370 – Commercial Bid Form (8 pages)

00370 - Commercial Bid Form

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

00370.1 Bid Submitted by	Bidder Response Column
Company Name	
Mailing Address/Number, Street	
Mailing Address/State, Zip Code	
Country	
Taxpayer ID Number (or EIN)	
Bidder's Bid Date	
Bidder's Bid No.	

00370.2 General Bid Parameters	Bidder Response Column
Bidder is providing the information defined by the articles comprising Section 00270, INSTRUCTIONS TO BIDDERS, in the corresponding fields of this Section 00370, COMMERCIAL BID FORM.	
00370.2.1 Bidder's Contact Information	
Bidder's Representative Name	
Title	
Mailing Address/Number, Street	
Mailing Address/City	
Mailing Address/State, Zip Code	
Delivery Address/Number, Street	
Delivery Address/State, Zip Code	
Country	
Email Address	
Phone Number	( ) - ( )
Mobile Phone Number	( ) - ( )
Fax Number	( ) - ( )
Business Interruption Plan	
Confirm that Bidder maintains a Business Interruption/Disaster Recovery Plan that documents how Bidder will respond to disaster or pandemic to help minimize impact - **Yes/No** If Yes, plan should be submitted with RFB.	
00370.2.2 Addenda to Request for Bid	
Bidder acknowledges receipt and inclusion of the following Addenda to the RFB - **Yes/No**	

	Addenda Number	Date Issued	Received and Incorporated

00370.3 Bid Pricing Information	Bidder Response Column
00370.3.1 Bid Prices	**See Attached Pricing Table(s) [Bidder to List Tables Used]**

00370.4 Supplemental Bid Information	Bidder Response Column
Bidder provides the following information to supplement the Bidder's bid pricing.	
00370.4.1 Company Status	
Bidder's company status is: (i.e. partnership, individual owned, joint venture, corporation, etc.)	
in State of	
in Country of	

00370.4.2 Contractor License	
Bidder certifies that it is licensed, as required, to engage in the RFB Work scope in the State/Province/Country the RFB Work is to be performed. - **Yes/No**	
1st License Title	
in State/Province of	
License Number	
2nd License Title	
in State/Province of	
License Number	

00370.4.3 Not Used

00370.4.4 Bid Validity Duration	
Bidder's bid is valid for acceptance by the Purchaser for a period of 180 days from the bid due date. - **Yes/No**	
00370.4.5 Firm Non-Escalatable Pricing	
All of Bidder's prices herein bid are firm and are non-escalatable. - **Yes/No**	
00370.4.6 Taxes	
Bidder's prices included herein are in accordance with Article 00571.6 Taxes. - **Yes/No**	
00370.4.7 Work at Jobsite	
Bidder's source of craft labor to be utilized in the performance of the Work is - **Open-Shop/Merit-shop/Union-shop**	
If applicable, identify the local union(s) used for hiring craft labor: 1st Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
2nd Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
Bidder has accounted for all Jobsite existing and controlling conditions and limitations which may affect the Work performance and the Bidder's Bid. - **Yes/No**	
Bidder proposes that it will perform all the Work at the Jobsite with its own forces. - **Yes/No**	
Bidder has indicated proposed sub-subcontracted Work in attached Table 00370.4.7. - **Yes/No**	
Bidder has provided proposed Small Business/Minority/Disadvantaged Entrepreneur Participation Plan with its bid. - **Yes/No**	

00370.5 Schedule Compliance	Bidder Response Column
Bidder agrees to meet the schedule dates indicated in the RFB documents: - **Yes/No**	
If No, Bidder has completed and submitted an attached alternative summary level schedule: - **Yes/No**	

00370.6 Compliance with Request for Bid	Bidder Response Column
NOTE: A bid based on Bidder's standard terms and conditions will not be considered.	
Bidder certifies that its bid complies with all RFB commercial and technical requirements. - **Yes/No**	

00370.7 Bid Attachments	Bidder Response Column
In addition to this Commercial Bid Form and Tables indicated herein, the Bidder's Bid contains supplemental information and details attached to this bid consisting of the following:	
(Attachment 1)	
(Attachment 2)	
(Attachment 3)	
(Attachment 4)	
(Attachment 5) (Add additional lines as needed)	

00370.8 Declarations	Bidder Response Column
The Bidder declares that it has familiarized itself with the conditions affecting the Work. The Bidder also declares that only the persons or firms interested in the bid as principal or principals are named herein; that no other persons or firms have any interest in this bid or in the Subcontract to be entered into; that this bid is made without connection with any person, company, or party likewise submitting a bid; and that it is in all respects for and in good faith, without collusion or fraud. - **Yes/No**	
If written notice of acceptance of this bid is delivered to the Bidder within "Bid Validity" days after the date set for receipt of bid, or any time thereafter before the bid validity expires, the Bidder will, within 5 days after receipt of a formal Subcontract for signature, exercise and deliver to Purchaser a signed Subcontract in the form provided by the Purchaser in accordance with the documents provided herein. - **Yes/No**	

Bidder Authorized Signature:

***must be signed, not typed**

Table 00370.3.1 - Unit Price Bid Form

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

Bid Submitted by: (Company Name)

00370.3 Bid Pricing Information

00370.3.1 Unit Pricing

Bidder proposes to complete the RFB Work based on firm, fixed, unit prices (US dollars), which prices multiplied by the final Work quantities would represent the full consideration to Bidder for its complete and satisfactory performance of the Work in compliance with all the terms and conditions of the RFB Documents. The Unit Prices in this Table include the cost of all the work which is required or implied by the RFB documents or which may be inferred therefrom, and which is customarily provided in furnishing a complete and finished work item of its kind. Further, any and all alterations, modifications, and adjustments to the work item, which is reasonably foreseeable or customarily encountered in providing and installing equipment, material, and services of the work item kind, will be performed without additional compensation.

In the event of a Purchaser-approved change in the scope of Work for which a unit price from this Table is not applicable, as determined by the Purchaser, the Subcontractor shall provide a new unit price for review and acceptance by the Purchaser. Subcontractor shall provide all information requested by the Purchaser to substantiate the value of the new unit price.

00370.3.1.1 Unit Prices Breakdown

Item Number	Item Description	Unit of Measure	Estimated Quantity	Bidder Response Columns: Unit Price	Bidder Response Columns: Extension Price
71.0420 Gravity Sewer Pkg B Construction					
South Bellevue Boulevard and Walker Street					
01000-01	Mobilization	Lump Sum	1		$ -
01100-02	Erosion Control	Lump Sum	1		$ -
01551-5.02	Traffic Control Devices for Construction Work Zones	Lump Sum	1		$ -
02530-6.02	Pavement Backfill	Cubic Yard	500		$ -
02530-6.07	Clay Tube by Mechanical Bore (10")	Linear Foot	623		$ -
0.2531-6.00	Plug Pipe Termination in Existing Sewer Manhole	Each	2		$ -
0.2531-6.01	Standard Depth Sewer Manhole	Each	3		$ -
0.2531-6.02	Extra Depth Sewer Manhole	Vertical Foot	24		$ -
0.2531-6.09	Sewer Manhole and Structure Abandonment	Each	1		$ -
02544-4.01.C-1	Post MSCP Level2 Manhole Inspection	Each	2		$ -
02544-4.02.A	Post GPS Coordinates of Manhole Cover	Each	2		$ -
02599-03	Hand Excavation / Hydro Excavation of Bore Pit	Each	3		$ -
02760-5.29	Lane Striping & Pavement Markings in Place a Per Planning Removal as Per Plan	Lump Sum	1		$ -
0.2950-05	Asphalt or Concrete Driveway and Paved Area Removal and Replacement	Square Yard	10		$ -
East McLemore Avenue and Wilson Street					
01000-01	Mobilization	Lump Sum	1		$ -
01100-02	Erosion Control	Lump Sum	1		$ -
01551-5.02	Traffic Control Devices for Construction Work Zones	Lump Sum	1		$ -
02530-6.02	Pavement Backfill	Cubic Yard	500		$ -
02530-6.07	Clay Tube by Mechanical Bore (8")	Linear Foot	232		$ -
02530-6.17.02.08	8 Inch PVC Serwer in Bored Hole without Liner Pipe	Linear Foot	142		$ -
02531-6.00	Plug Pipe Termination in Existing Serwer Manhole	Each	2		$ -
02531-6.01	Standard Depth Sewer Manhole	Each	2		$ -
02531-6.02	Extra Depth Sewer Manhole	Vertical Foot	28		$ -
02531-6.09	Sewer Manhole and Structure Abandonment	Each	2		$ -
02544-4.01.C-1	Post MSCP Level2 Manhole Inspection	Each	2		$ -
02544-4.02.A	Post GPS Coordinates of Manhole Cover	Each	2		$ -
02599-03	Hand Excavation / Hydro Excavation of Bore Pit	Each	2		$ -
02760-5.29	Lane Striping & Pavement Markings in Place a Per Planning Removal as Per Plan	Lump Sum	1		$ -
02950-05	Asphalt or Concrete Driveway and Paved Area Removal and Replacement	Square Yard	20		$ -

Item Number	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Extension Price
Madison Avenue and Manassas Street					
01000-01	Mobilization	Lump Sum	1		$ -
01100-02	Erosion Control	Lump Sum	1		$ -
01551-5.02	Traffic Control Devices for Construction Work Zones	Lump Sum	1		$ -
02530-6.02	Pavement Backfill	Cubic Yard	500		$ -
02530-6.07	Clay Tube by Mechanical Bore (8")	Linear Foot	190		$ -
02531-6.00	Plug Pipe Termination in Existing Sewer Manhole	Each	1		$ -
02531-6.01	Standard Depth Sewer Manhole	Each	1		$ -
02531-6.02	Extra Depth Sewer Manhole	Vertical Foot	5		$ -
02531-6.09	Sewer Manhole and Structure Abandonment	Each	1		$ -
02544-4.01.C-1	Post MSCP Level2 Manhole Inspection	Each	2		$ -
02544-4.02.A	Post GPS Coordinates of Manhole Cover	Each	2		$ -
02599-03	Hand Excavation / Hydro Excavation of Bore Pit	Each	1		$ -
02760-5.29	Lane Striping & Pavement Markings in Place a Per Planning Removal as Per Plan	Lump Sum	1		$ -
02950-05	Asphalt or Concrete Driveway and Paved Area Removal and Replacement	Square Yard	30		$ -
South Front Street					
01000-01	Mobilization	Lump Sum	1		$ -
01100-02	Erosion Control	Lump Sum	1		$ -
01551-5.02	Traffic Control Devices for Construction Work Zones	Lump Sum	1		$ -
02530-6.04	Pavement Backfill (COM SST-3)	Cubic Yard	2,752		$ -
02530-6.05	Service Connection Removal & Replacement	Each	3		$ -
02530-6.07.1.10.01	10 in PVC, 6.1-12 ft deep	Linear Foot	248		$ -
02530-6.07.1.10.02	10 in PVC, 12.1-18 ft deep	Linear Foot	680		$ -
02530-6.07.1.10.03	10 in PVC, 18.1-24 ft deep	Linear Foot	91		$ -
02531-6.00	Plug Pipe Termination in Existing Sewer Manhole	Each	3		$ -
02531-6.01	48" Diameter Precast Manhole Installation (standard depth of 6")	Each	5		$ -
02531-6.02	48" Diameter Precast Manhole Installation (VF more than 6' deep))	Vertical Foot	36		$ -
02531-6.09	Abandon Existing Sewer Structure	Each	1		$ -
02541-4.01.A	Post Light Cleaning & Mainline CCTV Inspection for 10" Pipe	Linear Foot	1,019		$ -
02544-4.01.C-1	Post MSCP Level2 Manhole Inspection	Each	5		$ -
02544-4.02.A	Post GPS Coordinates of Cleanout or Manhole Cover	Each	5		$ -
02599-03	Hand Excavation / Hydro Excavation	Linear Foot	1,019		$ -
02775-01.04	Sidewalk Removal and Replacement	Linear Foot	167		$ -
02950-04	Curb and Gutter Removal and Replacement	Linear Foot	41		$ -
02950-05	Asphaltic Concrete Pavement Removal and Replacement	Square Yard	2,753		$ -
71.0420 Gravity Sewer Pkg B Construction - Total Estimated Unit Price Value					$ -

Table 00370.4.7 - Sub-Subcontracts

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

Bid Submitted by: (Company Name)

00370.4.7 Sub-Subcontracts

Bidder proposes that specific portions of the Work scope not performed by Bidder will be Sub-Subcontracted to the Sub-subcontractors indicated below. The value of each Sub-subcontract is indicated as an approximate percentage value of the total monetary value of the Bidder's Bid.

Subcontractor must obtain a safety prequalification for any Sub-subcontractor that will be performing any portion of the Work at the Jobsite, prior to their arrival at the Jobsite. Refer to the "Subcontracting" article within the terms and conditions for applicable submission information.

00370.4.7.1 Sub-Subcontracted Work

Scope of Sub-Subcontracted Work	Sub-subcontractors (Name and Address)	MBE or WBE	% of Total Work Value	Safety Information Included (Y/N)	Current EMR
% of Work performed by Bidder.	(Bidder Company Name)		100%		
(a)					
(b)					
(c)					
(d)					
(e)					
(f)					
(g)					
Total Percentage Value (Must Equal 100%)			100%		

00370.7 Schedule Compliance

00370.7.1 Construction Milestone Completion Dates and Applicable Liquidated Damages

Item	Milestone Description	Construction Milestone Completion Date	*LDs Apply?	Bidder Complies? (Yes/No)
1	Substantial Completion[1] of Work under this Subcontract	**335** calendar days after Notice to Proceed	Yes	
2	Final Completion[2] of all Work under this Subcontract	**365** calendar days after Notice to Proceed	Yes	

In accordance with Subcontract Article 00574.4 Work Hours, the Work will be completed by **TBD**.

*LD indicates that completion of the Work after the "Construction Milestone Completion Date" is subject to liquidated damages per applicable Articles of Section 00571.

*Note: Subcontractor performance will directly impact future procurements for the SARP10 Program, schedule is critical and must be maintained.

[1] Substantial Completion is defined as the date the project is sufficiently complete, in accordance with the construction contract documents, so that the owner may use the facilities for the intended purpose.

[2] Final Completion is defined as: (a) the Work is complete and complies with the requirements of this Subcontract; and (b) Subcontractor has fulfilled all its obligations under this Subcontract except obligations that survive completion of the Work.

00370.8 Schedule of Submittals

Effective Date: TBD

The following are post-award Subcontract submittals. This list is not all-inclusive. The RFB documents contain submittal requirements that are not included in this list. It will, however, remain the successful Bidder's responsibility to comply with submittal requirements whether or not the submittal is included in the following list:

Item	Reference Section	Submittal Item	Submittal Dates				Bidder Agrees? Yes/No
			Calendar Days		Event	Due Date	
00370.8.1 Commercial Submittals							
C01	None	Executed Subcontract in the form provided by the Purchaser	5	After	Receipt of Subcontract for Signature		
C02	00571	Payment Estimate Breakdown	10	After	Effective Date and Prior to First Payment with monthly updates		
C03	00571	Security Instruments	10	After	Effective Date		
C04	00572	Lien Waivers and Report of Disadvantaged Business Enterprise Participation Form		With	Each Invoice		
C05	00572	Final Lien Waivers from Subcontractor, Sub-subcontractors, and Sub-subcontractors' subcontractors and Report of Disadvantaged Business Enterprise Participation Form		With	Final Invoice		
C06	00571	Final Payment Invoice and Report of Disadvantaged Business Enterprise Participation Form	45	After	Issuance of the Notice Of Final Completion and Acceptance		
C07	00572	Contractor Licenses	14	Before	Mobilization Onsite		
C08	00572	Written Notice and Supporting Documentation, of all Claims	5	After	Occurrence of Event Giving Rise to the Claim		
C09	00572	Insurance Certificates for Purchaser Approval		Prior to	Mobilization		
C10	00572	Initial Issue Subcontractor's Work Execution Schedule	30	After	Effective Date		
C11	00571	Subcontractor Actual Man-hours Expended and Quantities Installed	Weekly	After	Mobilization Onsite		
C12	00575	Subcontractor's Daily Report	Daily	After	Mobilization Onsite		
C13	00575	Signed Daily Reports		Daily	After Mobilization Onsite		
C14	00575	Weekly Coordination Meeting Agenda Input	Weekly	Prior to	Weekly Coordination Meeting		
C15	00575	Subcontractor's Safety, Health and Accident Prevention Program		Prior to	Mobilization Onsite		
C16	00575	Subcontractor’s Hazardous Waste Project Health and Safety Plan		Prior to	Mobilization Onsite		
C17	00575	Safety and Health Representative Resume		Prior to	Assignment and Mobilization		
C18	00575	Verification of meeting Hazardous Waste Requirements of 29CFR1910.120	5	Prior to	Mobilization Onsite		
C19	00575	Hazardous Materials Documentation		With	Each Hazmat Shipment		
C20	00575	Safety and Health Records	Monthly	After	Mobilization Onsite		
C21	00575	Evidence that Jobsite Personnel have Passed Drug Testing	10	Prior to	Mobilization Onsite		

00370.8 Schedule of Submittals

Effective Date: TBD

The following are post-award Subcontract submittals. This list is not all-inclusive. The RFB documents contain submittal requirements that are not included in this list. It will, however, remain the successful Bidder's responsibility to comply with submittal requirements whether or not the submittal is included in the following list:

Item	Reference Section	Submittal Item	Submittal Dates				Bidder Agrees? Yes/No
			Calendar Days		Event	Due Date	
C22	00575	Fall Protection Plan	5	Prior to	Starting Work Operations		
C23	00575	Chemical Hazard Communication Plan, as applicable	5	Prior to	Mobilization Onsite		
C24	00575	Substance Abuse Program	5	Prior to	Mobilization Onsite		
C26	00672.3	Certificate of Nondiscrimination for Subcontractor and Sub-subcontractors		With	Bid		
C27	00672.4	Equal Business Opportunity Program Compliance Form for Subcontractor and Sub-subcontractors		With	Bid		
C31	00672.7	Bid Bond		With	Bid		
C36	Technical	Technical Data Submittals	Weekly	After	Mobilization Onsite		Yes

Technical Submittals

Refer to Technical Specifications for Technical Submittal requirements.

00571 - Supplementary Terms and Conditions

00571.1 Notices and Correspondence

The parties agree to send all notices arising out of or related to this Subcontract by one of the following methods: (a) personal delivery; (b) certified mail with return receipt; (c) nationally recognized overnight mail or courier service, with delivery receipt requested; or (d) email. The parties may send routine correspondence by email or first-class mail, each without confirmation of receipt. The parties agree to address notices and correspondence as indicated in this article. Subcontractor agrees that delivery of a notice or of correspondence by Purchaser to Subcontractor's at the jobsite constitutes personal delivery.

Electronic Technical Correspondence

Addressed to Purchaser:	**Addressed to Subcontractor:**
To: Jerry Caldwell CaldwellJ@bv.com	To: [[name]] [[email address]] Cc: [[name]] [[email address]]

Non-Electronic Technical Correspondence

Addressed to Purchaser:	**Addressed to Subcontractor:**
Overland Contracting Inc. 845 Crossover Lane, Suite 120 Memphis, TN 38117 Attention: Jerry Caldwell 421848.71.0420	[[subcontractor entity]] [[street address]] [[city, state, zip code]] Attention: [[name]] 421848.71.0420

Electronic Commercial Correspondence (excluding invoices)

Addressed to Purchaser:	**Addressed to Subcontractor:**
To: Ginny Dorsey Dorsey@bv.com	To: [[name]] [[email address]] Cc: [[name]] [[email address]]

Non-Electronic Commercial Correspondence (excluding invoices)

Addressed to Purchaser:	**Addressed to Subcontractor:**
Overland Contracting Inc. 8400 Ward Parkway Kansas City, MO 64114 Attention: Ginny Dorsey 421848.71.0420	[[subcontractor entity]] [[street address]] [[city, state, zip code]] Attention: [[name]] 421848.71.0420

Electronic Invoices

Subcontractor will submit invoices via the web-based project management platform, Prolog. Invoices will be reviewed, and either approved or returned to Subcontractor for correction. The OCI Project Manager will forward invoices to Black & Veatch Accounts Payable, once they are approved.

In accordance with section 00572.4 Invoicing and Payment, each invoice must clearly show the invoice number, the complete Subcontract project number, the Purchase Order number, the Work covered by the invoice, taxes, and the billing period (if applicable).

00571.2 Not Used

00571.3 Payment Terms

The following payment terms shall apply in addition to the corresponding provisions contained in Article 00572.4 Invoicing and Payment.

The Parties will meet each month at an agreed time in order to determine the quantity of materials used and man-hours expended during the invoice period. The Parties will use the field progress measurement system to calculate that month's payment total by adding the Subcontract unit price totals based on actual Work completed.

00571.4 Security Instruments

Subcontractor shall give Purchaser separate performance and payment bonds in the format of AIA Document 312 - 2010 Performance Bond and Payment Bond, each in the amount of the Subcontract Price. Subcontractor shall submit the bonds to Purchaser by the due date specified in the Article titled "Schedule of Submittals and Applicable Liquidated Damages". The bonding company must be licensed to bond in the state in which the Project is located and must be rated "A" or better by A.M. Best and included in the Department of the Treasury's Listing of Approved Sureties (Department Circular 570).

00571.5 Liquidated Damages

00571.5.1 General

Subcontractor's failure to meet the requirements identified in this Article 00571.5 will cause Purchaser to incur harm that will be very difficult to ascertain with certainty. The Parties therefore agree the liquidated damages specified in this Article 00571.5 represent a reasonable estimate of Purchaser's harm and are not intended as a penalty. Subcontractor's obligation to pay liquidated damages for breach of one specified requirement, does not relieve Subcontractor of its obligation to pay liquidated damages for breach of another specified requirement. Subcontractor's payment of liquidated damages for breach of the specified requirement is Purchaser's sole and exclusive remedy with regard to Subcontractor's breach of that requirement, except for any other express remedies stated in the Subcontract. If Purchaser terminates the Subcontract for cause, liquidated damages will cease to accrue after the termination date and Subcontractor's remaining liability will be calculated in accordance with Article 00572.17.

00571.5.2 Not Used

00571.5.3 Construction Milestone Dates

Each construction milestone subject to liquidated damages for late completion is listed in the article titled "Construction Milestone Completion Dates and Applicable Liquidated Damages". If all portions of the Work comprising the construction milestone do not meet the Subcontract requirements on the construction milestone completion date, liquidated damages will accrue for each failure as shown below.

Beginning on the first calendar day after the specified construction milestone completion date for each construction milestone and continuing until the construction milestone is completed, delay liquidated damages will be assessed at the rate of one thousand ($1,000) dollars per calendar day.

Beginning on the thirty first calendar day after the specified milestone completion date for each milestone and continuing until the milestone is completed, delay liquidated damages will be assessed at the rate of one thousand dollars ($1,500.00) per calendar day.

00571.6 Taxes

Subcontractor shall pay all payroll and other related employment compensation taxes for Subcontractor's employees, federal, state and other taxes which may be assessed on Subcontractor's income from the Project, engineering and business license costs (collectively, the "Subcontractor Taxes"). Subcontractor shall administer and pay all sales, use, gross receipts and excise taxes (collectively, the "Project Taxes").

Subcontract price includes Subcontractor Taxes and all Project Taxes. Purchaser will not be responsible for any additional charges related to tax that were not included as part of the Subcontract Price. Where applicable, Purchaser shall furnish to Subcontractor a certificate complying with state and local governmental laws, regulations and ordinances identifying any components of the Work to be considered exempt from the Project Taxes. Subcontractor shall cooperate with Purchaser to establish appropriate procedures and minimize the amount of such taxes to the extent reasonable and practical. Subcontractor is responsible for all property taxes on the construction equipment; Owner is responsible for property taxes on all other items incorporated into the project. Subcontractor shall notify Purchaser, and Purchaser shall have the right to review prior to Subcontractor's response to such document, of any correspondence with a federal or local taxing authority as it relates to sales and use, gross receipts, or excise taxes.

00572 - General Terms and Conditions

00572.1 Definitions

The terms below have the following definitions when used in this Subcontract:

"Applicable Laws" means all laws, statutes, regulations, codes, rules, treaties, ordinances, judgments, permits, decrees, approvals, interpretations, injunctions, writs, orders, or other legal requirements of a governmental body entitled to exercise any administrative, executive, judicial, legislative, police, regulatory or taxing power and having jurisdiction over the jobsite or performance of the Work.

"Claims" means claims, actions, suits, liabilities, demands, damages, losses, costs, expenses (including reasonable attorneys' fees), impacts to price, impacts to schedule, awards, fines and judgments, of every kind and nature.

“Consent Decree” means the negotiated plan between Owner, Department of Justice, Environmental Protection Agency, Tennessee department of Environment and Conservation, and the Tennessee Clean Water Network that requires Owner to develop and implement plans to improve its wastewater systems.

"Final Completion" means: (a) the Work is complete and complies with the requirements of this Subcontract; and (b) Subcontractor has fulfilled all its obligations under this Subcontract except obligations that survive completion of the Work.

"Indemnified Parties" means Owner and its officials, Purchaser, Purchaser’s engineer, and the parent companies, related companies, affiliated companies, subsidiaries, successors, and assigns of each, including the shareholders, officers, directors, partners, employees, and agents of each of the above firms. “Indemnified Parties” does not include Subcontractor or any Sub-subcontractor.

“Notice to Proceed” means to written notice provided by Purchaser to Subcontractor releasing Subcontractor to proceed with all or part of the Work.

"Owner" means the City of Memphis, Tennessee.

“Program Manager” means Black & Veatch Corporation or Overland Contracting Inc. (OCI).

"Purchaser" means the party so identified in the Subcontract Agreement.

"Subcontract" means the agreement between Purchaser and Subcontractor consisting of: (a) the Subcontract Agreement; (b) the documents listed in the Subcontract Agreement; (c) written Subcontract revisions; (d) attachments, appendices and exhibits to the Subcontract documents; (e) documents expressly incorporated by reference into the Subcontract; and (e) any requirements that can be reasonably inferred from any of the foregoing.

"Subcontract Agreement" means the Subcontract form executed by Purchaser and Subcontractor.

"Subcontractor" means the party so identified in the Subcontract Agreement.

"Sub-subcontractor" means any party, at any tier, having an agreement with Subcontractor or with a Sub-subcontractor, to perform a portion of the Work.

“Substantial Completion” means the project is sufficiently complete, in accordance with the construction contract documents, so that the owner may use the facilities for the intended purpose.

"Work" means that which Subcontractor is to perform or provide under this Subcontract.

00572.2 Interpretation

00572.2.1 This Subcontract is the complete and final agreement between the parties relating to the Work. All prior or contemporaneous negotiations and agreements relating to the Work are superseded by this Subcontract. Exceptions or terms submitted by Subcontractor in the course of accepting this Subcontract are void.

00572.2.2 Provisions of this Subcontract that contemplate performance or obligations subsequent to completion or termination of the Work or contain waivers or limitations of liability will survive such completion or termination. Termination of the Work will not affect the rights and obligations that arose before termination.

00572.2.3 If any provision of this Subcontract is held to be unenforceable, the remaining provisions of this Subcontract will remain in effect.

00572.3 Subcontractor's Status

Subcontractor is an independent contractor in the performance of the Work. Subcontractor is solely responsible for the means, methods, sequences, procedures, and safety precautions used or adopted by Subcontractor and any Sub-subcontractor in the performance of the Work. Except as provided in Article 00574.2 and 00574.3, Subcontractor has sole authority and responsibility to employ, manage, discharge, and otherwise control its employees.

00572.4 Invoicing and Payment

00572.4.1 Subcontractor shall submit invoices to Purchaser with all documentation required to be submitted with the invoice. Each invoice must be itemized by the Subcontract line number. Each invoice must also clearly show the complete Subcontract project number, the Purchase Order number, the invoice number, the billing period (if applicable), the invoiced amount, retention (if applicable), and the net amount due. The final invoice must contain a copy of Purchaser's notice of Final Completion.

00572.4.2 Subcontractor agrees to provide additional itemization of the Subcontract price as Purchaser reasonably requests. If payment to Subcontractor will be on a time and material basis or a unit price basis, or if Subcontractor files a Claim under Article 00572.13, Subcontractor shall furnish Purchaser complete breakdowns and supporting information in the detail required by Purchaser to verify the accuracy of the invoiced or claimed amounts. Purchaser or Purchaser's designee may audit the aforementioned records at Purchaser's expense.

00572.4.3 Payment by Purchaser does not: (a) constitute approval or acceptance of any portion of the Work; (b) waive any of Purchaser's rights; or (c) relieve Subcontractor from responsibility or liability arising out of or related to this Subcontract. Acceptance by Subcontractor of final payment constitutes a release and waiver of all Claims by Subcontractor against Indemnified Parties.

00572.4.4 Purchaser may withhold or set-off amounts due under this Subcontract on account of Claims arising out of or related to Subcontractor's breach or reasonably anticipated breach of this Subcontract.

00572.4.5 Once Work that has undergone specified QA/QC is submitted, reviewed and approved by the Program Manager, the Subcontractor's invoice will be submitted along with the Program Manager's next invoice to the Owner. The Program Manager's invoice is typically submitted during the second week of each month for work performed during the previous month. Typical payment from the Owner to the Program Manager is anticipated to be forty-five (45) calendar days upon Owner's acceptance of invoice, and the Program Manager will cause the Purchaser to pay the Subcontractor within two weeks of Program Manager's receipt of payment from the Owner.

00572.4.6 Subcontractor agrees that all payments received by Subcontractor under this Subcontract will first be used for, and constitute trust funds for, the payment of all labor and materials used in the Work.

Purchaser may, but is not obligated to, issue joint checks to Subcontractor and a Sub-subcontractor or make payment directly to a Sub-subcontractor. Purchaser will deduct amounts paid by joint check to Subcontractor and a Sub-subcontractor or paid directly to a Sub-subcontractor from payment due Subcontractor under this Subcontract. Purchaser may also deduct a reasonable fee to cover administrative costs for such payments. Subcontractor agrees to accept the issuance of joint checks and agrees with Purchaser that neither the right to issue nor the issuance of any joint check is intended to create any contractual relationship with a third party, or any third-party beneficiary rights to payment by Purchaser.

00572.5 Schedule

Performance of the Work as scheduled under this Subcontract is of the essence. Subcontractor shall submit a Work schedule to the Purchaser at the initial preconstruction conference between the Parties. The schedule shall show the sequence of Work towards to complete the same by the required Work completion date specified hereunder. The Work schedule shall be updated and presented at each progress meeting throughout the Work progression under this Subcontract. Subcontractor shall give Purchaser written notice of any delay or anticipated delay within three calendar days after the occurrence of the event giving rise to the delay. Subcontractor's notice must identify the cause of the delay or the anticipated delay and the actions Subcontractor is undertaking to recover from or avoid the delay.

00572.6 Waivers of Lien

As a condition precedent to payment, Subcontractor shall furnish a lien waiver in the form of Article 00672.1 with each invoice except the final invoice. As a condition precedent to payment of the final invoice, Subcontractor shall furnish a lien waiver in the form of Article 00672.2 with the final invoice. If a lien is filed and Subcontractor does not remove or bond around the lien within seven calendar days after receipt of written notice from Purchaser or Owner, Purchaser or Owner may remove the lien. Subcontractor shall reimburse Purchaser or Owner, as applicable, for all costs and expenses incurred by Purchaser or Owner in removing the lien, including reasonable attorneys' fees and court costs.

00572.7 Assignment and Subcontracting

00572.7.1 Subcontractor may not assign all or part of this Subcontract voluntarily, by operation of law, or otherwise, nor may Subcontractor assign any of the money payable under this Subcontract, without obtaining Purchaser's prior written consent.

00572.7.2 Except for the supply of expendable materials and minor components or the supply of a portion of the Work for which a Sub-subcontractor is named in this Subcontract, Subcontractor may not subcontract the Work without first obtaining Purchaser's written consent. In addition, Subcontractor must obtain a safety prequalification for any Sub-subcontractor that will be performing any portion of the Work at the Jobsite, as outlined in Article 00575.9. If Subcontractor subcontracts any portion of the Work, Subcontractor remains responsible for complying with the Subcontract requirements and is liable to Purchaser for the acts and omissions of Sub-subcontractors, including their failure to comply with the requirements of this Subcontract or fulfill the obligations imposed on Subcontractor by this Subcontract, as if the acts and omissions were those of Subcontractor. Purchaser has the right to contact Sub-subcontractors to discuss their progress of the Work.

00572.8 Passage of Title, Risk of Loss, and Delivery

Subcontractor warrants that the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will be free of all liens, claims, charges, security interests, encumbrances or defects in title. Title to the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will pass to Purchaser upon the earlier of Subcontractor’s receipt of payment or delivery of the Work to the jobsite. Subcontractor retains the risk of loss of the Work until Purchaser issues the notice of Final Completion. The terms of delivery have the meanings assigned them in the 2020 edition of the Incoterms published by the International Chamber of Commerce, except as modified in this Subcontract.

00572.9 Final Completion

Subcontractor shall notify Purchaser in writing when Subcontractor believes the Work meets the requirements for Final Completion. Purchaser will inspect the Work within ten calendar days after Purchaser's receipt of Subcontractor's notice. If Purchaser identifies any defective or non-conforming Work, Subcontractor shall correct that Work in accordance with Article 00572.10. Purchaser will issue a notice that Final Completion has been achieved when the Work meets the requirements for Final Completion. Purchaser's issuance of the notice of Final Completion does not relieve Subcontractor of its obligations under this Subcontract.

00572.10 Warranty

00572.10.1 Subcontractor warrants to Purchaser and Owner that the Work: (a) will be new when delivered to the jobsite; (b) will be free from defects in design, material, and workmanship; (c) will comply with Applicable Laws; (d) will comply with the requirements of this Subcontract; and (e) will be fit for the purposes specified. Subcontractor also warrants to Purchaser and Owner that elements of the Work for which this Subcontract does not establish express standards of quality and fitness will comply with good industry practices for the specific application. Subcontractor agrees that Owner may directly enforce the warranties of this Article 00572.10.1.

00572.10.2 Subcontractor shall correct any breach of this warranty within five calendar days after Purchaser gives Subcontractor written notice of the breach. The cost of warranty work and removal or replacement of other work will be at Subcontractor's expense. Subcontractor shall work diligently and without interruption to correct the breach. In the case of emergency where, in the reasonable judgment of Purchaser, delay could result in serious loss or damage to persons or property, Purchaser may correct the defect or nonconformity at Subcontractor's expense.

00572.10.3 The warranty for the Work extends until one year after Final Completion. The warranty applies to all repairs and replacements to the same extent the warranty applies to the original Work. The warranty period for repaired Work or replacements will be extended for a period of one year after the repair or replacement is complete or until the original warranty period expires, whichever occurs later.

00572.10.4 This project is being implemented to provide services to the City of Memphis, through the City's Program Manager, for implementation of the Consent Decree executed on September 20, 2012, civil action number 2:10-cv-02083-SHM-dkv (CD). The City negotiated the Consent Decree with the United States Environmental Protection Agency and the Tennessee Department of Environment and Conservation to implement an assessment and rehabilitation program of the City's wastewater collection and transmission system. Per section II, paragraph 5 of the Consent Decree all contractors performing work required by the Consent Decree must be notified by the City that a copy of the Consent Decree is posted on the City's webpage. This article provides the required notification. The Consent Decree may be reviewed by accessing the City's webpage at:

http://www.memphistn.gov/Government/PublicWorks/ConsentDecree.aspx

This page provides a link to the Consent Decree and associated documents. An explanation of each document is also provided. Click on any link to access. Alternatively, the Consent Decree is available at:

http://www.sarp10.com/consent-decree/

00572.10.5 Subcontractor acknowledges that Owner's failure to achieve 100 percent compliance with the Consent Decree requirements may result in the imposition of penalties, costs, and other damages imposed against the Owner and Purchaser. To the extent caused by Subcontractor's failure to perform the Work in accordance with this Subcontract or to the extent caused by the negligence of Subcontractor or any Sub-subcontractor, Subcontractor agrees to pay penalties and costs incurred by Owner and Purchaser under the Consent Decree.

00572.11 Compliance with Laws

00572.11.1 Subcontractor shall comply with all Applicable Laws in effect during its performance of Work, including but not limited to the City of Memphis Prevailing Wage Ordinance, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA), and the Americans with Disabilities Act (ADA). Subcontractor shall obtain all licenses, permits, and inspections applicable to the Work except for licenses, permits, and inspections identified in this Subcontract as Purchaser's or Owner's responsibility. Subcontractor shall also comply with the USA's Foreign Corrupt Practices Act.

00572.11.2 Purchaser and Subcontractor shall abide by the requirements of 41 CFR §§ 60-1.4(a), 60-4.3(a), 60-300.5(a) and 60-741.5(a). These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

00572.11.3 Neither party shall engage in any conduct or activity in the performance of this Subcontract that constitutes a conflict of interest under Applicable Laws.

00572.11.4 Subcontractor shall comply with 18 U.S.C. §874, 40 U.S.C. §3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this Subcontract and any Sub-subcontracts hereunder.

00572.12 Business Practices

00572.12.1 Subcontractor shall uphold the good name and reputation of Purchaser and shall not take any action which is intended to, or which causes damage to or discredits Purchaser. Subcontractor shall not:

(a) Offer to give or agree to give any director, officer, employee or agent of any potential client a gift or consideration of any kind as an inducement or reward for: (i) doing or declining to do, or for having done or declined to do, any action in relation to obtaining or executing any contract or (ii) for showing or declining to show any favor or disfavor to any person in relation to any possible project; or

(b) Induce or attempt to induce any officer, servant, or agent of any private or public body to depart from his or her duties to his or her client or, in the case of any officer, servant or agent of a public body, his or her duties to the applicable public body, the applicable body politic, or both.

00572.12.2 Subcontractor shall not engage or employ, on a full, part-time or any other basis during the term of the Prime Agreement and for a period of one year after the termination or expiration, any professional or technical personnel who are or have been at any time during the term of the Prime Agreement in the employ of Owner without the explicit written consent of Owner.

00572.12.3 Nondiscrimination:

(a) Subcontractor certifies and agrees that all persons employed by it, its affiliates, subsidiaries, or holding companies are and will be treated equally without regard to or because of race, creed, color, religion, ancestry, national origin, sexual orientation, sex, age, condition of physical or mental handicap, marital status, or political affiliation, in compliance with all Applicable Laws. Subcontractor shall certify, at Purchaser's request that it is in full compliance with all applicable EEO rules and laws.

(b) Purchaser and Owner reserve the right to investigate any claims of illegal discrimination by Subcontractor and in the event a finding of discrimination is made and upon written notification thereof, Subcontractor shall take all necessary steps to cure and rectify such action to the reasonable satisfaction of Purchaser and Owner. Subcontractor's failure or refusal to do so shall be cause for termination of this Subcontract in accordance with the terms of this Subcontract.

00572.12.4 Purchaser is an affirmative action employer. Accordingly, the parties hereby incorporate by reference the requirements of Executive Order 11246, as amended, and the applicable regulations contained in 41 C.F.R. Parts 60-1 through 60-60; 29 U.S.C. Section 793 and the applicable regulations contained in 41 C.F.R. Part 60-741; 38 U.S.C. Section 4212 and the applicable regulations contained in 41 C.F.R. Part 60-250 and/or 60-300; and 29 C.F.R. Part 471, Appendix A to Subpart A.

00572.12.5 Subcontractor represents and warrants that it has a code of conduct or other set of compliance requirements that is at least as broad as Purchaser's Code of Conduct for Global Business Relationships (hereinafter "Code of Conduct"), or that it will comply with Purchaser's Code of Conduct in all dealings that affect Purchaser. The Code of Conduct and its amendments are expressly incorporated herein by reference and full text of the same can be found at:

https://www.bv.com/sites/default/files/reports-studies/Code-of-Conduct-for-Global-Business-Relationships

00572.13 Claims

Subcontractor must give written notice, with appropriate supporting documentation, of all Claims for extra compensation or additional time for performance of the Work within three calendar days after occurrence of the event giving rise to the Claim. Subcontractor acknowledges that failure of Subcontractor to give Purchaser notice and appropriate supporting documentation within the required time frame constitutes a waiver of all Claims arising out of or related to the event.

00572.14 Subcontract Revisions and Work Authorizations

00572.14.1 Purchaser may make additions, deletions, reductions in scope, or other changes to the Work. If a proposed change will cause a material increase or decrease in Subcontractor's cost or time for performance, Subcontractor shall so notify Purchaser in writing, accompanied by supporting documentation, within three calendar days after Subcontractor's receipt of Purchaser's notice of change. If Purchaser agrees with Subcontractor's notice, the parties will negotiate an equitable adjustment to the Subcontract price, to the schedule, or both, in accordance with the Subcontractor's fee for overhead and profit as listed in Article 00572.14.2 below. These adjustments will be reflected in a written Subcontract revision.

00572.14.2 The Subcontractor's fee for overhead and profit shall be determined as follows:

For costs incurred for labor the maximum fee shall be fifteen percent to the Subcontractor or the Sub-subcontractor performing the Work.

For costs incurred for materials and equipment the maximum fee shall be five percent to the Subcontractor or the Sub-subcontractor providing the materials and equipment.

If applicable, the Subcontractor may receive an additional fee of five percent on labor or materials and equipment performed or provided by a Sub-subcontractor, as long as the total combined fee does not exceed fifteen percent.

00572.14.3 A written Subcontract revision is required before Subcontractor is entitled to payment for the Work performed under the Work authorization. Subcontractor will bear the expense of performing any change not supported by a written Work authorization or written Subcontract revision. Purchaser will not be liable to Subcontractor for Claims arising from a decrease in the Work. No change is effective without a written Work authorization or a written Subcontract revision issued by Purchaser.

00572.15 Non-Disclosure

Subcontractor shall not make any news releases, authorize or participate in any interview concerning this Subcontract, or issue other advertising pertaining to the project or this Subcontract without the prior written approval of Purchaser. Subcontractor shall treat all information provided by Purchaser as confidential and only disclose such information as necessary to perform the Work, and will require the employees, agents, and Subcontractors who need to know to adhere to the terms of this provision.

00572.16 Suspension of Work

Purchaser may, at any time and in its sole discretion, suspend performance of all or part of the Work by written notice to Subcontractor. If the suspension is unrelated to Subcontractor's failure to comply with this Subcontract, Purchaser will adjust the schedule to reflect the reasonable delay due to the suspension and will reimburse Subcontractor for the reasonable and direct additional costs incurred by Subcontractor due solely to the suspension. Subcontractor shall promptly resume performance of all or part of the suspended Work in accordance with Purchaser's written authorization to resume the Work.

00572.17 Termination for Cause

If Subcontractor defaults in any obligation under this Subcontract and does not cure the default within ten calendar days after receipt of Purchaser's written notice identifying the default, Purchaser may terminate all or part of the Work.

00572.18 Termination Without Cause

Purchaser may, at any time and in its sole discretion, terminate all or part of the Work. Subject to Subcontractor's compliance with this Subcontract, Subcontractor will recover from Purchaser, as the complete and final settlement for the terminated Work and all related Claims, a sum equal to Subcontractor's direct cost for the terminated Work satisfactorily performed as of the effective date of termination, plus an allowance for reasonable overhead and profit on such direct cost.

00572.19 Purchaser's Remedies

00572.19.1 Purchaser may reject defective or nonconforming Work and return the rejected Work to Subcontractor, at Subcontractor's risk and expense, for repair, replacement or credit, at Purchaser's option. If Purchaser chooses to accept defective or nonconforming Work, Subcontractor shall correct the defect or nonconformity in accordance with Article 00572.19.2 However, if Purchaser chooses to accept defective or nonconforming Work without correcting it, Subcontractor and Purchaser will negotiate an equitable reduction in the Subcontract Price to account for the defect or nonconformity.

00572.19.2 If Purchaser discovers a defect or nonconformity in the Work before the Warranty Period begins, Subcontractor shall correct the defect or nonconformity within ten calendar days after Purchaser gives Subcontractor notice of the defect or nonconformity. In the case of emergency, where in the reasonable judgment of Purchaser, delay could result in serious loss or damage to persons or property or if Purchaser at its sole discretion determines that the Project schedule would be adversely affected if the correction of such defect or nonconformity is not performed before the ten day period expires, Purchaser may correct the defect or nonconformity at Subcontractor’s expense.

00572.19.3 If Subcontractor by its action or inaction indicates that it is unable or unwilling to proceed with the Work in a reasonable time or if Purchaser intends to perform any corrective work under Article 00572.10 or 00572.19.3, Purchaser may, upon written notice to Subcontractor, accomplish the Work in question by the most expeditious means available and backcharge Subcontractor for the costs incurred. Subcontractor shall sign and return the notice of backcharge within one calendar day after receipt.

00572.19.4 Subcontractor shall pay all direct costs incurred by Purchaser under Articles 00572.19.2 and 00572.19.3, including engineering, labor, material, transportation, insurance, subcontracts, tools, and equipment. Subcontractor shall also pay twenty-five percent of the direct costs incurred by Purchaser under Articles 00572.19.2 and 00572.19.3 for Purchaser's overhead and general and administrative costs. The performance of Work under this Article 00572.19 does not relieve Subcontractor of its obligations under this Subcontract including, but not limited to, warranty, liquidated damages, and indemnity.

00572.19.5 Purchaser's remedies under this Subcontract and existing at law or in equity are cumulative and may be exercised concurrently.

00572.20 Indemnity

00572.20.1 SUBCONTRACTOR AGREES TO DEFEND, INDEMNIFY, AND HOLD HARMLESS THE INDEMNIFIED PARTIES AGAINST ANY CLAIM, LOSS, DAMAGE, EXPENSE, OR LIABILITY (INCLUDING ATTORNEYS' FEES AND COSTS OF ANY SUCCESSFUL ENFORCEMENT OF THIS INDEMNITY ARTICLE) ARISING OUT OF THE PERFORMANCE OR NON-PERFORMANCE BY SUBCONTRACTOR OR ITS SUB-SUBCONTRACTORS, OR THEIR OFFICERS, EMPLOYEES, OR AGENTS.

00572.20.2 Providing that Purchaser is not in breach of its obligation to make payments to Subcontractor for the Work, Subcontractor shall indemnify, defend and hold harmless the Indemnified Parties from any claims or mechanic's liens brought against the Indemnified Parties or against the Project as a result of the failure of Subcontractor, or those for whose acts it is responsible, to pay for any services, materials, labor, equipment, taxes or other items or obligations furnished or incurred for or in connection with the Work. Within three (3) days of receiving written notice from Purchaser that such a claim or mechanic's lien has been filed, Subcontractor shall commence to take the steps necessary to discharge said claim or lien, including, if necessary, the furnishing of a mechanic's lien bond. If Subcontractor fails to do so, Purchaser will have the right to discharge the claim or lien and hold Subcontractor liable for costs and expenses incurred, including attorneys' fees.

00572.20.3 Subcontractor will immediately notify Purchaser of any claim or suit made or filed against Subcontractor or its Sub-subcontractors in which Purchaser or Owner is named as a co-defendant.

00572.20.4 Subcontractor expressly understands and agree that any insurance coverage required by this Purchase Order or otherwise provided by Subcontractor shall in no way limit Subcontractors responsibility to indemnify, defend, save and hold harmless the Indemnified Parties.

00572.21 Insurance Requirements

00572.21.1 Subcontractor shall, at its sole cost, maintain insurance as required by this Subcontract and shall impose the obligations of this Article 00572.21.1 on all Sub-subcontractors. Subcontractor shall give Purchaser ACORD insurance certificates evidencing the required coverage by the due date identified in article titled "Schedule of Submittals" and as Purchaser may request from time to time. Insurance certificates shall specifically note "City of Memphis SARP10 Program" in the notes or description area. Subcontractor shall ensure the policies:

(a) Contain a provision or endorsement that the coverage will not be cancelled, materially changed, or renewal refused unless the insurer gives at least thirty calendar days prior written notice to Purchaser.

(b) Remain in effect through the warranty period if coverage is occurrence-based and remain in effect at least one year after expiration of the warranty period if coverage is claims-based.

(c) Are primary with respect to insurance covering Indemnified Parties as additional insureds. All insurance carried by Indemnified Parties will be excess insurance.

(d) Contain a waiver of all rights of subrogation by the insurance carriers in favor of Indemnified Parties.

(e) Comply with all Applicable Laws of the jurisdiction in which any part of the Work is to be performed including, but not limited to, admitted and compulsory coverage.

(f) Are rated "A-" or better by A.M. Best's "Insurance Guide and Ratings."

00572.21.2 Subcontractor shall maintain broad form commercial general liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds (using endorsements CG 20 10 and CG 20 37 or their equivalent), against claims arising out of bodily injury or property damage arising from the Work. The policy must include a cross-liability or severability of interest clause, a per project aggregate

endorsement, and coverage for personal injury liability, contractual liability, products and completed operations (covering lawsuits brought in the USA and the country of the jobsite), explosion, building collapse, and damage to underground property. The policy also must not exclude coverage for wildfire and Consultant shall provide a certificate of insurance verifying no such exclusions exist. The policy must include coverage for riggers liability if applicable to the Work. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.3 Subcontractor shall maintain worker's compensation insurance protecting Subcontractor against all claims under applicable worker's compensation laws, including, but not limited to, the United States Longshoremen's and Harbor Worker's Act and the Jones Act. If Subcontractor is required to maintain worker's compensation insurance in the USA, the worker's compensation insurance must contain an "all states" or "other states" endorsement. For Work performed in the USA, Subcontractor shall also maintain employer's liability insurance protecting Subcontractor against claims for injury, disease or death of employees which are not covered by the worker's compensation insurance. Subcontractor shall maintain worker's compensation policy limits as required by statute and, if applicable to this Subcontract, employer's liability policy limits of at least one million dollars for each occurrence.

00572.21.4 Subcontractor shall maintain comprehensive automobile liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds, against all claims for injuries to members of the public and damage to property of others arising from the use of motor vehicles, whether owned, non-owned, or hired. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.5 Subcontractor shall maintain umbrella liability insurance that follows the form of the commercial general liability insurance, the employer's liability insurance and the automobile liability insurance. The umbrella liability insurance must protect Subcontractor, and Indemnified Parties as additional insureds, against claims in excess of the limits of the commercial general liability insurance, the employer's liability insurance, and the automobile liability insurance. Subcontractor shall maintain policy limits of at least four million dollars for each occurrence.

00572.21.6 Subcontractor is responsible for maintaining any and all property insurance on their own equipment and shall require all Sub-subcontractors to do likewise.

00572.22 Audit

Purchaser reserves the right to audit the records of Subcontractor. Accordingly, Subcontractor shall make and keep as the same accrue, full and complete records and books of accounts of revenue and income, and costs and expenses that specifically relate to performance under this Subcontract. Records and books of account, together with any or all memoranda pertaining thereto that may be kept, maintained, or possessed by Subcontractor, shall be opened to examination during regular business hours by Purchaser or its representatives for the purposes of inspecting, auditing, verifying, or copying the same or making extracts therefrom. Subcontractor shall make and keep said records and books of account for a period of seven (7) years after the completion of the contract obligations of the final payment under the Subcontract, whichever is later.

00572.23 Governing Law and Disputes

00572.23.1 Except as detailed in Article 00572.23.2, claims and disputes arising out of or related to this Subcontract will be governed by the law of the State of Tennessee, USA, excluding provisions that would apply the law of another jurisdiction. The Parties hereby elect to exclude application of the United Nations Convention on Contracts for the International Sale of Goods pursuant to Article 6 of the Convention.

00572.23.2 Subcontractor agrees to be bound by all decisions arising out of the claims and dispute resolution process set forth in the Prime Agreement to the extent: (a) the decisions relate to the Work; (b) a claim by Owner against Purchaser involves the performance of Subcontractor or the Work; or (c) a Claim of Subcontractor gives rise to a claim by Purchaser against Owner. The initiation of claim and dispute

resolution under the Prime Agreement will stay claim and dispute resolution under this Subcontract on any claim related to the claim under the Prime Agreement. The Parties shall first use their best efforts in an attempt to settle the dispute through negotiations involving themselves and their representatives.

00572.23.3 To the extent Subcontractor will be bound as set forth in Article 00572.23.2, Purchaser consents to Subcontractor's participation in such claim and dispute resolution process. Subcontractor and Purchaser will each bear their own costs associated with their participation in the claim and dispute resolution process. A Party will follow the other Party's directions regarding that other Party's Claims, unless such directions adversely affect the Party's own Claims. In that event, the Parties will agree on how to proceed. Each Party will give the other Party reasonable assistance.

00572.23.4 Disputes between Subcontractor and Purchaser not addressed in Articles 00562.27.2 and 00572.23.3, will be resolved exclusively by the courts of the State of Tennessee located in Shelby County as their jurisdiction permits. To the extent Purchaser or Subcontractor prevails against the other Party on such dispute, reasonable dispute resolution costs including attorney fees are recoverable from the losing Party.

00572.23.5 Pending resolution of any claim or dispute, and without prejudice to Subcontractor's rights, Subcontractor shall continue to perform as directed by Purchaser.

00572.24 Hazardous Conditions

00572.24.1 Subcontractor is not responsible for any Hazardous Conditions encountered in the performance of the Work at the Jobsite. Upon encountering any Hazardous Conditions, Subcontractor will stop services immediately in the affected area and duly notify Purchaser. For purposes of this Subcontract, Hazardous Conditions is defined as any materials, wastes, substances and chemicals deemed to be hazardous under any Applicable Law or the handling, storage, remediation, or disposal of which are regulated by Applicable Laws and applies to any hazardous or toxic substance, material, or condition present at the locations in which the Work is performed which was not brought onto such site or sites by Subcontractor for the exclusive benefit of Subcontractor.

00572.24.2 Subcontractor shall be obligated to resume the Work at the affected areas only after Owner’s expert provides it with written certification that (i) the Hazardous Conditions have been removed or rendered harmless and (ii) all necessary approvals have been obtained from all Governmental Authority having jurisdiction over the location.

00572.24.3 Subcontractor will be entitled, to an adjustment in its compensation and all times for performance of the Work to the extent Subcontractor cost or time of performance have been adversely impacted by the presence of Hazardous Conditions, subject to submission of appropriate documentation by Subcontractor and Subcontractor’s duty to mitigate.

00572.25 Force Majeure

00572.25.1 If Subcontractor is delayed in the performance of the Work due to acts, omissions, conditions, events, or circumstances beyond its control, the times for performance shall be reasonably extended by on a not less than day for day basis. By way of example and not of limitation, events that will entitle Subcontractor to an extension of the times for performance include without limitation acts or omissions of Owner or Purchaser, or anyone under Owner’s control (including separate contractors), Hazardous Conditions, wars, terrorism, civil unrest, actions and inactions of delay of Governmental Authorities, floods, labor disputes and unrest, unusual delay in transportation, epidemics, earthquakes, tsunami, adverse weather conditions, and acts of God.

00572.25.2 In addition to Subcontractor’s right to a time extension for those events set forth above, Subcontractor shall also be entitled to an appropriate increase in the compensation due to the impacts or delays arising from such events. Subcontractor will file all claims in accordance with Article 00572.13.

00574 – Jobsite Operations Terms and Conditions

00574.1 Subcontractor Scope of Work

Except as expressly provided in this Subcontract, Subcontractor shall furnish all materials, tools, equipment, vehicles, supplies, services, labor and supervision required to perform the Work. Unless otherwise stated in this Subcontract, the Work includes unloading, off transport, hauling, receiving, storing, maintaining, protecting, erecting, installing, cleaning, adjusting, and all other work required to make the Work ready for use.

00574.2 Safety Requirements

00574.2.1 Subcontractor shall conduct all operations under this Subcontract in a manner that avoids the risk of bodily harm and damage to property. At a minimum, Subcontractor shall comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements. Subcontractor's failure to comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements constitutes a material breach of this Subcontract.

00574.2.2 When at the jobsite, Subcontractor shall continuously inspect all Work and conduct surveys of all Work areas to identify any unsafe condition and shall immediately take adequate precautions against any unsafe condition identified. Subcontractor is solely and exclusively responsible for the discovery and correction of such conditions. Subcontractor agrees that nothing contained in this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements shifts responsibility for bodily harm or damage to property sustained resulting from violation of those provisions from Subcontractor to Owner or Purchaser. Subcontractor remains solely and exclusively responsible for compliance with all safety requirements.

00574.2.3 Subcontractor shall immediately correct any unsafe condition identified by Purchaser. If, in Purchaser's sole discretion, Subcontractor has not taken sufficient precautions for the avoidance of bodily harm and damage to property, or in response to Purchaser's identification of an unsafe condition, Purchaser may stop the Work at Subcontractor's expense or implement suitable precautions at Subcontractor's expense, or both. Purchaser's right to stop the Work and to implement suitable precautions does not impose on Purchaser a duty to exercise those rights and does not relieve Subcontractor of responsibility for damage resulting from violation of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements.

00574.2.4 Compliance with this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements is the minimum standard required of Subcontractor. Subcontractor is responsible for examining all Work-related requirements and determining whether additional or more stringent health and safety provisions are required or appropriate for the Work. Subcontractor shall notify Purchaser promptly in writing if a charge of noncompliance with this Article 00574.2, Section 00575, the Loss Control Manual or Owner's safety requirements has been filed against Subcontractor or a Sub-subcontractor in connection with the performance of the Work.

00574.3 Labor

Subcontractor shall designate a supervisor at the jobsite who has the authority to act on behalf of and to bind Subcontractor in all matters relating to or arising out of this Subcontract. The supervisor must be fluent in English. Subcontractor agrees to replace, at no cost to Purchaser, any Sub-subcontractor or any personnel of Subcontractor or Sub-subcontractor who Purchaser reasonably requests be replaced.

00574.4 Work Hours

Typical Work days consist of a Monday through Friday schedule with a 7am start at the earliest, and a 6pm finish at the latest. Saturday Work may be permitted as necessary. Sunday Work will not be permitted, unless deemed by the Program Manager to be of a critical or emergency nature. No Work is

permitted on Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Thursday and Friday, Christmas Eve, Christmas, and New Year's Day, during the Subcontract duration.

For weekend operations, requests must be submitted in writing by Wednesdays at 5pm.

In cases where the Program Manager does not have the resources available to observe Saturday, Sunday, and/or night work, the request will be denied, and no time extension or impact will be considered.

Night Work, when deemed necessary by the Program Manager; will be permitted as requested (48-hour advanced notice required). Noise attenuated equipment for night work is required when working in residential neighborhoods.

00574.5 Protection and Restoration of Property

00574.5.1 Subcontractor shall, at its expense, protect the Work, the environment, and all other property from hazards arising out of or relating to the Work and from natural elements. Subcontractor shall, at its expense, promptly repair or remove and replace any damage or loss and, to the extent practicable, restore property affected by the Work to its original condition, as determined by Purchaser. Subcontractor is solely responsible for protection of the Work until Final Completion.

00574.5.2 At the completion of the Work, Subcontractor shall remove all Subcontractor-furnished items that are not intended to become a permanent part of the project from the jobsite and shall remove and deposit in Subcontractor-furnished waste facilities all scrap, trash, waste materials, and debris resulting from the Work. Subcontractor shall thoroughly remove all accumulations of dust, scraps, waste, oil, grease, weld spatter, insulation, paint, and other foreign substances resulting from performance of the Work and shall restore all surfaces affected by those substances.

00575 - Safety, Health and Accident Prevention

00575.1 Project Safety and Health Program

Purchaser will implement and coordinate the overall Project Safety and Health Program as defined in the Loss Control Manual which is available for inspection at http://www.sarp10.com/safety/.

00575.2 Safety, Health, and Accident Prevention Program

00575.2.1 Subcontractor shall implement and maintain a written Safety, Health and Accident Prevention Program specifically applicable to the Work. Subcontractor's Safety, Health and Accident Prevention Program must meet the requirements of Applicable Laws and adhere to the Project Safety and Health Program, if implemented by Purchaser. Subcontractor shall submit Subcontractor's Safety, Health and Accident Prevention Program for Purchaser's review at least thirty calendar days before starting Work at the jobsite. Purchaser's review does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's review limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

00575.2.2 Purchaser may monitor Subcontractor's safety and health performance and may require changes to Subcontractor's Safety, Health and Accident Prevention Program during the performance of the Work. Purchaser's monitoring and requirement of changes does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's monitoring and requirement of changes limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

00575.3 Hazardous Waste Project Health and Safety Plan

00575.3.1 Subcontractor understands that the Work involves hazardous substances or hazardous wastes. Subcontractor shall comply with all Applicable Laws, Owner's facility rules and regulations, and applicable guidance documents. Subcontractor shall prepare and implement a jobsite-specific Hazardous Waste Project Health and Safety Plan, based on Subcontractor's Safety, Health and Accident Prevention Program and all written programs required by Applicable Laws. Subcontractor is responsible for the completeness and accuracy of Subcontractor's Hazardous Waste Project Health and Safety Plan. Subcontractor shall submit Subcontractor's Hazardous Waste Project Health and Safety Plan to Purchaser at least thirty calendar days before starting Work at the jobsite and shall maintain a copy at the jobsite for review by Purchaser, Owner, and regulatory personnel.

00575.3.2 Before starting Work at the jobsite, Subcontractor shall submit written verification that:

(a) personnel assigned to the Work have received forty-hour health and safety training that meets the requirements of 29 CFR 1910.120(e) or 1926.65(e);

(b) the assigned field supervisor has completed eight hours of supervisor training that meets the requirements of 29 CFR 1910.120(e)(4) or 1926.65(e)(4); and

(c) personnel assigned to the Work are participating in a medical surveillance program that meets the requirements of 29 CFR 1910.120(f) or 1926.65(f).

00575.4 Protective Clothing, Equipment and Instrumentation

Subcontractor agrees to furnish special protective clothing, respiratory protective equipment, and monitoring instrumentation as required by Applicable Laws, the project's safety-related plans and programs, and Purchaser's and Owner's rules and regulations. Subcontractor shall ensure that personnel performing Work at the jobsite properly use the clothing, equipment, and instrumentation. Subcontractor shall furnish and maintain all safety equipment, including but not limited to, barriers, signs, warning lights, and guards necessary for adequate protection of persons and property.

00575.5 Safety and Health Representative

The Subcontractor shall identify a qualified person to be its representative for Environmental, Safety, Health & Security matter and make this person available as needed and requested by the Purchaser. The representative must have authority to correct unsafe conditions and to stop Work in the area of an unsafe condition. In addition, the representative shall routinely visit the jobsite.

00575.6 Safety and Health Goal

Subcontractor shall endeavor to attain the project's safety goal of zero injuries. Subcontractor shall maintain accurate accident and injury reports and shall furnish Purchaser a monthly summary of injuries and man-hours lost due to injuries by the third of each month. Subcontractor accident rates must be calculated monthly in accordance with the Bureau of Labor Statistics incident rate, frequency rate, and days away from work rate methods. If Subcontractor or Sub-subcontractor accident rates exceed the project's safety goal, Subcontractor shall take immediate corrective action, which may include, but is not limited to:

(a) Submittal of a written corrective action plan to Purchaser by Subcontractor;

(b) Additions or modifications to Subcontractor's Safety, Health and Accident Prevention Program;

(c) Removal from the jobsite of any Subcontractor or Subcontractor personnel not implementing or following the necessary safety and health measures; and

(d) Increasing the amount of Subcontractor safety and health training.

00575.7 Drug Prevention Program

As part of the Work, Subcontractor shall assist Purchaser in administering the project requirements for a drug detection and prevention program. Subcontractor agrees that all costs for drug testing and alcohol testing are included in the Subcontract price. Subcontractor must provide evidence to Purchaser that all personnel assigned to the Work at the jobsite have passed the drug test within three calendar days of completion of the test. The drug detection and prevention program will include, but will not be limited to, the following: (a) a pre-jobsite assignment test; and (b) post-jobsite assignment tests, such as reasonable suspicion tests, post-accident tests, and unannounced random drug tests of ten percent of the workforce on a monthly basis.

00575.8 Fall Protection

The OSHA Fall Protection Standard 29 CFR 1926 Subpart M shall be strictly adhered to by the Subcontractor. Fall protection is required for all of Subcontractor's Work operations one hundred percent of the time, whether climbing, traveling, or working. NO WORK OPERATION is exempt from the six (6) foot fall protection requirement.

Prior to starting work operations requiring fall protection, Subcontractor shall submit to Purchaser a fall protection plan. The fall protection plan shall include, but not be limited to, the following:

- Name of qualified person in charge of operation.
- Description of work operation.
- List of fall exposures.
- Description of fall protection methods used to eliminate fall exposures.
- Training and enforcement methods used to ensure employee compliance with the plan.

Fall protection body harnesses, lanyards, and lifelines shall be used in accordance with OSHA Standard 1926 Subpart 502D, with the following exceptions:

- Full body harnesses shall be used in lieu of safety belts.
- Only lanyards with shock absorbers and locking type snap hooks shall be used.
- At least two lanyards shall be used to provide one hundred percent fall protection when moving around obstructions, connection points, or other similar items.

Fall protection guardrail systems shall comply with OSHA Standard 1926 Subpart 502(b) except manila, plastic, or synthetic rope shall not be used as guardrails.

00575.9 Sub-subcontractor Safety Prequalification

Prior to any Sub-subcontractor performing Work on the Jobsite the Sub-subcontractor must obtain a Sub-subcontractor safety prequalification from Purchaser. In order to obtain the safety prequalification, Subcontractor or its Sub-subcontractor shall submit to Purchaser evidence that the Sub-subcontract has an Experience Modification Rating or equivalent rating of 1.0 or less and that incident rates (Recordable Incident Rate, Loss Time Incident Rate, and Days Away/Restricted or Job Transfer rate) are below the national average during the last three years. In addition, Subcontractor or Sub-subcontractor must submit sufficient information to allow Purchaser to evaluate any Occupational Safety and Health Administration (OSHA) violations received by Sub-subcontractor within the last three years and any other documentation Purchaser may reasonably require. Purchaser's safety manager will review the submission and provide a safety prequalification if Purchaser, in its sole discretion, determines the Sub-subcontractor meets Purchaser's safety requirements. Subcontractor or its Sub-subcontractor must submit the requirements prior to Sub-subcontractor first mobilizing to the Jobsite.

00575.10 Confined Spaces

All employees entering confined spaces and all attendants for such entries including supervisors shall receive confined space entry training and emergency rescue training at a minimum of once per year.

00575.11 Third Party Medical Triage

Subcontractor shall retain the services of a third-party medical triage company that meets the following criteria:

- Must employ medical doctors that understand occupational medicine and the rules set forth by OSHA for first aid treatment of work-related injuries and illnesses
- Ability to provide virtual real-time consultation with medical doctors for injury triage, with injured worker
- Available 24 hours a day, 7 days per week, and 365 days per year

Subcontractor shall require retention of identical services for each subcontractor, with the further requirement that each lower tier subcontractor shall include identical requirements in any lower tier subcontracts, which might in turn be made.

00672 - General Conditions Attachments

00672.1 Partial Waiver and Release of Lien Rights

AFFIDAVIT AND PARTIAL WAIVER OF CLAIMS AND LIENS AND RELEASE OF RIGHTS FOR SUBCONTRACTORS

The undersigned, who is the _____ (designate title) of _____ which is the Subcontractor (designate whether subcontractor, supplier or otherwise) for the Gravity Sewer Package B Construction (designate the type of work, supplies or services rendered) on the improvements constructed on the premises hereafter identified, declares that his or her contract with **Overland Contracting, Inc. (Purchaser)** is in the total amount of $_____, which includes extras and all change orders to the date hereof.

The undersigned further states that as of _____ (date) the total value of work completed, and material stored is $_____. Of this amount $_____ has been received (the receipt and sufficiency of which is hereby acknowledged by the undersigned including $_____ in payment of Payment Application or Invoice Number _____).

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to **Overland Contracting, Inc. (Purchaser)** any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or **Overland Contracting, Inc. (Purchaser)** or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

Project Name: Gravity Sewer Package B Construction

Address of Project:

City: Memphis County: Shelby State: TN Zip Code: _____

The undersigned further represents and warrants that he or she is duly authorized and empowered to sign and execute this waiver on his or her own behalf and on behalf of the company or business for which he or she is signing; that he or she has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner through the date of said payment application or invoice; that he or she has paid for all the labor, materials, equipment, and services that he or she has used or supplied to the above premises through the date of said payment application or invoice; that he or she has no other outstanding and unpaid payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against **Overland Contracting, Inc. (Purchaser)** as of the date of the aforementioned payment application; and that any materials which have been supplied or incorporated into the above premises were either taken from his or her fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)** for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.

The undersigned further accepts and acknowledges the receipt of the aforesaid sums in full accord and satisfaction for the aforementioned claims with full knowledge that the contractors, **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)**, their successors and assigns, are relying thereon; and furthermore, the undersigned agrees to perform, now and in the future, each and every covenant and provision of this written contract or supplier's agreement (as the case may be) as modified or changed in writing with **Overland Contracting, Inc. (Purchaser)** or any subcontractor of **Overland Contracting, Inc. (Purchaser)** hereby acknowledging that said contract or supplier's agreement is now in full force and effect.

In addition, for and in consideration of the amounts and sums received, the undersigned hereby waives, releases and relinquishes any and all claims, rights or causes of action whatsoever arising out of or in the course of the work performed on the above-mentioned project, contract or event transpiring prior to the date hereof, excepting the right to receive payment for work performed and properly completed and retainage, if any, after the date of the above-mentioned payment application or invoices.

Signed and delivered the _____ day of _____, 20___.

Company _____

By: _____
(Printed Name)

_____
(Signature)

Title: _____

Before me, the undersigned Notary Public in and for the said County and State, personally appeared _____, and acknowledged execution of the foregoing affidavit as his or her voluntary act and deed and further stated that the facts recited are true of his or her personal knowledge.

My Commission Expires: _____

_____
Notary Public

Residence County/State: _____

00672.2 Final Waiver and Release of Lien Rights

AFFIDAVIT AND FINAL WAIVER OF CLAIMS AND LIENS AND RELEASE OF RIGHTS FOR SUBCONTRACTORS

The undersigned, who is the _____ (designate title) of _____ which is the Subcontractor (designate whether subcontractor, supplier or otherwise) for the Gravity Sewer Package B Construction (designate the type of work, supplies or services rendered) on the improvements constructed on the premises hereafter identified, declares that his or her contract with **Overland Contracting, Inc. (Purchaser)** is in the total amount of $_____, which includes extras and all change orders to the date hereof.

The undersigned further states that as of _____ (date) all work on said project has been performed and completed in accordance with the plans and specifications for the project, and said work has been accomplished in accordance with the terms and conditions of his or her subcontract and those documents which, by reference, are a part of said subcontract. The total value of work completed and material stored is $_____. Of this amount $_____ has been received (the receipt and sufficiency of which is hereby acknowledged by the undersigned including $_____ in payment of Payment Application or Invoice Number _____).

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to **Overland Contracting, Inc. (Purchaser)** any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or **Overland Contracting, Inc. (Purchaser)** or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

Project Name: Gravity Sewer Package B Construction

Address of Project:

City: Memphis County: Shelby State: TN Zip Code: _____

The undersigned further represents and warrants that he or she is duly authorized and empowered to sign and execute this waiver on his or her own behalf and on behalf of the company or business for which he or she is signing; that he or she has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner as required by the contract; that he or she has paid for all the labor, materials, equipment, and services that he or she has used or supplied to the above premises as required by the contract; that he or she has no other outstanding and unpaid payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against **Overland Contracting, Inc. (Purchaser)**; and that any materials which have been supplied or incorporated into the above premises were either taken from his or her fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)** for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.

The undersigned further accepts and acknowledges the receipt of the aforesaid sums in full accord and satisfaction for the aforementioned claims with full knowledge that the contractors, **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)**, their successors and assigns, are relying thereon; and furthermore, the undersigned agrees to perform, now and in the future, each and every covenant and provision of this written contract or supplier's agreement (as the case may be) as modified or changed in writing with **Overland Contracting, Inc. (Purchaser)** or any subcontractor of **Overland Contracting, Inc. (Purchaser)** hereby acknowledging that said contract or supplier's agreement is now in full force and effect.

In addition, for and in consideration of the amounts and sums received, the undersigned hereby waives, releases and relinquishes any and all claims, rights or causes of action whatsoever arising out of or in the course of the work performed on the above-mentioned project, contract or event transpiring prior to the date hereof, except retainage, if any, after the date of the above-mentioned payment application or invoices.

Signed and delivered the _____ day of _____, 20___.

Company _____

By: _____
(Printed Name)

_____
(Signature)

Title: _____

Before me, the undersigned Notary Public in and for the said County and State, personally appeared _____, and acknowledged execution of the foregoing affidavit as his or her voluntary act and deed and further stated that the facts recited are true of his or her personal knowledge.

My Commission Expires: _____

_____
Notary Public

Residence County/State: _____

00672.3 Certificate of Nondiscrimination

As Bidder, Contractor, or Subcontractor on Purchaser's Contract, **Gravity Sewer Package B Construction**

The undersigned states that it does not discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex and, if awarded a contract for this project, agrees in performance of work:

1. Not to discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national original or sex;

2. To maintain payrolls of laborers and mechanics employed on this contract until seven (7) years after final release and final payment by the City;

3. To require a similar certificate to be executed by each subcontractor at the time a subcontract is executed under the contract with the requirement that such subcontractor agrees to require a similar certificate of requirement on any lower tiers of subcontracts.

4. To conform to federal law, state statutes, executive orders, and local ordinances identified and listed under Non-discrimination.

_____
Subcontractor's Name

_____
Date

_____
Signature

_____
Printed or Typed Name and Title

THIS FORM MUST BE SUBMITTED WITH THE BID OR THE BID MAY BE CONSIDERED NON-CONFORMING.

00672.4 Equal Business Opportunity Program

This form must be submitted with Bidder's bid. Failure to execute and submit this document with Bidder's bid may cause the Bid to be rejected as non-conforming. In addition, each Sub-Subcontractor must execute the form.

This Subcontract will be subject to the requirements of the City of Memphis Ordinance #5384 which establishes the Equal Business Opportunity ("EBO") Program. It is up to the Respondent to ensure that all requirements of this ordinance are met. The Ordinance may be accessed on the City's website at www.memphistn.gov under "Business – Contract Compliance". The intent of the EBO Program is to increase the participation of locally owned minority and women owned business enterprises ("M/WBE").

SARP10 DBE Participation Goal:
DBE minimum **20%**
(Vendors from the City of Memphis EBO list only)

Participation Plan
The Participation Plan must include: (1) level and dollar amount of participation your firm anticipates achieving in the performance of contract resulting from this RFB; (2) the type of work to be performed by the M/WBE participation; and (3) the names of the M/WBE and/or DBE firm(s) the Respondent plans to utilize in the performance of the contract resulting from this RFB.

Eligible M/WBE and/or DBE Firms
To qualify as a M/WBE firm, per the requirements of City of Memphis Ordinance #5384, a firm must be included on the City of Memphis EBO list of certified M/WBE firms.

A list of the City's eligible M/WBE firms may be requested from Purchaser as a guide only. If a Bidder desires to utilize an M/WBE firm not included on the list, it is the Bidder's responsibility to confirm that the desired firm is certified by the City of Memphis. Such confirmation must be obtained from the City's Contract Compliance Office, in writing, before the bid/response due date. Requests for verification must be submitted to the City's Contract Compliance Office listed below:

Ken Moody
City of Memphis, Contract Compliance Office
125 North Main Street, Suite 546
Memphis, TN 38103
Phone: (901) 576-6210
Fax: (901) 576-6560
Email: ken.moody@memphistn.gov

MINORITY/WOMEN BUSINESS ENTERPRISE COMPLIANCE FORM

SUBCONTRACT TITLE: Gravity Sewer Package B Construction

Project Participation Goal: DBE minimum **20%**

The following sections must be completed by Bidder. A certified subcontractor or supplier is defined as a firm from the list of certified firms provided with this specification.

_____
Bidder's Name

Section A - If the Bidder is a certified firm, so indicate here with a check mark.

_____ MBE _____ WBE _____ DBE

Section B - Identify below those certified firms that will be employed as subcontractors or suppliers on this Project. By submitting this Proposal, the Bidder commits to the use of the firms listed below.

$ = Show the dollar value of the subcontract to be awarded to this firm

% = Show the percentage this subcontract is of your base Proposal

M/WBE = Show by inserting an M or W whether the subcontractor is an MBE or WBE

$	%	M/WBE	DBE	CERTIFIED SUBCONTRACTOR NAME, ADDRESS, TEL #

$ _____ **%** _____ **=** ***Total M/WBE and/or DBE***

THIS FORM MUST BE SUBMITTED WITH THE PROPOSAL OR THE PROPOSAL MAY BE CONSIDERED NON-CONFORMING

00672.5 Report of Disadvantaged Business Enterprise Participation Form (1 page)

PROJECT NUMBER: 421848.71.0420

SUBCONTRACTOR'S REPORT OF DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION

Project Name: Gravity Sewer Pkg B Construction Month of ____________, 2025

General Contractor: ____________________

Contact Person: ____________________ Telephone: ____________

Address: ____________________ Email: ____________

Amount of Subcontract: $ ____________ MBE %: ________ WBE %: ________

DBE Information: Circle Either MBE or WBE and Complete Form.

MBE / WBE Firm Name: ____________ Contact Person: ____________

Date of Award: ____________ Contract Value: $ ____________

Completed to Date: $ ____________ Paid to Date: $ ____________

Work Description: ____________ Telephone: ____________

Amount Invoiced This Period: $ ____________ Email: ____________

MBE / WBE Firm Name: ____________ Contact Person: ____________

Date of Award: ____________ Contract Value: $ ____________

Completed to Date: $ ____________ Paid to Date: $ ____________

Work Description: ____________ Telephone: ____________

Amount Invoiced This Period: $ ____________ Email: ____________

MBE / WBE Firm Name: ____________ Contact Person: ____________

Date of Award: ____________ Contract Value: $ ____________

Completed to Date: $ ____________ Paid to Date: $ ____________

Work Description: ____________ Telephone: ____________

Amount Invoiced This Period: $ ____________ Email: ____________

MBE / WBE Firm Name: ____________ Contact Person: ____________

Date of Award: ____________ Contract Value: $ ____________

Completed to Date: $ ____________ Paid to Date: $ ____________

Work Description: ____________ Telephone: ____________

Amount Invoiced This Period: $ ____________ Email: ____________

Attach additional pages as required.

General Contractor's Signature: ____________________ Date: ____________

00672.6 Not Used

00672.7 Bid Bond

Know all men by these presents, that we, the undersigned,
_____ as

Principal, and _____ as surety,

Hereby held and firmly bound unto _____ as Owner on the sum of _____ for the payment of which, well and truly to be made, We hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this _____ day of _____, 2025.

This condition of the above obligation is such that whereas the principal has submitted to the Purchaser a certain bid, attached hereto and hereby made a part of hereof to enter into a contract in writing for the construction of:

SARP 10 Program 421848.71.0420 Gravity Sewer Package B Construction

Now therefore,

A) If said bid shall be rejected, or in the alternative,

B) If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto (properly completed in accordance with said bid), required insurance certificates, and shall furnish a Bond for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bond,

Then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the amount of this obligation as herein stated.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extension of the time within which the Purchaser may accept such bid; and said surety does hereby waive notice of any such extension.

In witness whereof, the principal and the surety hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year set forth above.

CONTRACTOR	**SURETY**
Contractor's Company Name	Surety Name
Signature (principal)	By: Attorney in Fact - Signature
Printed or Typed Name and Title	Printed or Typed Name and Title

00672.8 Schedule Impact Due to Weather

Program Manager will determine Contractor's entitlement to an extension of the Contract Time as a result of weather delays, based on the data included in Tables 1 and 2. Extensions of time will be granted at the discretion of the Program Manager for circumstances not covered by the flow chart.

The following rules apply to any analysis for weather related delays to this Project. Weather delay days may be awarded if the first two rules are met. Additional days may be awarded if conditions in Rule 3 are met for unusually heavy precipitation independent of Rules 1 and 2.

Rule 1: The average monthly precipitation amount must have been exceeded.

If the total amount of actual precipitation in a month exceeds the average for that month shown in Table 1, the first test has been met. Go to rule number 2. (Precipitation is defined as the quantity of water deposited by rain, hail, sleet, or snow.)

Rule 2: The number of days in a month with actual precipitation greater than the threshold amount shown in Table 2 has been exceeded.

The numbers of days with actual precipitation greater than the threshold amounts shown in Table 2 are eligible for award as weather delays days. Additional days may be awarded for unusually heavy precipitation independent of meeting the rules above.

Rule 3: Unusually heavy precipitation has occurred.

Precipitation greater than one inch in a single day may be justification for an additional day, time extension for each precipitation day. This rule may be applied singly but not in addition with any other rule.

National Weather Service Data for
Memphis International Airport – Years 2009-2019

Table 1

Average Precipitation by Month (In Inches)											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3.66	5.26	5.75	6.30	5.84	4.59	4.74	3.75	2.61	3.85	4.55	5.05

Table 2

Average Number of Days with Precipitation Greater than 0.25 Inches											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4	5	6	6	6	4	4	4	2	4	5	6

Any weather-related extension of Contract time shall be non-compensable. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather days is less than expected, shall contribute to the project float and shall not affect the Contract Times. Application for a weather-related extension of time shall be submitted to the Program Manager and shall state the extension requested and be supported by the relevant weather data.

00672.9 SARP10 Safety Guidelines

Black & Veatch
Memphis SARP10 Safety Guidelines

Anyone working for the SARP10 Program must comply with these basic safety requirements, except where their individual employer's safety requirements are more stringent. It is the employer's responsibility to ensure that their employees are informed of the Project safety policies and that they work in compliance with the Program safety policies.

Black & Veatch is committed to the safety and health of all employees, subcontractors, vendors and visitors. In our effort to minimize hazards and provide the safest worksite possible, we expect all workers on the Program to know and practice the following safe work rules as a minimum. The following rules are not all inclusive.

Noncompliance with the Rules We Live By will result in removal from the Program.

Rules We Live By

- **Confined Spaces** - Comply with all requirements of Confined Space Entry permits and DO NOT enter a confined space without a permit.
- **Fall Protection** - Comply with the Fall Protection procedures when working above the applicable working height. Always use 100 percent of the fall protection techniques when tying off. Note: An open manhole is a fall exposure and must be protected.
- **Lock Out Tag Out (LOTO)** - Follow all Lock Out/Tag Out procedures at all times.
- **Trench and Excavation** - Do not start any excavation activities without a Trench & Excavation permit and comply with all requirements. Excavations must be properly sloped, shored or shielded before entering, and proper access/egress must be in place.
- **Drugs and Alcohol** - Drugs and alcohol have NO place in the work environment. Do NOT come to work if you are under the influence of illegal drugs or alcohol.
- **You** - Make a difference today. Don't walk by any unsafe situation and be a Safety Leader.

PPE Requirements

- Safety glasses with side shields, ANSI Z87.1 approved are mandatory on the worksite.
- Hard hats, ANSI Z89.1 approved, with no modifications or deformities are mandatory on the worksite.
- Good quality, over the ankle, work boots with safety toes (steel toe) are required. Sneakers of any kind are prohibited.
- High visibility work vests with reflective markings shall be worn in all construction areas. Must be ANSI Class II specification as and be fluorescent (orange or lime green)
- You are the person most responsible for your safety. Observe and obey all signs and barricades.

General Safety and Health Requirements

- 100% fall protection is required when working on unprotected surfaces at or above 6 feet. Full body harnesses and shock absorbing lanyards with double locking hooks are the only acceptable method of personnel fall protection.
- DO NOT use the top two steps of a step ladder or the top three steps of a straight ladder. Use the 3-point rule (both feet / one hand or two hands / one foot) when using ladders.
- When on site, be aware of moving vehicles and equipment. Before traveling in front of or behind pieces of equipment make eye contact with the operator and wait for an indication to proceed. Spotters are required at all times.
- DO NOT cross a red barricade without permission from the owner of that barricade.
- Immediately correct safety hazards if within your authority. If you cannot make the correction report it to your supervisor. Unresolved hazards or conditions not corrected by the previous methods must be brought to the attention of the Site Project Manager.
- Immediately report injuries, fires, spills, near misses, accidents or unsafe conditions or practices to the Safety Department.
- Pay attention to barricades, signs and announcements.

00770 – Loss Control Manual

The Loss Control Manual is available for viewing on the SARP10 website:

http://www.sarp10.com/safety/

Contact Tom Gilmer, Safety Manager for additional information:

GilmerTR@bv.com

(913) 458-4207

Technical Specifications

PLEASE NOTE: The drawings in this RFB package have been compressed to reduce the overall PDF file size. Full resolution files will be available for viewing and/or downloading on the SARP10 website.

SPECIFICATIONS

City of Memphis

Gravity Sewer Improvement Package B for SARP 10

A2H No. 21117.05

Prepared By:

A2H
ENGINEERS · ARCHITECTS · PLANNERS
3009 Davies Plantation Road
Lakeland, TN 38002
901.372.0404
www.A2H.com
A2H, Inc.

SPECIFICATIONS
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CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01140 WORK RESTRICTIONS

PART 1 – USE OF PREMISES

1.01 The Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment, the Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against the Owner by any such owner or occupant because of the performance of the Work, the Contractor shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. The Contractor shall indemnify and hold the Owner harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequently out of any action, legal or equitable, brought by any such other party against the Owner to the extent based on a claim arising out of the Contractor's performance of the Work.

1.02 During the progress of the Work, the Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, the Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by the Owner. The Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.

1.03 The Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall the Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

PART 2 – RIGHTS-OF-WAY AND EASEMENTS

2.01 The Owner will provide lands, including rights-of-way, permanent easements, and temporary construction easements considered by the Owner to be sufficient for the construction of the facilities included in the Contract. Reference is made to Section 01700.

2.02 The Contractor, at his expense, shall provide any additional land, by temporary agreement or other means, required by him for storage of equipment and materials or for construction activities. He shall be responsible for obtaining temporary agreements or property owner's permission as necessary to gain access to the site of the Work and to lands provided by the Owner for that Work. The above is considered to be incidental to the Work, and no additional payment to the Contractor will be made.

2.03 Should lands to be provided by the Owner not be acquired on some portions of the Project after the Notice to Proceed is issued or after Work is under way, and should such conditions delay the progress of the Work, an extension will be made to the Contractor by the Owner on the time allowed for the Contract in an amount to be determined by the Owner. No other considerations or compensation will be due the Contractor from the Owner for delays of Work due to the inability of the Owner to acquire rights-of-way or easements by a specific time.

2.04 The Contractor will be held responsible for any damage to crops or property outside the lands provided by the Owner for the construction of the Project.

2.05 The Contractor is warned that the locations of utilities and obstructions within the lands provided and shown on the Plans are approximate only and are not intended as an accurate and completed representation. Obstructions and utilities not shown on the Plans but encountered by the Contractor must also be removed and, if necessary, replaced in the original state or protected by the Contractor at no cost to the Owner. Utilities are considered to be all publicly and privately owned facilities for providing services such as electrical power, natural gas, water, telephone, and CATV but excluding City owned

sewer and drainage facilities and traffic control equipment. If utilities are encountered in the construction, whether shown on the Plans or not, the Contractor shall be subject to the provisions of Specification Section 01710.

PART 3 – MAINTENANCE OF TRAFFIC AND ACCESS TO PROPERTIES

3.01 TRAFFIC CONTROL PLAN.
No road, street, or highway, or any lane or section thereof, shall be closed to traffic an no construction operations that will for any reason render the roadway or any lane or section of the roadway unsuitable for use of the traveling public shall be started until a Traffic Control Plan as described in Section 02890, Division 2 of these specifications has been approved by the Owner.

3.02 MAINTENANCE OF TRAFFIC.
Unless otherwise stipulated in the Contract Documents, all roads and streets, while under construction, shall be kept open to all traffic by the Contractor. Where so provided on the Plans, the Contractor may direct the traffic over approved detour routes. The Contractor shall keep the portion of the Project being used by public traffic in such condition that traffic will be adequately and safely accommodated. He shall also provide and maintain in a safe condition temporary approaches, or access to, crossings and intersections with trails, roads, streets, businesses, parking lots, railroads, residences, garages, and farms. The Contractor shall bear all expense of maintaining traffic over the section of road or street under construction and maintaining such approaches, crossings, intersections, or other features as may be necessary without direct compensation, except that materials used at the direction of the Owner to construct and maintain such approaches, crossings, intersections, and other features will be paid for by the Owner at Contract unit prices. All public roads and streets that are designated on the Plans as detours, but not designated as “Haul Roads”, will be maintained by the Owner; however, detour roads constructed by the Contractor shall be maintained by the Contractor for the life of the Contract at no additional cost to the Owner other than the first cost of construction.

3.03 PUBLIC USE DURING CONSTRUCTION.
After the completion of any length of pavement for a road or street considered usable by the Owner, the same shall be opened for public traffic; however, such public use will not constitute an acceptance of that section by the Owner. The Contractor shall maintain such sections until final acceptance by the Owner.

3.04 MAINTENANCE OF ACCESS TO PROPERTIES.
The Contractor must maintain proper, sufficient, and continuous ingress and egress to private properties and access to buildings unless otherwise specified in the Contract Documents or where temporary interference to access is authorized by the Owner. Provision shall be made for owners and occupants to reach their premises. The Contractor shall provide access to private properties by bridging, use of steel plates, or other means acceptable to the Owner. Where temporary interference is authorized, it shall be interrupted only for such time as necessary to provide temporary substitutes for surfaces disturbed by the construction and to restore street and sidewalk surfaces after the completion of the Work. The expense to the Contractor in fulfilling the obligations of this subsection (01140 para. 3.04) are considered incidental to the Contract, and no extra compensation will be allowed.

PART 4 – WORK IN PRIVATE PROPERTY

4.01 Where Work is done in private property and easements thereon, the Contractor shall conduct his operations so as to cause the property owners the least inconvenience. The Work shall be completed without delay and the premises cleaned up and all walks, driveways, fences, streets, shrubbery, trees, turfed areas and similar facilities, repaired or replaced.

PART 5 – MAINTENANCE DURING CONSTRUCTION

5.01 The Contractor shall maintain the Work of any Project involving public traffic of any kind during construction until the Project or authorized sections thereof are complete and accepted by the Owner.

This maintenance shall constitute continuous and effective Work prosecuted day by day, with adequate equipment and forces so that the facilities affecting traffic are kept in satisfactory condition at all times.

END OF SECTION 01140

SECTION 01141 – WELDING AND OTHER HOT WORK

PART 1 – GENERAL

1.1 Scope. Welding, cutting, open torches and other hot work operations and equipment shall comply with this section.

1.2 Permits. Permits shall be required as set forth in Section 3.3.

1.3 Restricted areas. Hot work shall only be conducted in areas designed or authorized for that purpose by the personnel responsible for a Hot Work Program. Hot work shall not be conducted in the following areas unless approval has been obtained from the fire code official:

1. Areas where the sprinkler system is impaired.

2. Areas where there exists the potential of an explosive atmosphere, such as locations where flammable gases, liquids or vapors are present.

3. Areas with readily ignitable materials, such as storage of large quantities of bulk sulfur, baled paper, cotton, lint, dust, or loose combustible materials.

4. At other locations as specified by the fire code official.

1.4 Cylinders and containers. Compressed gas cylinders and fuel containers shall comply with this chapter and Chapter 30 of the 2009 International Fire Code (2009 IFC).

1.5 Design and installation of oxygen-fuel gas systems. An oxygen-fuel gas system with two or more manifold cylinders of oxygen shall be in accordance with NFPA 51.

PART 2 – DEFINITIONS

2.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown below.

HOT WORK. Operations including cutting, welding, Thermite welding, brazing, soldering, grinding, thermal spraying, thawing pipe, installation of torch-applied roof systems or any other similar activity.

HOT WORK AREA. The area exposed to sparks, hot slag, radiant heat, or convective heat as a result of the hot wok.

HOT WORK EQUIPMENT. Electric or gas welding or cutting equipment used for hot work.

HOT WORK PERMITS. Permits issued by the City of Memphis Fire Prevention Bureau for the facility where hot work operations will be conducted.

HOT WORK PROGRAM. A permitted program, carried out by the City of Memphis Fire Prevention Bureau. The intent is to have trained; on-site, responsible personnel ensure that required hot work safety measures are taken to prevent fires and fire spread.

RESPONSIBLE PERSON. A person trained in the safety and fire safety considerations concerned with hot work. Responsible for reviewing the sites prior to the commencement of hot work operations and following up as the job progresses.

TORCH-APPLIED ROOF SYSTEM. Bituminous roofing systems using membranes that are adhered by heating with a torch and melting asphalt back coating instead of mopping hot asphalt for adhesion.

PART 3- GENERAL REQUIREMENTS

3.1 General. Hot Work conditions and operations shall comply with this chapter.

3.2 Temporary and fixed hot work areas. Temporary and fixed hot work areas shall comply with this section.

3.3 Hot work program permit. Hot work permits shall be requested from:

City of Memphis Fire Prevention Bureau
2668 Avery Avenue
Memphis, TN 38112
Ph (901) 636-5401
Fire.Prevention@memphistn.gov

An approved Hot Work Permit must be on site prior to the commencement of any hot work operations.

3.4 Signage. Visible hazard identification signs shall be provided where where the hot work area is accessible to persons other than the operator of the hot work equipment, conspicuous signs shall be posted to warn others before they enter the hot work area. Such signs shall display the following warning:

CAUTION
HOT WORK IN PROGRESS
STAY CLEAR.

PART 4 – FIRE SAFETY REQUIREMENTS

4.1 Protection of combustibles. Protection of combustibles shall be in accordance with Section 4.1.1 through 4.1.9.

4.1.1 Combustibles. Hot Work areas shall not contain combustibles or shall be provided with appropriate shielding to prevent sparks, slag or heat from igniting exposed combustibles.

4.1.2 Openings. Openings and cracks in walls, floors, ducts or shafts within the hot work area shall be tightly covered to prevent the passage of sparks to adjacent combustible areas, or shielded by metal fire-resistant guards, or curtains shall be provided to prevent passage of sparks or slag.

4.1.3 Housekeeping. Floors shall be kept clean within the hot work area.

4.1.4 Conveyor systems. Conveyor systems that are capable of carrying sparks to distant combustibles shall be shielded or shut down.

4.1.5 Partitions. Partitions segregating hot work areas from other areas of the building shall be noncombustible. In fixed hot work areas, the partitions shall be securely connected to the floor such that no gap exists between the floor and the partition. Partitions shall prevent the passage of sparks, slag, and heat from the hot work area.

4.1.6 Floors. Fixed hot work areas shall have floors with noncombustible surfaces.

4.1.7 Precautions in hot work. Hot work shall not be performed on containers or equipment that contains or has contained flammable liquids, gases or solids until the containers and equipment have been thoroughly cleaned, inert or purged; except that “hot tapping” shall be allowed on tanks and pipe lines when such work is to be conducted by approved personnel.

4.1.8 Sprinkler protection. Automatic sprinkler protection shall not be shut off while hot work is performed. Where hot work is performed close to automatic sprinklers, noncombustible barriers or damp cloth guards shall shield the individual sprinkler heads and shall be removed when the work is completed. If the work extends over several days, the shields shall be removed at the end of each workday.

4.1.9 Fire detection systems. Approved special precautions shall be taken to avoid accidental operation of automatic fire detection systems.

4.2 Fire watch. Fire watches shall be established and conducted in accordance with Sections 4.2.1 through 4.2.6

4.2.1 When required. A fire watch shall be provided during hot work activities and shall for a minimum of 30 minutes after the conclusion of the work. The fire code official, or the responsible manager under a hot work program, is authorized to extend the fire watch based on the hazards or work being performed.

Exception: Where the hot work area has no fire hazards or combustible exposures.

4.2.2 Location. The fire watch shall include the entire hot work area. Hot work conducted in areas with vertical or horizontal fire exposures that are not observable by a single individual shall have additional personnel assigned to fire watches to ensure that exposed areas are monitored.

4.2.3 Duties. Individuals designated to fire watch duty shall have fire-extinguishing equipment readily available and shall be trained in the use of such equipment. Individuals assigned to fire watch duty shall be responsible for extinguishing spot fires and communicating an alarm.

4.2.4 Fire training. The individuals responsible for performing the hot work and individuals responsible for providing the fire watch shall be trained in the use of portable fire extinguishers.

4.2.5 Fire hoses. Where hose lines are required, they shall be connected, charged and ready for operation.

4.2.6 Fire extinguisher. A minimum of one portable fire extinguisher with a minimum 2-A:20-B:C rating shall be readily accessible within 30 feet of the location where hot work is performed.

4.3 Area reviews. Before hot work is permitted and at least once per day while the permit is in effect, the area shall be inspected by the individual responsible for authorizing hot work operations to ensure that it is a fire safe area.

4.3.1 Pre-hot work check. A pre-hot work check shall be conducted prior hot work operations to ensure that all equipment is safe and hazards are recognized and protected. A report of the check shall be kept at the work site during the work and available upon request. The pre-hot work check shall determine all of the following:

1. Hot work equipment to be used shall be in satisfactory operating condition and in good repair.

2. Hot work site is clear of combustibles or combustibles are protected.

3. Exposed construction is of noncombustible materials or, if combustible, then protected.

4. Openings are protected.

5. Floors are kept clean.

6. No exposed combustibles are located on the opposite side of partitions, walls, ceilings or floors.

7. Fire watches, where required, are assigned.

8. Approved actions have been taken to prevent accidental activation of suppression and detection equipment in accordance with Sections 4.1.8 and 4.1.9.

9. Fire extinguishers and fire hoses (where provided) are operable and available.

PART 5 – GAS WELDING AND CUTTING

5.1 General. Devices or attachments mixing air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall not be allowed unless approved.

5.2 Cylinder and container storage, handling and use. Storage, handling and use of compressed gas cylinders, containers and tanks shall be in accordance with this section.

5.2.1 Cylinders connected for use. The storage or use of a single cylinder of oxygen and a single cylinder of fuel gas located on a cart shall be allowed without requiring the cylinders to be separated when the cylinders are connected to regulators, ready for service, equipped with apparatus designed for cutting or welding and all of the following:

1. Carts shall be kept away from the cutting or welding operation or fire-resistant shields shall be provided.

2. Cylinders shall be secured to the cart to resist movement.

3. Carts shall be in accordance with Section 2703.10.3 of the 2009 IFC.

4. Cylinder valves not having fixed hand wheels shall have keys, handles or nonadjustable wrenches on valve stems while the cylinders are in service.

5. Cylinder valve outlet connections shall conform to the requirements of CGA V-1.

6. Cylinder valves shall be closed when work is finished.

7. Cylinder valves shall be closed before moving the cart.

5.2.1.1 Individual cart separation. Individual carts shall be separated from each other in accordance with Section 2703.9.8 of the 2009 IFC.

5.3 Precautions. Cylinders, valves, regulators, hose and other apparatus and fittings for oxygen shall be kept free from oil or grease. Oxygen cylinders, apparatus and fittings shall not be handled with oily hands, oily gloves, or greasy tools or equipment.

5.4 Acetylene gas. Acetylene gas shall not be piped except in approved cylinder manifolds and cylinder manifold connections, or utilized at a pressure exceeding 15 pounds per square inch gauge (psig) (103 kPa) unless dissolved in a suitable solvent in cylinders manufactured in accordance with DOT 49 CPR Part 178. Acetylene gas shall not be brought in contact with unalloyed copper, except in a blowpipe or torch.

5.5 Remote locations. Oxygen and fuel-gas cylinders and acetylene generators shall be located away from the hot work area to prevent such cylinders or generators from being heated by radiation from heated materials, sparks or slag, or misdirection of the torch.

5.6 Cylinders shutoff. The torch valve shall be closed and the gas supply to the torch completely shut off when gas welding or cutting operations are discontinued for a period of 1 hour or more.

5.7 Prohibited operation. Welding or cutting work shall not be held or supported on compressed gas cylinders or containers.

5.8 Tests. Tests for leaks in piping systems and equipment shall be made with soapy water. The use of flames shall be prohibited for leak testing.

PART 6 – ELECTRIC ARC HOT WORK

6.1 General. The frame or case of electric hot work machines, except internal-combustion-engine-driven machines, shall be grounded. Ground connections shall be mechanically strong and electrically adequate for the required current.

6.2 Return circuits. Welding current return circuits from the work to the machine shall have proper electrical contact at joints. The electrical contact shall be periodically inspected.

6.3 Disconnecting. Electrodes shall be removed from the holders when electric arc welding or cutting is disconnected for any period of 1 hour or more. The holders shall be located to prevent accidental contact and the machines shall be disconnected from all power source.

6.4 Emergency disconnect. A switch or circuit breaker shall be provided so that fixed electric welders and control equipment can be disconnected from the supply circuit. The disconnect shall be installed in accordance with NFPA 70.

6.5 Damaged cable. Damaged cable shall be removed from service until properly repaired or replaced.

PART 7 – CALCIUM CARBIDE SYSTEMS

7.1 Calcium carbide storage. Storage and handling of calcium carbide shall comply with Chapter 27 of of the 2009 IFC and Chapter 9 of NFPA 51.

PART 8 – ACETYLENE GENERATORS

8.1 Use of acetylene generators. The use of acetylene generators shall comply with this section and Chapter 6 of NFPA 51 A.

8.2 Portable generators. The minimum volume of rooms containing portable generators shall be 35 times the total gas- generating capacity per change of all generators in the room. The gas-generating capacity in cubic feet per change shall be assumed to be 4.5 times the weight of carbide per charge in

pounds. The minimum ceiling height of rooms containing generators shall be 10 feet (3048 mm). An acetylene generator shall not be moved by derrick, crane or hoist while charged.

8.3 Protection against freezing. Generators shall be located where water will not freeze. Common salt such as sodium chloride or other corrosive chemicals shall not be utilized for protection against freezing.

PART 9 – PIPING MANIFOLDS AND HOSE SYSTEMS FOR FUEL GASES AND OXYGEN

9.1 General. The use of piping manifolds and hose systems shall be in accordance with Section 9.2 through 9.7, Chapter 30 of the 2009 IFC and Chapter 5 of NFPA 51.

9.2 Protection. Piping shall be protected against physical damage.

9.3 Signage. Signage shall be provide for piping and hose systems as follows:

1. Above-ground piping systems shall be marked in accordance with ASME AI3.1.

2. Station outlets shall be marked to indicate their intended usage.

3. Signs shall be posted, indicating clearly the location and identify of section shutoff valves.

9.4 Mani-folding of cylinders. Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be located at least 20 feet away from combustible material such as oil or grease, and gas cylinders containing flammable gases, unless the gas cylinders are separated by a fire partition.

9.5 Identification of manifolds. Signs shall be posted for oxygen manifolds with service pressures not exceeding 200 psig (1379 kPa). Such signs shall include the words:

LOW-PRESSURE MANIFOLD
DO NOT CONNECT HIGH-PRESSURE CYLINDERS
MAXIMUM PRESSURE 250 PSIG

9.6 Clamps. Hose connections shall be clamped or otherwise securely fastened.

9.7 Inspection. Hoses shall be inspected frequently for leaks, burns, wear, loose connections or other defects rendering the hose unfit for service.

END OF SECTION 01141

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01270 UNIT PRICES

PART 1 – PAYMENT

1.01 The Contractor shall receive and accept compensation on the basis of the Contract unit price provisions set forth in Specification Section 00710 Article 4 of the Contract General Conditions, or of other specifications provided for the work.

1.02 In all cases of conflict between unit price and the amount shown on the Proposal Sheets, the unit price shall govern. The amount to be considered in the Proposal will be the product of the quantity shown multiplied by the unit price shown by the Bidder.

1.03 Payment procedures shall be as defined in Specification Section 00710 Article 4 Paragraph 4.2 of the Contract General Conditions.

1.04 Compensation to the Contractor as provided for in the Contract and as described above shall be full payment for completion of the Work as specified, indicated, or directed, and in full accordance with all provisions, stipulations, requirements, and conditions of the Contract; for completing all incidentals thereto; for furnishing all materials, equipment, tools, labor, and incidentals required to complete the Work; for cleaning up the site; and for all risk, loss, damage, or expense of whatever character arising out of the nature or performance of the Work.

1.05 If the "Payment" clause in the Specifications relating to any unit price in the Proposal Sheet(s) requires that the price of any Contract item cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other item which may appear elsewhere in the Specifications.

1.06 When the accepted quantities of Work vary from the quantities in the Proposal Sheet(s), the Contractor shall accept as payment in full, so far as Contract items are concerned, payment at the original Contract unit prices for the accepted quantities of Work done. No allowance will be made on any claim of the Contractor for extra compensation except as provided for in Specification Section 00710 Article 9 of the General Conditions.

END OF SECTION 01270

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 – PRECONSTRUCTION CONFERENCE

1.01 Within ten (10) working days after the Notice to Proceed, but before the Contractor starts the Work at the site, a conference attended by the Contractor, Owner and others as appropriate will be held to discuss the schedules referred to in Specification Section 00710, Articles 3, 4 and 15 of the Contract General Conditions to discuss procedures for handling Shop Drawings and other submittals and for processing the Application for Payment, and to establish a working understanding among the parties as to the Work.

END OF SECTION 01310

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01550 – VEHICULAR ACCESS AND PARKING

PART 1 – STREET NAME MARKERS AND TRAFFIC CONTROL SIGNS

1.01 Street name markers are to be maintained by the Contractor during the construction period. If construction requires removal of any street name markers, the Contractor shall temporarily reinstall the markers as near the intersections as possible. When construction is completed, the Contractor shall reinstall any markers removed at a location designated by the Owner, except that if the marker is a concrete post it shall be removed and disposed of by the Contractor.

1.02 All regulatory signs shall remain in service unless otherwise approved by the Owner. Existing STOP, YIELD, ONE WAY, DO NOT ENTER, TURNING PROHIBITION, and other regulatory signs are to be maintained by the Contractor during the construction period. All regulatory signs shall remain in service unless approved by the Owner. If any such signs must be removed or temporarily relocated during any phase of the construction, the Contractor shall notify the Owner and receive his approval before removing or relocating signs. The Contractor shall provide temporary signing to replace those removed or replaced as directed by the Owner. The contractor shall notify the Owner when construction has progressed to the point where any such signs removed or relocated can be returned to their proper locations.

1.03 The Contractor shall furnish, install, and remove any temporary parking restriction signs required for construction.

PART 2 – CONSTRUCTION TRAFFIC CONTROL DEVICES

2.01 Where any land or section of road, street, or highway is closed for construction operations of any type, or when traffic is to be maintained along a road, street, or highway under construction or affected by construction activities, or when any section thereof is opened to traffic prior to completion of all Work on the section, the Contractor shall protect the workers and provide for safe and convenient public travel by providing, erecting, and maintaining to the satisfaction of the Owner and in accordance with the Traffic Control Plan all signs, signals, markings, barricades, warning lights, flaggers, and other traffic control devices required for the type of operation being performed. Construction traffic control devices shall be provided by the Contractor according to the requirements of the Plans and Sections 02890 and 02891 of these Standard Construction Specifications.

2.02 Where detours are used, detour signing meeting the requirements of MUTCD shall be placed along the approaches and complete route of the detour and maintained for the course of the Work. Detour signing shall be included in and installed and maintained according to the Traffic Control Plan.

2.03 Closure of a road, street, or highway to all but local traffic will not relieve the Contractor of the responsibility to provide for safe and convenient public travel. The Contractor shall provide, erect, and maintain according to the Traffic Control Plan and to the satisfaction of the Owner, all traffic control devices necessary to protect the Work and to safeguard local traffic.

PART 3 - COMPENSATION

3.01 The expense to the Contractor in fulfilling the obligations of this Specification are considered as incidental to the Work of the Contract and no direct compensation will be allowed except that payment to the Contractor for traffic control devices used will be made by the Owner according to Sections 02890 and 02891 of these Standard Construction Specifications.

END OF SECTION 01550

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01551 TRAFFIC CONTROL FOR CONSTRUCTION WORK ZONES

PART 1 - SCOPE

This work shall consist of furnishing, erecting, illuminating, handling, and maintaining all construction signs (warning, regulatory, and guide), barricades, and other traffic control devices designated for installation at locations specified by the Plans or the approved Traffic Control Plan, or directed or approved by the Owner for the purpose of handling traffic safely through construction work zones. This work shall include the provision of flaggers or special measures necessary to assure the handling of traffic safety through construction work zones.

PART 2 - MATERIALS

2.01 GENERAL REQUIREMENTS

A. All signs, barricades, markers, lights, and other traffic control devices for use in construction work zones shall meet the requirements of Part VI of the Tennessee Manual on Uniform Traffic Control Devices (MUTCD). Materials used in the fabrication, construction, and installation of the construction signs, barricades, and other traffic control devices shall conform to the requirements of the MUTCD, the Plans, and the section of these Specifications as follows"

1. Signs	Specification Section 02891 Para. 2.02
2. Pavement Markings	Specification Section 02760 Para. 2.01
3. Drums, Cones, Barricades, Barriers, and Warning Lights	Specification Section 01550 Para. 2.02

B. Items are not required to be new. Used items may be acceptable provided the following conditions are met:

1. Units are in good repair, clean, and structurally sound.

2. Reflective sheeting on any unit is clean and in good repair.

3. All legends and messages are sharp, clean, and legible.

4. Reflectivity of said units during the hours of darkness shall provide acceptable, clean and uniform delineation without dead spots.

C. No test reports are required, but the Owner will visually inspect all units and accessories for compliance with the various dimensional and material stipulations noted before approving their use in the work. The approval of any unit for use is subject to satisfactory field performance and does not preclude the Owner ordering replacements for deteriorated, damaged or otherwise unsatisfactory performance of units; said replacements for these previously approved units shall be without additional compensation.

2.02 CHANNELIZING AND WARNING DEVICES.

Reflectorization of channelizing and warning devices shall be accomplished using materials meeting the requirements of Specification Section 02891 Paragraph 2.02 F.

A. Traffic Cones.

Traffic cones and tubular markers shall be a minimum of 18 inches in height with a broadened base and shall be made of materials to withstand impact without damage to themselves or to vehicles. Orange shall be the predominant color on cones and tubular markers. For nighttime use they shall be reflectorized or equipped with lighting devices for maximum visibility. The design of traffic cones and tubular markers shall be according to the requirements of Section 6C of the MUTCD.

B. Vertical Panels.
Vertical panels used as channelizing or warning devices shall be 8 to 12 inches in width and a minimum of 24 inches in height. They shall be orange and white striped and reflectorized. The design or vertical panels shall be according to Section 6C of the MUTCD.

C. Drums.
Drums used for traffic warning or channelization shall be approximately 36 inches in height and a minimum of 18 inches in diameter. The markings shall be horizontal, circumferential, orange and white reflectorized stripes meeting the requirements of Section 6C of the MUTCD.

D. Barricades.
A barricade is a portable or fixed device having from one to three rails with alternate orange and white reflectorized stripes used to control traffic by closing, restricting, or delineating all or a portion of the right-of-way. Barricades shall be of one of three types: Type I, Type II, and Type III. The characteristics and design of each type of barricade shall be according to Section 6C of the MUTCD.

E. High Level Warning Devices.
High level warning devices are used to supplement other controls and warning devices and are designed to be seen over the top of preceding vehicles. They shall consist of an orange diamond and three flags. The lowest point of all three flags shall be no less than 8 feet above the roadway. The design shall be according to the requirements of Section 6C of the MUTCD.

F. Warning Lights.
As used herein, warning lights are portable, lens directed, enclosed lights. The color of the light emitted shall be yellow. They may be used either in a steady burn or flashing mode. Warning lights shall be in accordance with the current requirements of ITE Standard for Flashing and Steady Burn Warning Lights (Table 01551-1) and Section 6E of the MUTCD.

TABLE 01551-1

WARNING LIGHTS

	Type A Low Intensity	Type B High Intensity	Type C Steady Burn
Lens Directional Faces	1 or 2	1	1 or 2
Flashing Rate per Minute	55 to 75	55 to 75	Constant
Flash Duration[1]	10%	8%	Constant
Minimum Effective Intensity[2]	4 Candelas	35 Candelas	
Minimum Beam Candle Power[2]			2 Candelas
Hours of Operation	Dusk to Dawn	24 hrs/day	Dusk to Dawn

[1] Length of time that instantaneous intensity is equal to or greater than effective intensity.
[2] These values must be maintained within a solid angle 9^0 on each side of the vertical axis and 5^0 above and 5^0 below the horizontal axis.

2.03 OTHER CONSTRUCTION TRAFFIC CONTROL DEVICES.
Other construction traffic control devices may be required for a project by the Traffic Control Plan or by the Owner including, but not limited to, illumination of signing, illumination of the work zone, provision of special

signs, provision of special lighted variable message signs and advance warning flashing or sequencing arrow panels, and installation of portable concrete or metal barriers. The requirements for such special traffic control devices shall be included in the Plans or Special Provisions for the Project.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 GENERAL REQUIREMENTS.

A. A Traffic Control Plan shall be developed by the Owner or Contractor and approved by the Owner before any road, street, or highway, or any section or lane thereof is closed to traffic and construction operations that will for any reason render the roadway generally unsuitable for use of the traveling public are started. Where the Plans and Contract Documents for projects involving roads, streets, and highways do not specify a Traffic Control Plan, and where so required by the Contract Documents, the Contractor shall prepare and submit to the Owner for approval a Traffic Control Plan for the project which shall include, but not be limited to, signing; application and removal of pavement markings; construction; scheduling; closure of streets or lanes; detours; methods and devices for delineation and channelization; placement and maintenance of devices for delineation and channelization; roadway lighting; traffic regulations; and surveillance and inspection. The Traffic Control Plan shall define in detail the sequence of construction and the proposed number, type, color, size, and placement of construction traffic control devices for each construction phase, all in accordance with Part VI of the Tennessee Manual on uniform Traffic Control Devices for Streets and Highways (MUTCD).

B. The Contractor shall designate or otherwise provide personnel to furnish continuous surveillance over his traffic control operations. This designee will also be available at night to respond to calls involving damage to barricades, lights, signs, and similar items, either through vandalism or traffic accident. The Contractor shall make known the name of the person providing the surveillance at the preconstruction conference.

C. All traffic control devices necessary for the first stage of construction shall be properly placed and in operation before any construction is allowed to start. When work of a progressive nature is involved, such as resurfacing a road under traffic, the necessary signs shall be moved concurrently with advancing operation.

D. All construction signs shall be erected such that all supports are vertical, sign panels generally perpendicular to the travelway and legends horizontal so that they effectively convey the intended message. These signs shall be mounted on stationary or temporary supports as directed by the Owner and dependent on the type work being performed. In general, work being performed at spot locations and of short duration will necessitate the use of temporary supports properly weighted for stability. If the construction signs are not to be lighted, the supports shall not extend above the top edge of the sign panel.

E. The location, horizontal and vertical placement with respect to the pavement, legends, sheeting, dimensions, and spacing of supports of warning signs, barricades, and other traffic control devices shall be as required by the Plans, the Traffic Control Plan, the MUTCD, and as directed or approved by the Owner. The Contractor must advise and have the approval of the Owner prior to installing or removing traffic control devices from the project.

F. During periods of nonuse, construction signs and other devices shall be removed from the work area, or covered with opaque material, or otherwise positioned so they do not convey their message to the traveling public. If covered, the covering material shall be installed in accordance with the Plans and in such manner that no damage will occur to the sign panel during installation. Covering material shall be maintained in a neat manner during its use.

G. All construction signs, barricades, and other devices which require lighting, as designated by Plans or directed by the Owner, shall be provided with warning lights or electric incandescent or

fluorescent lighting. It will be the Contractor's responsibility to install electric lighting in a safe manner and in accordance with the latest edition of the National Electrical Code, National Electrical Safety Code, and/or all local codes. The Contractor will be responsible for investigating, procuring, and bearing the expense of a continuous power source whether by battery, generator, or commercial A.C. supply.

H. Flaggers with proper attire and flags shall be provided when ordered by the Owner or when the Contractor deems flaggers necessary to safely handle traffic through the construction zone. Flaggers shall wear either an approved uniform or a vest of fluorescent orange color an be equipped with either a red flag of fluorescent material or a paddle with a reflective red and white STOP sign on one side and a reflective orange and black SLOW sign on the other side. Flaggers are considered a general requirement of all traffic control schemes and no direct payment will be made for such.

I. If at any time the Owner determines that proper provisions for safe traffic control are not being provided or maintained, he may order suspension of the work until the proper level is achieved. In cases of serious or willful disregard for safety of the public or his employees by the Contractor, the Owner may proceed forthwith to place the traffic control measures in proper condition and deduct the cost thereof from payment due or becoming due the Contractor.

3.02 MAINTENANCE

A. The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades, and other traffic control devices. Maintenance shall include but shall not be limited to replacement of sign panels, barricades, and other devices which in the opinion of the Owner are damaged or deteriorated beyond effective use; replacement of broken supports; plumbing of leaning signs; cleaning of dirty signs, barricades, and other devices; repair of defaced signs; and replacement of stolen items.

B. All items used for traffic control shall be generally maintained in its original placement condition and such maintenance will be considered a part of the original installation cost. Failure to maintain all traffic control devices in such manner as to provide adequate continuous safety to the public will be cause for action by the Owner as noted in Specification Section 01551 Paragraph 3.01.I.

PART 4 – MEASUREMENT

Each accepted item related to traffic control for construction work zones shall be measured as described herein. All work not described herein shall be considered incidental to the provision of traffic control for construction work zones.

4.01 TRAFFIC CONTROL PLAN.
Development of a Traffic Control Plan for the construction work zone will be paid for on a lump sum basis and no measurement will be made.

4.02 TRAFFIC CONTOL DEVICES FOR CONSTRUCTION WORK ZONES.
Furnishing, erecting, and maintaining traffic control devices and other incidentals and personnel required for handling traffic safely through construction work zones will be paid for on a lump sum basis and no measurement will be made.

PART 5 – PAYMENT

Payment for accepted work shall be made at the appropriate contract price which shall be payment in full for all work required under the pay item. Payment will be made under the pay items listed at the end of this Specification Section.

5.01 TRAFFIC CONTROL PLAN.

Payment will be made for the work completed and accepted by the Owner at the contract lump sum price, which shall be full compensation for development of a Traffic Control Plan.

5.02 TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES.

A. Payment will be made for the work completed and accepted by the Owner at the contract lump sum price, which shall be full compensation for furnishing, erecting, illuminating, handling, and maintaining all construction signs (warning, regulatory, and guide), barricades, and other traffic control devices designated for installation at locations specified by the Plans, the Traffic Control Plan, or directed or approved by the Owner for the purpose of handling traffic safety through construction work zones for the duration for the project. Payment shall also include provision for flaggers or special measures necessary to assure the handling of traffic safely through construction work zones.

B. Payment will be made under:

Item No.	Pay Item	Pay Unit
01551-5.01	TRAFFIC CONTROL PLAN	Lump Sum
01551-5.02	TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES	Lump Sum

END OF SECTION 01551

SECTION 01570 TEMPORARY CONTROLS

PART 1 – MAINTENANCE OF WATER COURSES AND SURFACE DRAINAGE

1.01 Where the Work contemplated in the Contract intercepts or in any way affects any stream, ditch, drain, or culvert, the Contractor shall, where necessary, arrange for keeping the same open by rebuilding, repairing, or extending the same or by building drains, culverts, or other structures of approved materials. Unless otherwise provided for in the Plans and Contract Documents, the expense to the Contractor in fulfilling the obligations of this Section 01570 are incidental to the Contract, and no extra compensation will be allowed.

END OF SECTION 01570

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01580 – PROJECT IDENTIFICATION

PART 1 – PROJECT SIGNS

1.01 From the time that construction begins until the Project is completed, the Contractor shall provide a sign at each end of the Project, clearly visible to the public. The sign shall be constructed and shall provide project information as shown in the Design Standards. The sign shall be maintained in a suitable and acceptable condition, as determined by the Owner, for the duration for the project.

END OF SECTION 01580

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01610 – BASIC PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 All materials and permanently installed equipment (for example, traffic signalization equipment, sewer pumps, and other such items) furnished by the Contractor for the Work shall conform to the requirements of the Plans and Contract Documents, including the applicable City of Memphis Standard Construction Specifications and Design Standards.

1.02 Throughout the entire Project, all units of any one item of installed equipment shall be of the same manufacture and model unless otherwise approved by the Owner.

PART 2 – EQUIVALENT MATERIALS AND EQUIPMENT

2.01 Section 00710 Article 5 of the Contract General Conditions allows for the substitution of equivalent materials and equipment, with the written approval of the Owner.

2.02 Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of materials and equipment required for the Work. It is not intended to exclude products equivalent in quality and similar in design. Whenever any article, material, or equipment is identified by using the name of a manufacturer or vendor, the term "or approved equal" if not inserted shall be implied.

2.03 If the Contractor proposes to furnish materials or supplies other than those specified, he shall furnish complete descriptive data, including performance capabilities, specifications, and other data as required in Section 00710 Article 5 of the Contract General Conditions. The provisions of this substitution of materials shall not relieve the Contractor of the responsibility of meeting the requirements of the Plans and Contract Documents. All materials must be approved by the Owner before any installation will be permitted.

PART 3 – LIST OF MAJOR EQUIPMENT AND MATERIALS

3.01 The Contractor shall submit to the Owner for approval, with due promptness after award of Contract but in no case later than at the preconstruction conference, a list of major equipment and materials which he proposes to provide. The list shall include in sufficient detail to identify the materials, the name of the manufacturer's model number of all material that is identified on the Plans or in the Contract Documents, including catalog literature for standard equipment and detailed scale drawings of any nonstandard or special equipment and of any proposed deviation from the Plans. A signed statement shall accompany this list stating that materials and equipment are in exact accordance with Project specifications. No charge shall be made to the Owner for any materials or equipment purchased, labor performed, or delay to the Work prior to approval of materials by the Owner.

PART 4 – SOURCE OF SUPPLY

4.01 The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Owner before delivery is started.

PART 5 – SAMPLES AND TESTING

5.01 Representative samples of materials included for incorporation in the Work shall be submitted to the Owner for his examination and/or testing when so specified or requested.

5.02 All testing of materials shall be made in accordance with the standard methods of testing of the ASTM, AASHTO, NEMA, ITE, or other applicable standard specifications.

PART 6 – PROPOSAL QUANTITIES

6.01 The quantities appearing in the Proposal Sheet(s) of the Proposal are approximate and are proposed and shown for the comparison of bids and award of a Contract except that quantities shown on the Proposal Sheet(s) for Item No. 02315-01, Excavation (Unclassified) and Item No. 02330-01, Embankment (Unclassified) are absolute unless a Plans change is made. For all other items of construction, the Owner does not guarantee or assume any responsibility that the quantities indicated on the Plans or in the Proposal will hold true and accurate in the construction of the Project. The Contractor shall not plead deception or misunderstanding because of variation from these quantities. Unless otherwise provided in the Contract Documents, payment to the Contractor will be made only for the actual quantities of Work performed and accepted, and materials and equipment furnished and placed in accordance with the Contract. The Contractor is reminded of the limitation provided by Section 838 of the Charter of the City of Memphis which limits the total amount of the increase in the Contract Price, for any reason, to ten (10) percent of the original Contract award amount. There are no specific limitations on the amount by which the Contract Price and project quantities may be decreased.

PART 7 – MEASUREMENT

7.01 Measurement of Quantities

A. All Work completed under the Contract will be measured by the Owner according to United States standard measure.

B. The term “ton” will mean the short ton consisting of 2,000 pounds avoirdupois.

C. The determination of quantities for specific items will be made as set for the in the subsection titled “Measurement” under the applicable Sections of the Standard Construction and Material Specifications hereof, or of other Specifications provided for the Work.

D. Longitudinal and transverse measurements for surface area computations will be to the exact dimensions shown in the horizontal plane on the Plans or as ordered in writing by the Owner.

E. Structures will be measured according to the lines and exact dimensions shown on the Plans or as altered to fit field conditions by direction to the Owner.

F. In all cases where measurement of materials is based on certified weights, the Contractor shall furnish the Owner certified weigh bills showing the net weight of materials received in each shipment. In no instance will the Owner pay for materials in excess of the amounts represented by the certified weigh bills.

G. When certified scale weights are not used for measurement, all materials which are measured or proportioned by weight shall be weighed on accurate, approved scales, by competent, qualified personnel, at locations designated by the Owner.

H. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the Owner directs, and each truck shall bear a plainly legible identification mark.

I. Measurements for payment will be made to the nearest fractional units specified below, unless otherwise specified herein or in the Contract Documents for the project.

Unit of Measurement	Nearest Unit
Linear Foot	0.1 LF
Square Foot	0.1 SF
Square Yard	0.1 SY
Ton	0.1 Ton
Cubic Yard	0.01CY
1,000 SF Unit	0.1 Unit

END OF SECTION 01610

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01710 SITE EXAMINATION

PART 1 – INSPECTION OF SITE

1.01 Each Bidder shall inspect and carefully examine the site of the Work, including the surrounding terrain and access facilities, before submitting a Proposal. He shall also examine in detail the Plans, Specifications and all other documents making up the Proposal which cover the Work. During the site visit, he shall fully inform himself as to all existing conditions and limitations and shall include, in the unit prices of the Proposal, sums to cover the cost of all items contemplated by the Plans as required by the conditions existing on the site. It is mutually agreed that submission of a Proposal shall be considered prima facie evidence that the Bidder has made such examinations and has fully familiarized himself with the character, quality, and quantity of Work to be performed, and of the materials to be furnished. Reference if made to Section 00710, Article 10 of the Contract General Conditions for other requirements relating to the Contractor and the site of the Work.

PART 2 – PHYSICAL CONDITIONS

2.01 The Contractor shall have full responsibility with respect to subsurface conditions at the site.

2.02 EXISTING STRUCTURES.

Reference is made to the Supplemental Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities covered later in this section) which are at or contiguous to the site that have been utilized by the Owner in preparation of the Contract Documents. The Contractor shall have full responsibility with respect to physical conditions in or relating to such structures.

A. Report of Differing Conditions: If the Contractor believes that:

1. Any technical data on which the Contractor is entitled to rely as provided for in paragraph 2.02 is inaccurate, or

2. Any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents,

The Contractor shall, promptly after becoming aware thereof and before performing any Work in connection therewith (except in an emergency as permitted by Section 00710 Article 12.4 I of the Contract General Conditions) notify the Owner in writing about the inaccuracy or difference.

B. Owners Review: The Owner will promptly review the pertinent conditions and determine the necessity of obtaining additional explorations or tests with respect thereto.

C. Possible Document Change: If the Owner concludes that there is a material error in the Contract Documents a Change Order may be issued as provided in 00710, Article 9, of the Contract General Conditions to reflect and document the consequences of the inaccuracy or difference.

D. Possible Price and Time Adjustments: In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are authorized by law and approved by the Owner.

2.03 UNDERGROUND FACILITIES.

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to the Owner by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. The Owner shall not be responsible for the accuracy or completeness of any such information or data; and,

2. The Contractor shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof as provided in Section 00710 Article 12.4.and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

B. Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which Contractor could not reasonably have been expected to be aware of, Contractor shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by Section 00710 Article 12.4l), identify the owner of such Underground Facility and give written notice thereof to that owner and to the Owner. The Owner will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, the Contractor shall be responsible for the safety and protection of such Underground Facility as provided in Section 00710 Article 12.4. The Contractor may be allowed an increase in the Contract Price or and extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and of which the Contractor could no reasonably have been expected to be aware. If the parties are unable to agree as to the amount or length thereof, the Contractor shall follow the procedures in Section 00710 Article 11.2.

END OF SECTION 01710

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01720 SITE PREPARATION

PART 1 – REFERENCE POINTS

1.01 The Owner shall provide engineering surveys to establish reference points for construction which in the Owner's judgment are necessary to enable the Contractor to proceed with the Work. The Contractor shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of the Owner. The Contractor shall report to the Owner whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

PART 2 – SURVEYING AND STAKING

2.01 The responsibilities of the Owner and the Contractor for the surveying and staking necessary for the construction of Project facilities shall be as defined herein unless otherwise defined in the contract Documents.

2.02 The Owner will provide all surveying necessary to establish the horizontal and vertical control of the Project including the setting of monuments and benchmarks for such control.

2.03 The Contractor will provide all construction survey and staking necessary for layout and construction from the control point provided by the Owner, which shall be considered incidental to the work of the Contractor.

2.04 All surveying and staking provided by the Owner will be furnished one time only unless otherwise provided in the Contract Documents. The Contractor shall be responsible for protecting and preserving all such surveys provided by the Owner, including monuments, benchmarks, survey stakes, reference points, or other survey markers and shall be required to bear the expense of replacing or resetting same if damaged or destroyed by other than Owner forces.

2.05 The Contractor will provide all surveying and staking necessary to establish or re-establish property corners as directed by the Owner. Property corners will be established when the project has required the taking of right-of-way. Property corners will be re-established when the area of the property corner has been disturbed during construction, whether or not a property corner marker existed prior to construction. The establishment of a property corner means that a property corner is to be set in accordance with standard surveying practices and conventions. The property corner shall be marked with either a crow's foot in either the top of the curb or the back of the sidewalk on the property line where the property line is adjacent to curb and gutter construction or by the setting of a ½" diameter or larger, minimum 18 inches long, recessed iron pin. The establishment of the property corners must be performed under the supervision of a Registered Land Surveyor licensed to practice surveying in the State of Tennessee.

END OF SECTION 01720

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 01740 SITE CLEANING

PART 1 – CLEANING UP / DISPOSAL OF DEBRIS

1.01 Before final acceptance of the Work, all rights-of-way, easements, material pits, waste areas, and access roads used by the Contractor, all streams in and over which he has worked, and all ground occupied by the Contractor in connection with the Work shall be cleaned of all debris, construction plant, and materials.

1.02 Clean up shall include the Work described in Section 01140 Paragraph 1.02 of the General Requirements.

1.03 Right-of-way and easement areas not designated for alteration by the Contract Documents shall be restored to their original condition, in accordance with the Plans and Specifications.

1.04 Waste and debris shall be disposed of in areas outside of the rights-of-way and easements and provided by the Contractor, unless otherwise stipulated in the Plans or Contract Documents or allowed by the Owner. Where the Owner has granted permission to dispose of waste and debris within the right-of-way, the Owner will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance of the completed Project.

1.05 Disposal of waste or debris in active public waste or disposal areas will not be permitted without prior approval of the Owner.

1.06 Burning of debris will be allowed only with the written permission of the Owner and acquisition of a permit from the Memphis and Shelby County Health Department by the Contractor. If perishable material is burned, it shall be burned under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

1.07 No direct payment will be made to the Contractor for the Work under this Section (01740). Payment at the Contract prices for the various items in the contract will be full compensation for all Work covered by this Section.

END OF SECTION 01740

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATION
SECTION 02220 SITE DEMOLITION

PART 1 – SCOPE

1.01 This work shall consist of the removal and satisfactory disposal of all buildings, structures, old pavements, fences, and abandoned pipe lines. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits; the preservation from injury or defacement of all vegetation and objects designated to remain; and all necessary replacement of fences, trees, hedges, shrubs, and flowers.

PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the Work shall be on the project and approved before the Work will be permitted to begin.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

A. The Contractor shall raze, remove, and dispose of all buildings, foundations, bridges, drainage structures, curbs, curbs and gutters, pavements, sidewalks, and other obstructions not covered under Specification Section 02230 Paragraph 3.01 except for those for which other provisions have been made. Demolition of buildings shall be done in accordance with all applicable sections of the City Building Code.

B. Structures and obstructions shall be removed to a depth of not less than one (1) foot below natural ground except that within construction limits removal shall be to a depth of not less than two (2) feet below subgrade elevation. Basement floors shall be broken up to prevent holding of water and bridges and drainage structures shall be removed or broken up in a manner to prevent voids below subgrade elevation, and the cavities left shall be filled to the level of the surrounding ground and compacted in accordance the provisions of Specification Section 02335 Paragraph 3.01. With the approval of the Owner, sewer and drainage pipes and structures may be abandoned in place and filled with sand or grout. Any blasting or other operations necessary for the removal of an existing structure or obstruction which may damage new work shall be completed prior to placing the new work. Where property line adjustments are required by the Work, existing fencing shall be removed from the original property lines, replaced with in-kind fencing along the new property lines, and tied back to the old fence.

C. When specified on the Plans or Right-of-Way Agreement or so directed by the Owner, all fences removed for construction purposes shall be replaced with salvaged existing materials or with acceptable in-kind new materials to enclose the original enclosed area as nearly as possible and tie back to the old fence.

D. When specified on the Plans, trees, hedges, shrubs, flowers, or other growth shall be replaced or substituted for in-kind as nearly as possible to its original position, and growth established at the completion of the contract.

E. All pavements, base courses, sidewalks, curbs, gutters, and other improvements designated for removal shall be removed and the material disposed.

F. All salvageable pipe, frames and grates, manhole rims and covers, precast manhole sections, cobblestones, or granite curbs shall be carefully removed and every precaution taken to avoid damage. These salvaged items shall be taken to Collins Yard or other designated storage locations as directed by the Owner.

3.02 DISPOSAL OF DEBRIS

A. All material from removal of structures and obstructions except salvaged items shall be disposed of off the Project and it shall be the Contractor's responsibility to secure any permits necessary for the disposal.

PART 4 – MEASUREMENT

4.01 A. This item will be paid from a lump sum basis and no measurement will be made.

PART 5 – PAYMENT

5.01 Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price will be full compensation for removal and disposal of structures and obstructions; backfilling of depressions below subgrade elevation, protection of trees to remain; restoration of fences, trees, hedges, shrubs, flowers, or other growth as required; and moving salvageable materials to designated storage locations in accordance with the stipulations and provisions of the contract.

5.02 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02220.01	Removal of Obstructions and Structures	Lump Sum

END OF SECTION 02220

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02230 SITE CLEARING

PART 1 – SCOPE

1.01 This work shall consist of clearing and grubbing, removal, and disposal of all vegetation and debris within the limits of the rights-of-way and easement areas. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits; the preservation from injury or defacement of all vegetation and objects designated to remain; and all necessary replacement of fences, trees, hedges, shrubs, and flowers.

PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the Work shall be on the project and approved before the Work will be permitted to begin.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 CLEARING AND GRUBBING

A. The Owner will establish rights-of-way lines and construction limits. All trees, shrubs, edges, fences, and other items to remain shall be as indicated on the Plans or as directed by the Owner.

B. The rights-of-way shall be cleared of all vegetation and debris except items designated to remain. All other trees, stumps, roots, brush, hedges, and other protruding obstructions within the excavation area shall be completely grubbed. In embankment areas, sound undisturbed stumps and roots which will be a minimum of five (5) feet below subgrade or slope of embankment will be allowed to remain in place provided undercutting or other corrective measures are not stipulated in the plans or directed by the Owner and providing stumps do not extend more than six (6) inches above the ground surface. If excavation is not required, the area shall be grubbed to a minimum depth of six (6) inches below existing grade to remove grass, roots, and other organic material.

C. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed by the Owner. Tree limbs and branches shall be trimmed to provide twenty (20) feet vertical clearance over the entire right-of-way. All trimming shall be done by skilled workmen in accordance with good tree surgery practices, and cut or scarred surfaces of trees or shrubs to remain shall be treated with an approved asphalt base paint prepared especially for tree surgery.

D. Within embankment areas, all depressions resulting from grubbing operations shall be backfilled with suitable material and left uniform. All depressions in excavation areas below subgrade elevation shall be backfilled with suitable material and compacted in accordance with the provisions of Specification Section 02315.

E. When specified on the Plans or Right-of-Way Agreement or so directed by the Engineer, all fences removed for construction purposes shall be replaced with salvaged existing materials or with acceptable in-kind new materials to enclose the original enclosed area as nearly as possible and tie back to the old fence.

3.02 DISPOSAL OF DEBRIS

A. All material from removal of structures and obstructions except salvaged items shall be disposed of off the Project and it shall be the Contractor's responsibility to secure any permits necessary for the disposal.

PART 4 – MEASUREMENT

4.01 A. This item will be paid from a lump sum basis and no measurement will be made.

PART 5 – PAYMENT

5.01 Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price will be full compensation for clearing and grubbing vegetation; removal and disposal of vegetation, debris, backfilling of depressions below subgrade elevation, protection of trees to remain; restoration of fences, trees, hedges, shrubs, flowers, or other growth as required; and moving salvageable materials to designated storage locations in accordance with the stipulations and provisions of the contract.

5.02 Payment will be made under:

Item No.	Pay Item	Pay Unit
02230-01	Clearing and Grubbing	Lump Sum

END OF SECTION 02230

SECTION 02447
EROSION CONTROL MEASURES

PART I - GENERAL

1.01 DESCRIPTION

A. This item shall consist of temporary control measures as shown on the plans or as directed by TDEC, the Construction Manager, or the Engineer throughout the construction and post construction period to control water pollution, and siltation through the use filter bags, silt fences, rock silt screen, erosion control blanket, filter sock, and other erosion control devices or methods.

PART 2 - MATERIALS

2.01 DEWATERING BAG

Dewatering bags for trench dewatering shall be a Dandy Products “Dandy Dewatering Bag” orapproved equal.

2.02 FILTER SOCK

Filter Sock shall be Erosion Tech “Excelsior Sediment Logs” 12 in. dia. or approved equal.

2.03 OTHER

All other materials shall meet commercial grade standards, meet the standards of the latest edition of the Tennessee Erosion & Sediment Control Handbook, and shall be approved by the Purchaser before being incorporated into the project.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 EQUIPMENT

A. All equipment necessary for the satisfactory performance of this work shall be on the project and approved, before work will be permitted to begin.

3.02 GENERAL

A. Excavation, trenching, backfilling, and grading operations to elevations as needed to meet the requirements shown on the Contract Documents, shall be done in such a manner as to cause the least amount of soil erosion and siltation.

B. The Contractor shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

C. If site earthwork is halted for more than 14 days on any disturbed areas, the Contractor shall temporarily stabilize the area until earthwork resumes at no extra cost to the Purchaser.

3.03 EXECUTION

A. Excavation, trenching, backfilling, and grading operations to elevations as needed to meet the requirements shown on the Contract Documents, shall be done in such a manner as to cause the least amount of soil erosion and siltation.

B. Appropriate erosion and sediment control measures shall be in place before any clearing of vegetation or other earth moving operations begin.

C. Provisions required to maintain uninterrupted surface water flow shall be maintained during the work. Storm water flow in existing gutters, surface drains, and swales shall not be interrupted.

D. The Purchaser shall be notified of any unexpected subsurface or other unforeseenconditions. Work shall be discontinued until the Purchaser provides notification to resumework.

E. Erosion and sediment control shall be in accordance with the Tennessee Water Quality Control Act of 1977, as amended, and the Federal Act Pl 92-59.

F. The Tennessee Department of Conservation Publication, Tennessee Erosion & Sediment Control Handbook, latest revision, shall be used as a guide for construction of projects that require erosion and sediment controls to protect adjoining property and waters of the state.

G. Whenever possible, a buffer strip of vegetation cover shall be kept adjacent to grading operations.

H. All surface water flowing toward the construction area shall be diverted around the area as much as possible to reduce erosion potential by using beams, channels, and/or sediment traps as necessary.

I. Erosion control measures shall be removed when they have served their useful purpose. The disturbed soil shall be fine graded, top soiled, and planted with permanent vegetationas soon as the construction sequence allows to prevent further potential erosion and sedimentation. Any seeded areas which are eroded shall be reworked as soon aspossible.

II. A vegetation buffer strip shall be maintained between any stream and pipe trenching. Excavated material from the trench shall not be placed between the trench and stream.

III. Erosion control measures shall be removed when they have served their useful purpose. The disturbed soil shall be fine graded, top soiled, and planted with permanent vegetationas soon as the construction sequence allows to prevent further potential erosion and sedimentation. Any seeded areas which are eroded shall be reworked as soon aspossible.

IV. Outside of the work areas identified on the plans, the Contractor shall submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Purchaser.

V. Regardless of the erosion control measures shown on the plans, it is the Contractor's sole responsibility to ensure that no water of objectionable color or quality leaves the construction site. Water from all sources shall have sediment removed before leaving the construction site. In the event of inadequate results from the erosion control measures being employed by the Contractor, additional measures above and beyond those shown on the plans will be employed until adequate results are reached.

3.04 CONSTRUCTION DETAILS

A. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Purchaser, such work shall be performed by the Contractor at his/her own expense. No additional payment will be made for maintenance or reinstallation of erosion control features installed for this contract.

B. Temporary pollution control may include work outside the construction limits such as haul roads, equipment and material storage sites and temporary plant sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.

C. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

D. Sediment basins, if required, shall be treated by the use of flocculation. The contractor shall use Applied Polymer Systems (APS) APS 700 Floc Logs. Floc Logs must meet the requirements of the TN CGP as well as any and all TDEC requirements. Floc Logs shall be placed in drainage structures 8 and 33 at a minimum. Floc Logs shall be tethered within structure to allow for natural agitation within the drainage structure during a rain event. All flocculation shall be complete within 24 hours of a rain event. Sediment basin shall not be dewatered prior to the 24-hour flocculation period. Sediment basin shall be dewatered such as to restore the water level to the wet storage elevation as depicted on the plans. Contractor shall excavate flocculated sediment from the sediment basin regularly to ensure that basin maintains adequate storage for future rain events. Contractor shall coordinate with APS to determine the proper application rate based on the soils found on the project site. Application rates shall be approved by the Purchaser

PART 4 – NOT USED

PART 5 – METHOD OF MEASUREMENT

5.01 SILT FENCE WITH BACKING

A. Slit fence will be measured per linear foot placed in accordance with the plans andspecifications and as directed by the Purchaser.

5.02 CONSTRUCTION EXITS

A. Construction exits will be measured per each placed in accordance with the plans andspecifications and as directed by the Purchaser.

5.03 ROCK CHECK DAMS

A. Rock Check Dams will be measured per each placed in accordance with the plans andspecifications and as directed by the Purchaser.

5.04 HIGH VISIBILITY FENCE

A. High visibility fence will be measured per linear foot placed in accordance with the plansand specifications and as directed by the Purchaser

6.01 SILT FENCE WITH BACKING

A. Silt fence will be paid for at the contract unit price per foot, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, posts, fasteners, backing, trenching, backfill, compaction, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required

6.02 CONSTRUCTION EXITS

A. Construction exits will be paid for at the contract unit price per each, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, rock, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required.

6.03 ROCK CHECK DAMS

A. Rock check dams will be paid for at the contract unit price per each, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, rock, trenching, backfill, compaction, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required.

6.04 HIGH VISIBILITY FENCE

A. High visibility fence will be paid for at the contract unit price per foot, which price shall be full compensation for furnishing, installing, and maintaining all fabric, posts, fasteners, removal at the conclusion of the project, and all other appurtenant work as required.

6.05 PAYMENT WILL BE MADE UNDER

Item No.	Pay Item	Pay Unit
02447-6.01	SILT FENCE WITH BACKING	LF
02447-6.02	CONSTRUCTION EXITSROCK CHECK	EACH
02447-6.03	ROCK CEHCK DAMS	EACH
02447-6.04	HIGH VISIBILITY FENCE	LF

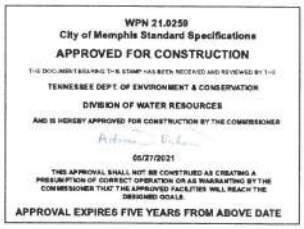
END OF SECTION 02447

CITY OF MEMPHIS

STANDARD CONSTRUCTION SPECIFICATIONS FOR SANITARY SEWERS AND APPURTENANCES

Issued for State approval

Prepared by: City of Memphis
Division of Engineering
Sewer Design Department



Faraedoon Qaladize
Sewer Design Engineer

City of Memphis Division of Engineering
125 N. Main Street., Room 644
Memphis, TN 38103

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02530 SEWER PIPE INSTALLATION

PART 1 - SCOPE

1.01 This Work will consist of the construction of sanitary sewers, siphons, and service connections of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished by these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Without specifications that state the quality of any work, the Contractor is required to perform such items using first-quality construction. Unless otherwise provided, the Contractor will furnish all material, equipment, tools, labor and incidentals necessary to complete the Work.

1.02 The Engineer may change the Plans, Specifications, character of work or quantity of work, provided the cost of the changes does not exceed 10% of the contract price.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. Construction Material

1. All material furnished by the Contractor will be new, high quality and free from defects. Previously used material in acceptable condition may be used for bracing, forms, false work, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

B. Higher Strength Pipe

1. The Contractor may substitute a higher strength pipe of the same type as that specified subject to the approval of the Engineer.

C. Qualifications of Manufacturers

1. Pipe for sanitary sewers will be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Contractor will be subject to approval by the Engineer. No material will be delivered until the manufacturer and product have been approved by the Engineer. For any construction project, pipe and appurtenances for each pipe material shall be the product of a single manufacturer having a minimum of 10 years domestic experience producing the type of pipe supplied.

D. Material Inspection and Testing

1. Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested. All material to be used in the work will be sampled, inspected, and tested by current ASTM specifications, or other standard specifications. The Contractor will furnish the Engineer with three copies of certified reports from an accredited testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each length of pipe delivered to the project will show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Contractor.

2. The Contractor will notify the Engineer before any deliveries of material and will make whatever provisions are necessary to aid the Engineer in the inspection and culling of the material before installation.

E. Storage

1. The Contractor will provide and maintain storage facilities and exercise such measures to maintain the specified quality and fitness of material to be incorporated in the work. The interior and sealing surfaces of the pipe, fittings and adapters will be kept free from dirt and foreign matter. PVC pipe, fittings, and adapters stored outside and exposed to sunlight will be covered with an opaque material with proper ventilation.

F. Prestressed Concrete Cylinder Pipe

1. All prestressed concrete cylinder pipe shall conform to the requirements of AWWA C 301 and C 304 and will be designed for a variable depth of cover as shown on the profile; the maximum trench loading that can occur on an empty pipe after backfill is in place; and a live load equal to the AASHTO HS20 loading or the minimum live load as specified in AWWA C 301, whichever is greater. The interior surface of the pipe will be a smooth, cylindrical surface. Cement will meet all the requirements ASTM C 150, Type II. Steel cylinder shall be made of steel sheets not lighter than No. 16 gauge with a minimum yield strength of 33,000 psi, and conforming to the requirements of "Standard Specification for Hot-Rolled Carbon Steel Sheets and Strip Structural Quality", Grade 33, ASTM designation A 1011. Steel used for the bell rings for pipe and fittings shall have a minimum yield strength of 30,000 psi and conform to the requirements of ASTM A 1011. Steel plate and special shapes for spigot joint rings shall conform to the requirements of ASTM A 36 or the other ASTM specifications listed in AWWA C 301. High tensile prestressing wire shall be a minimum of No. 6 gauge and maximum class shall be Class III. The wire shall conform to the requirements of "Standard Specification for Steel Wire, Hard-Drawn for Prestressing Concrete Pipe", ASTM A 648. No lifting holes will be allowed. The pipe will be furnished complete with gaskets, grout bands and lubricant as required for proper installation.

2. The interior of all 36 inch and larger diameter pipe will be fully lined with a PVC liner as specified in Section 02530 Paragraph 2.01.DD. The liner will be installed by the pipe manufacturer prior to pipe delivery.

3. The liner will be welded at each joint after installation and testing of the pipe. Exceptions to the welding requirement may be granted at the direction of the Engineer.

4. Fittings shall be composed of cut and welded steel plate with all welds inspected, and the completed cylinder shall be tested for tightness by the dye penetrant method. Fittings shall have wire reinforcement applied to the interior and exterior surfaces. Concrete and mortar linings shall be at least 3/8 inch thick and exterior mortar coating shall be 1 inch thick unless otherwise indicated. All materials and workmanship shall be as specified in AWWA C 301.

a. Curves of long radius may be formed by the use of pipe on which the spigot joint rings are placed on a bevel or by the use of bevel adapters. Special pipes shall be designed to provide the same strength as the adjacent pipe. Branch connection or openings, such as manholes and bypass pumping connections, shall be incorporated in straight pipe and shall be suitably reinforced. Special pipes shall be provided with joint rings corresponding to those on adjoining straight pipes. Special ends shall be provided on concrete pipe, where required to connect to pipe of other manufacturers and special structures.

G. Reinforced Concrete Pipe

1. All reinforced concrete pipe for gravity sewer applications will conform to the requirements of ASTM C 76 for circular pipe, Wall B for the specified diameter and strength class. If no class is specified, Class III pipe will be used. The interior surface of the pipe will be a smooth, cylindrical surface. Cement will meet all the requirements ASTM C 150, Type I. No lifting holes will be allowed. The pipe will be furnished complete with gaskets, grout bands and lubricant as required

for proper installation. Pipe will be designed for a 0.01 inch crack D-Load. The ultimate D-Load will be at least 1.5 times the 0.01 inch D-Load.

2. The interior of all 36 inch and larger diameter pipe will be fully lined with a PVC liner as specified in Section 02530 Paragraph 2.01.DD. The liner will be installed by the pipe manufacturer prior to pipe delivery.

3. The liner will be welded at each joint after installation and testing of the pipe. Exceptions to the welding requirement may be granted at the direction of the Engineer.

4. Joints in reinforced concrete pipe less than 30 inches in diameter will have compression gaskets or trapped O-ring gaskets. Pipes 30 inches in diameter or greater will have trapped O-ring gaskets meeting the requirements of ASTM C 443. When required, concrete pipe ends will be manufactured with steel bell and spigot end rings with a groove on the spigot for an O-ring rubber gasket. This joint will meet the joint requirements of ASTM C 443 and ASTM C 361. The shape, dimensions, and tolerances of the bell and spigot or tongue and groove ends of the pipe will meet the requirements of ASTM C 443. The ends of the rubber gasketed pipe will be accurately manufactured so that, when adjacent pipe sections are drawn together, the rubber gasket will be uniformly compressed around the periphery of the pipe to provide a watertight seal.

H. Ductile Iron Pipe and Fittings

1. Ductile iron pipe for gravity sewer and service connections will conform to ASTM A 746. Ductile iron pipe for force main applications will conform to ANSI A 21.51. The pipe thickness design will conform to ANSI A 21.50. If no thickness class is specified on the Plans or Contract Documents, Class 50 or approved equivalent will be used. All ductile iron pipe will be lined with either Protecto 401 Ceramic Epoxy, SewPer Coat Cement Mortar Lining, or Polyethylene. Linings will be applied according to manufacturer's recommendations. Fittings will conform to the requirements of ANSI A 21.10. Unless otherwise specified, joints will be push-on gasket type conforming to the requirements of ANSI A 21.11. Mechanical joints will conform to the requirements of ANSI A 21.11. Flanged joints will conform to the requirements of ANSI A 21.15. Flexible joint ductile iron pipe for river crossing applications will conform to ASTM A 536 and will be Grade 70-50-05. Steel retainer rings will conform to ASTM A 148 for Grade 90-60.

I. Deleted.

J.

J.01 Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (8-15 inch Diameter)

1. All PVC gravity pipe and fittings 8-15 inches in diameter shall be solid wall PVC; no profile wall PVC pipe is allowed for pipes 15 inches or less in diameter. PVC solid wall pipe and fittings for gravity sewer applications will conform to the requirements of ASTM D 3034. The standard dimension ratio (SDR) will be SDR 26 (Type PSM). PVC resin will conform to ASTM D 1784 cell class 12454C. A different cell class will be allowed only if the material meets the requirements of a superior cell class than 12454C. Fittings for PVC gravity sewer pipe will be fabricated from PVC meeting the respective ASTM PVC pipe standard for molded or extruded PVC. The wall thicknesses of the waterway and bell of fittings will be no less than the respective minimum thicknesses for the equivalent pipe. All fittings will be compatible with the pipe to which they are attached.

2. All PVC gravity pipe joints will be gasketed bell and spigot push-on type conforming to ASTM D 3212, unless directed otherwise in these Specifications. Gaskets will be part of a complete pipe section and purchased as such. Lubricant will be as recommended by the pipe manufacturer.

3. Solvent welded PVC saddle wye's may only be used on existing PVC and truss gravity sewer mains. Collar joints for fittings will be either Type SC (solvent cement) or Type OR (flexible gasketed compression joint) and will conform to the requirements of ASTM D 2680.

J.02 Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (6 inch Diameter) Service Connection

6 Inches in diameter service connection may conform to either the SDR 26 Specification (ASTM D1784) or to ASTM D1785 and ASTM D 2665 (Schedule 40). All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and Shelby County, Tennessee code requirements. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656.

K. Polyvinyl Chloride (PVC) Pipe and Fittings (18-36 inch Diameter)

1. All 18-36 inch diameter PVC gravity sewer pipe and fittings shall be designed and manufactured in accordance with ASTM F 679, F 794, F 949, or F 1803. All PVC sewer pipe and fittings shall be manufactured from PVC resin with a cell classification of either 12454C or 12364C as defined in specification ASTM D 1784. The pipe shall be furnished complete with gaskets, fittings, lubricant, etc. as required for proper installation and completion of the line. The minimum pipe stiffness at 5% deflection shall be 46 psi when tested in accordance with ASTM D 2412 and as specified in ASTM F 679, F 794, F 949, or F 1803, as applicable. Samples of the type of pipe to be used shall be tested in accordance with ASTM D 2412. Impact tests shall be conducted in accordance with ASTM D 2444 and shall comply with ASTM F 679, F 794, F 949, or F 1803. Tests may be conducted by the manufacturer in the presence of the Engineer. The City shall have the right to make unannounced visits to the pipe manufacturer's facility to inspect the manufacturing process.

2. All joints shall be the bell and spigot type and conform to ASTM D 3212. Gaskets shall meet ASTM F 477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket which is positively retained. No solvent cement joints will be permitted in field construction.

3. The pipe manufacturer shall furnish to the Engineer a notarized certificate(s) of inspection stating that each piece of pipe used on this project was made and tested in accordance with these specifications.

4. All pipeline material shall be generically the same throughout the project with the permissible exception of utilizing different material for piping used for tie-ins of smaller lines, or as noted on the plans or as approved by the Engineer.

L. Glass Fiber Reinforced Polymer Mortar Pipe and Fittings up to 72 inch Diameter

1. Pipe shall meet the requirements of ASTM D 3262 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe. The pipe shall be manufactured to form a dense, non-porous, corrosion-resistant, composite pipe that is resistant to corrosion from hydrogen sulfide and other corrosive materials normally found in sewerage systems, all without the use of special HDPE or PVC liners.

2. Minimum acceptable nominal length for joints of pipe shall be 20 feet except where field conditions require otherwise or approved by the Engineer.

3. Design: The design of the pipe shall comply with all requirements of the latest revision of ASTM D - 3262 for non-pressure (gravity) flow conditions. The pipe shall also be designed for a variable depth of cover as shown on the profile; the maximum trench loading that can occur on an empty pipe after backfill is in place; and a live load equal to the AASHTO HS20 loading or the minimum live load as specified in the latest revision of ASTM D - 3262, whichever gives the greater live load.

4. Resin Systems: These shall be only polyester resin systems with a proven history of satisfactory performance in sewage applications. Historical data shall have been acquired from a composite material of similar construction and composition.

5. Glass Reinforcements: Reinforcing glass fibers used in the manufacture of the pipe shall be of the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

6. Interior Lining: All interior surfaces of the pipe shall be lined with a fiberglass reinforced polyester lining as a part of the manufacturing process.

7. Joints: The pipe shall be field connected with fiberglass sleeve couplings that utilize full face elastomeric sealing gaskets of EPDM rubber compound, providing a zero leakage joint. The coupling shall be factory assembled to one end of the pipe. Each joint shall be tested after installation in accordance with Specification Section 02530 4.02.

8. Tests and Examinations: Tests, in-process and final examinations shall be performed by the manufacturer, or an independent testing laboratory approved by the Engineer, in accordance with the latest revision of ASTM D 3262, in order to assure conformance. All instruments, gauges, and other testing and measuring equipment shall be of the proper range, type and accuracy to verify conformance and test equipment shall be checked at least annually against calibrated and certified test gauges and instruments. The Engineer shall have access to all records of tests and inspections related to the manufacture of the pipe, and, without notice to the manufacturer, shall also have the right to witness the manufacture of the pipe and any tests being performed by the manufacturer or his suppliers relative to products, materials, or the pipe being produced. Copies of records of tests and inspections shall be submitted if requested by the Engineer.

a. Pipes: These shall be manufactured and tested in accordance with ASTM D 3262.
b. Joints: Coupling joints shall meet the requirements of ASTM D 4161 and/or produce a zero leakage joint.
c. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D 2412 shall be 46 psi.

9. Fittings and Special Pipe: Fittings shall be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays, all capable of withstanding all operating conditions when installed.

10. Curves of long radius shall be formed by the use of bevel end pipe or by the use of bevel adapters. Deflection of pipe joints to form the long radius curves will not be accepted. Special pipes shall be designed to provide the same strength as the adjacent pipe. Branch connections or openings, such as manholes and bypass pumping connections, shall be incorporated in straight pipe and shall be suitably reinforced. Special pipes shall be provided with joints corresponding to those on adjoining straight pipes. Special ends shall be provided on pipe, where required, to connect to pipe of other manufacturers and special structures.

11. Unloading Handling and Storage: All pipe shall be inspected at time of delivery, and damaged pieces rejected and removed from the site of the work. Unloading shall be done by mechanical equipment designed to properly handle the pipe, and dropping from delivery vehicles will not be permitted. Pipe shall be stored in an orderly manner to protect the pipe from injury, and from damage by freezing, all in accordance with the manufacturer's written instructions.

M. High Density Polyethylene (HDPE) Pipe and Fittings

1. High Density Polyethylene Pipe (HDPE) may be used in construction of inverted siphons. No HDPE will be allowed in any other gravity sewer application. All HDPE shall be manufactured from virgin, extra high molecular weight, high density PE4710 polyethylene pipe grade resin to a minimum cell classification of PE445574C as determined by ASTM D3350. No post-consumer recycled polyethylene materials shall be allowed.

2. All HDPE pipe and fittings shall conform to ASTM F714 and ASTM D3261, respectively, and have a Standard Dimension Ratio (SDR) of 17, maximum.

3. Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of 75 psi and temperature of 400□ F. All such connections shall be performed in strict accordance with the manufacturer's instructions.

N. Polyvinyl Chloride (PVC) Pressure Pipe and Fittings

1. PVC pipe and couplings for force main applications will conform to the requirements of ASTM D 2241 and AWWA C 900 Standard for Polyvinyl Chloride (PVC) Pressure pipe 4 inches through 12 inches for Water. The minimum pressure class will be Class 100 or as specified and outside diameter base (IPS or CI) will be as specified in the Plans or Contract Documents.

2. Joints for pipe and couplings will be solid ring elastomeric gasket type. Gaskets must withstand internal pressures of not less than the minimum sustained pressure and burst pressure requirements specified for the pipe with which they are designed to be used. No solvent cement joints will be allowed. Joints will conform to the requirements of AWWA C 900 and/or ASTMD 2241.

O. High Density Polyethylene (HDPE) Pressure Pipe and Fittings

1. All HDPE shall be manufactured from virgin, extra high molecular weight, high density PE4710 polyethylene pipe grade resin to a minimum cell classification of PE445574C as determined by ASTM D3350. No post-consumer recycled polyethylene materials shall be allowed.

2. All HDPE pipe and fittings shall conform to ASTM F714 and ASTM D3261, respectively, and have a Standard Dimension Ratio (SDR) of 17, maximum.

3. Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of 75 psi and temperature of 400□ F. All such connections shall be performed in strict accordance with the manufacturer's instructions.

P. Air/Vacuum Valves, Automatic Air Release Valves and Combination Valves

1. The Air/Vacuum Valves shall be single body, double orifice and shall automatically exhaust air from the force main while being initially filled with fluid. After the air has been exhausted from the line, the valve shall close tightly. The valve shall remain closed as long as the sewer line is under positive pressure. Should the force main pressure fall below atmospheric pressure, the valve shall reopen to allow air to enter the pipe thereby preventing a negative pipe pressure. The valve shall be designed to prevent clogging due to solids in the fluid. Each of these valves shall be designed to separate the liquid from the sealing mechanism. The Air/Vacuum Valves shall be as manufactured by A.R.I. or approved equal.

2. The Combination Air Valve shall consist of a combination of an air and vacuum large orifice and an automatic small orifice in a single body. The valve must be designed to operate with liquids carrying solid particles. The valve shall discharge air during the filling or charging of the system and admit air to the system while being emptied of liquid and discharge accumulated air from the system while it's under pressure and operating. Each of these valves shall be designed to separate the liquid from the sealing mechanism. The valve shall have a working pressure range up to 150 psi or as specified on the plans. Combination Valves shall be A.R.I. or approved equal.

3. The manufacturer shall certify venting capacity and provide three copies of installation and maintenance manuals for each type of Combination Air Valve and Air/Vacuum Valve supplied.

4. The Manufacturer shall guarantee all items specified to be free from defects in design, materials and workmanship for one year from the date of acceptance. During the guarantee period, the Manufacturer shall furnish and install replacement parts for any defective component at no additional cost.

Q. Check Valves, Gate Valves and Ball Valves

1. All check valves shall have external arms so that the valve may be opened and closed by hand. Check valves shall be controlled closing swing check valves and shall be Golden-Anderson Series 250, or Valve and Primer Series 6000, or as approved. Each check valve shall have a cast iron body, stainless steel plates, stainless steel springs, stainless steel hinge pins and stops, Teflon spring and hinge bearings and standard trim for IBBM construction. All wetted components shall be 316 stainless steel. Each check valve shall have Buna N seals.

2. All check valves shall be class 125 vertical or horizontal swing type with iron body and flanged ends.

3. Knife gate valves will be manufactured by Red Valve Company, Inc, Pittsburgh, PA; and shall be their Standard Flexgate, or approved equal. Knife gate valves must conform to AWWA C-504 requirements. The shaft shall be constructed of Type 304 stainless steel. The knife gate shall be Type 316 stainless steel. The valve seat shall be a resilient, mechanically retained, field replaceable, polytetraflouroethylene elastomer. The upper and lower bearings shall be self-lubricating Teflon. The valve shall be equipped with a handwheel.

4. Wedge gate valves will be resilient wedge gate valves as manufactured by Mueller Co., or approved equal. Wedge gate valves must conform to AWWA C 509 or AWWA C 515 and will be either series 2360 or series 2361.

5. All ball valves for 2 inch and 3 inch diameter fittings shall be full port, brass ball valves, shall be rated to 125 psi minimum, and shall meet the requirements of NSF/ANSI 61/8. Ball valves will have threaded connections and blowout proof stems. Ball valves will be Series FBV-3C as manufactured by Watts, or as approved.

6. Valve manufacturer shall furnish certification that each valve has been subjected to a hydrostatic water pressure twice the pressure class and that each valve is free of defects. The valve manufacturer shall guarantee all items specified to be free from defects in design, materials and workmanship for one year from the date of acceptance. The manufacturer shall, during the guarantee period, furnish and install replacement parts for any defective component at no additional cost.

R. Steel Casing Pipe

1. Casing pipe will conform to ASTM A 139. Minimum yield strength will be 35,000 psi. Wall thickness will meet the requirements of the latest revision of the American Railway Engineering Association Manual of Recommended Practice unless otherwise specified. Wall thickness will be:

Nominal Thickness Inches	Nominal Diameter Inches
0.188	Less than 14
0.219	14 and 16
0.250	18
0.281	20
0.312	22
0.344	24
0.375	26
0.406	28 and 30
0.438	32
0.469	34 and 36
0.500	38, 40, and 42

2. When casing is installed without a protective coating and is not cathodically protected, the wall thickness shown above will be increased to the nearest standard size that is a minimum of 0.063 inches greater than the thickness shown. This requirement does not apply to casing diameters less than 12 3/4 inches.

S. Lubricants for Prefabricated Pipe Gaskets

1. The lubricant used in jointing pipes fitted with flexible, rubber gaskets will be as recommended by the pipe manufacturer. Lubricants will be suitable for use at temperatures from 5□ to 120□ F(-15□C to 50□C). Containers will be labeled with the intended, compatible pipe material and the manufacturer's name.

T. Primers and Adhesives

1. All primers and solvents used with ABS Composite Sewer pipe will conform to ASTM D 2235 and will be applied as recommended by the manufacturer. For bonding PVC to PVC, solvent cement will conform to ASTM D 2564. For bonding PVC to ABS, solvent cement will conform to ASTM D 3138. Adhesives used to fasten flexible rubber or rubber gaskets will conform to the requirements of the gasket manufacturer.

U. Adapters and Couplings

1. At the direction of the Engineer, a connection of sanitary sewer pipes, 6 inches through 16 inches, of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made by means of an approved compression or mechanical connector or adapter. The gaskets for compression connectors or adapters will be manufactured of an approved preformed elastomeric material conforming to applicable sections of ASTM Standards C 425, C 564, C1173, D 3212, and D 5926. Mechanical couplings or adapters will have tightening clamps or devices made of 300 series stainless steel with a stainless steel shear ring and stainless steel hardware, as specified in ASTM A 240. If a stainless steel shear band is not used a concrete collar is required. Each connector and adapter will bear the manufacturer's name and required markings. Installation will be by the manufacturer's recommendations.

2. At the direction of the Engineer, a connection of sanitary sewer pipes (18 inches in diameter and larger) of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made in accordance with Specification Section 02530 Paragraph 3.09.C. Mechanical connectors meeting the above requirements may be used at the direction of the Engineer.

V. Portland Cement Concrete

1. Portland Cement Concrete will be of the class and dimensions shown on the Plans, or as directed by the Engineer. The classes of concrete are called Class A and Class C. Class A concrete is intended principally for concrete structures designed for high strength. Class C concrete is low strength concrete, intended principally for foundation stabilization, pipe cradles and encasement and other general-purpose uses. All portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures, their proportioning, mixing, delivery, minimum strength, sampling and testing will be as specified in Specification Section 03050.

W. Crushed Limestone

1. Crushed limestone will be size No. 67 Coarse Aggregate meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction and the following gradation:

Total Percent by Dry Weight,
Passing Each Sieve (U.S. Standard)

Size No.	1"	3/4"	3/8"	No. 4	No. 8
67	100	90-100	20-55	0-10	0-5

2. Crushed limestone meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction, size No. 57 Coarse Aggregate will be used as directed by the Engineer or as shown on the plans. Size No. 57 Coarse Aggregate will meet the following gradation:

Total Percent by Dry Weight,
Passing Each Sieve (U.S. Standard)

Size No.	1-1/2"	1"	1/2"	No. 4	No. 8
57	100	95-100	25-60	0-10	0-5

X. Deleted

Y. Mortar

1. Mortar will be composed of one part portland cement, two parts masonry sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients will be proportioned by measurements and not by estimating. All portland cement, sand, and water will be as specified in Specification Section 03050. All hydrated lime will be as specified by ASTM C 206.

2. The mortar will be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime will be thoroughly mixed in a clean, tight, mortar box until the mixture is of uniform color, after which water will be added. Machine mixed mortar will be prepared in an approved mixer and will be mixed not less than 1½ minutes. Mortar will be used within 30 minutes after mixing.

Z. Bracing Lumber

1. Lumber for tunnel bracing will be a minimum of 3 inches thick and made of bridge oak. All timbers will be of good quality, straight grained, and free from weakening knots and other defects. Bracing will be placed to form a structurally sound timber tunnel. The timber tunnel lining will remain in place after laying the pipe and backfilling.

AA. Pit Run Gravel

1. Pit run gravel will consist of one of the three gradations shown in the table below.

	Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)						
Size No.	2½"	2"	1½"	1"	3/8"	No.40	Clay *
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

*Clay content will be determined by the Hydrometer Test-AASHTO T 88. Clay content up to 15 percent may be used with the approval of the Engineer.

2. That portion passing the No. 40 sieve will be known as the binder. The binder aggregate will consist of hard durable particles of limestone or sound siliceous material. Shale aggregate or pipe clay binder will not be acceptable. The percent of silt will not exceed the percent of clay by more than 25 percent. If the binder material is insufficient to bond the aggregate a satisfactory binding material may be incorporated, as approved by the Engineer, so that the resultant mixture will comply with these Specifications. The mixing will be done uniformly, and blending of material on stockpiles or in the pits by bulldozers, clamshells, draglines, or similar equipment will not be permitted.

BB. Brick

1. All brick will conform to ASTM C 55 for Grade A. Unless otherwise approved by the Engineer, bricks will conform to the following dimensions:

	Depth (in)	Width (in)	Length (in)
Standard Size	2 1/4	3 3/4	8
Allowable Variation	+ 1/4	+ 1/4	+ ½

2. All brick will be new and whole, of uniform standard size and with straight and parallel edges and square corners. Bricks will be tough and strong and free from harmful cracks and flaws. Brick will be culled after delivery if required and all culls will be removed from the work site.

3. The Contractor may be required to furnish the Engineer with at least five bricks of the character and make he proposes to use, at least one week before any bricks are delivered for use. All brick will be of the same quality as the accepted samples.

CC. Non-Shrinking Grout

1. Grout will be mixed in small quantities as needed and will not be re-tempered or used after it has begun to set. Unless otherwise specified, the grout will consist of one-part portland cement, two parts masonry sand by volume, a non-shrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When non-shrinking or non-shrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

2. The formulation, admixture or the premixed grout used will be subject to the approval of the Engineer and will be mixed and used according to the recommendations of the manufacturer. These special grouts will be classified as follows:

Type I – Non-shrinking Grout
Type II – Non-shrinking, Fast Setting Grout

Portland cement, masonry sand, and water will conform to the requirements of Specification Section 03050.

DD. Polyvinyl Chloride (PVC) Protective Lining for Concrete Pipe and Structures

1. Liner shall be Ameron T-Lock as manufactured by Ameron Protective Coatings Division, Brea, California or approved equivalent.

2. The material used in the liner and in all joint, corner, and welding strips shall be a combination of polyvinyl chloride resin, pigments, and plasticizers, specially compounded to remain flexible. Material color shall be white.

3. Polyvinyl chloride resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

4. Tensile specimens shall be prepared and tested in accordance with ASTM D412 using die B. Weight change specimens shall be 1-inch by 3-inch samples of the sheet thickness. Specimens may be taken from sheet and strip at any time prior to final acceptance of the work.

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

6. All plastic liner plate sheets, including locking extensions, all joint, corner and welding strips shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material. The Engineer may authorize the repair of such defects by approved methods.

7. The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to 1/4-inch settling cracks, which may occur in the pipe or in the joint after installation, without damage to the lining.

8. The lining shall be repairable at any time during the life of the structure.

9. Liner shall be a minimum of 0.065 inches in thickness. Locking extensions (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2.5 inches apart and shall be at least 0.375 inches high.

10. Sheets shall have transverse strap channels cut in the locking extensions so that the strap can be placed into and perpendicular to the locking extensions.

11. These channels shall be not less than 3/4 inch wide and not more than 1 1/4 inch wide and shall be cut so that a maximum 3/16 inch of the base of the locking extension remains in the base of the strap channel. Strap channels shall be provided at intervals of not less than 15 inches and no more than 20 inches center-to-center. The strap channels will not be cut through the final two locking extensions on each edge of the sheet.

12. Transverse flaps shall be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that a maximum of 1/64 inch of the base of the locking extension is left on the sheet.

13. Weld strips shall be approximately 1 inch wide with a minimum width of 7/8 inch. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal 1/8 inch.

14. All sheets used shall be shop tested for pinholes using an electrical spark tester set at 20,000 volts minimum. Any holes shall be repaired and retested.

EE. Tracer Wire for Sewer Line and Force Mains

1. Tracer wire shall be installed along the length of all sewer pipes, service connections, manholes and stubs. All tracer wire shall have HDPE insulation intended for direct bury, green in color, and be suitable for wet or dry applications. All system components, including tracer wire, connectors, ground rods and access points, must be compatible.

2. Tracer wire shall be copper-clad steel 12-AWG, and must conform to ASTM B910/ B910M. Minimum brake load of tracer wire is 450 lb. in open cut and 1,150 lb. in directional drilling. Tracer wire for pipe bursting shall be copperhead with Extreme Strength 7x7 stranded 4,700 lb. break load. Conductor shall be annealed copper and meet or exceed all applicable ASTM standards, including ASTM B3 and ASTM B170.

3. Insulation shall be high density, high molecular weight, polyethylene (HDPE) with a minimum flexural strength of 120,000 psi and shall meet or exceed ASTM D790. Insulation shall be green in color with a minimum thickness for open cut, directional drilling, and pipe bursting of 30, 45, and 50 mils respectively.

4. Connector shall be specifically manufactured for use in underground tracer wire and shall be dielectric silicone filled to seal out moisture and corrosion, and shall be installed in a manner to prevent any uninsulated wire exposure. Non-locking, friction fit, twist on, or taped connectors are prohibited.

5. Grounding of tracer wire shall be achieved by using a 1.5-lb, drive-in, magnesium ground rod with a minimum 20-feet HDPE insulated copper-clad steel wire connected to the rod specifically manufactured for this purpose.

6. All two-terminal tracer wire access points must include a manually interruptible conductive/ connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection. All at-grade access points shall include an encapsulated magnet molded into the top portion of the tube, to allow for detection by a ferrous metal detector. On both public and private properties, tracer wire shall terminate at an approved

at-grade, two-terminal access box near the sewer clean-out. For sewer lines over 500 linear feet without service laterals, tracer wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground tracer wire access box shall be delineated using a minimum 48" polyethylene marker post, green in color. All at-grade access points shall be supplied with anti-corrosion wax-gel to protect wires.

FF. Reserved

GG. New Material and Methods

1. The City encourages development of new products and technology and will consider the use of products or methods not previously specified. Product submittals will be reviewed by the City Engineer and a determination will be made as to the acceptability of the product. Consideration or review of a new product does not mean the City will accept its use on the Project.

2.02 EQUIPMENT

A. The Contractor will furnish and maintain in good condition all equipment and facilities as required for the proper execution and inspection of the Work. All equipment and facilities will be on site and approved by the Engineer before work will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 SITE PREPARATION AND RESTORATION

A. Rights-of-Way and Easements

1. Rights-of-way and/or easements as shown on the Plans and/or rights-of-way/easement plats are provided by the City to the Contractor for construction of sanitary sewer facilities. The Contractor will confine his construction activities to these areas. The Contractor will be responsible for obtaining written agreements for use of private property outside City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Contractor will immediately provide a copy of all such written agreements to the City upon obtaining the same.

B. Clearing of Rights-of-Way and Easements

1. The Contractor will confine his clearing of rights-of-way and easements to the least area necessary for construction of facilities shown on the Plans. The Contractor will protect as many trees and shrubs within the area as possible. Where necessary for construction the Contractor will clear all live and dead vegetation and growth, pole stubs, logs, and other objectionable material. Cleared material will be removed to within 3 inches of existing ground. This work will be done well before excavation operations but only after erosion controls have been placed.

C. Location of Existing Obstructions

1. Locations of obstructions shown on the Plans are approximate and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Contractor will be removed and replaced in their original state or protected by the Contractor at no additional cost to the City.

D. Removal of Obstructions

1. The Contractor will demolish and remove all structures and structure foundations, abandoned vehicles, appliances, and rubbish within the right-of-way/easement limits necessary for the performance of the work.

E. Protection of Obstructions Outside Easement Limits

1. The Contractor will protect and avoid damage to all trees, shrubs, plants, fences, structures, and all other objects outside the right-of-way/easement limits shown on the Plans and/or Plats due to construction operations. All damage will be repaired or restored at the Contractor's expense. Particular attention will be paid to avoid damage to trees, shrubs, bushes, and private property located next to rights-of-way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

F. Special Protection of Obstructions Inside Easement Limits

1. Wherever the underground installation of sanitary sewer facilities will go through surface improvements previously made by the City, other governmental bodies, or property owners, the Contractor will be responsible for their protection and preservation. This responsibility includes the removal and storage of such improvements to allow replacement and restoration as close as possible to the undisturbed condition.

G. Disposal of Debris

1. All trees, brush, logs, snags, leaves, sawdust, bark, and refuse will be collected and disposed of according to the City Code of Ordinances at the expense of the Contractor. There will be no separate pay item for disposal of debris. Debris will be removed from the site when practical and will not be left until the completion of the contract. If burning of debris is allowed by the Engineer all precautions will be exercised to prevent the spread of fire and such burning will be according Specification Section 01740 Paragraph 1.06. Burning will be done only at approved locations and in conformity with the laws, ordinances and requirements of agencies and officials having jurisdiction. Besides obtaining the permission of the Engineer, the Contractor will obtain and pay for any permits required. When material is to be disposed of outside the easement, the Contractor will first obtain written permission from the property owner on whose property the disposal is to be made and will file a copy with the Engineer. Unless otherwise provided in the Contract Documents, the Contractor will arrange for disposing of such material outside the right-of-way/easement. No debris will be deposited in wetlands.

2. As approved by the Engineer, wood chips, mulch, etc. placed by the Contractor to prevent soil erosion are not considered debris. All erosion prevention materials will be placed and maintained in accordance with the Memphis and Shelby County *Storm Water Management Manual* and/or the Tennessee Department of Environment and Conservation *Erosion and Sediment Control Handbook*.

H. Replacement of Fences

1. Any fences disturbed inside the right-of-way/easement limits will be replaced or restored to their original or better condition. Any fences removed will be replaced in their original location. Fences in such poor condition that they cannot be taken down and rebuilt with the same material will be replaced with new fence material similar in original quality, size, and appearance to the removed fence. Exceptions to this requirement will be allowed if written releases are obtained from the property owners by the Contractor and submitted to the Engineer. For chain link fence, new fence material and construction methods will conform to the requirements of Specification Section 02820.

I. Restoration of Turfed Areas

1. All areas will be restored as nearly as practicable to their original condition. Finished lawn areas where soil has been deposited will be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled will be resodded. Areas where sod is only slightly damaged may be reseeded if so permitted by the Engineer. After final restoration of the settled trench surfaces, trench areas and areas regraded as part of the construction will be resodded, unless otherwise shown on the Plans or directed by the Engineer. Seeding and sodding material and construction methods will conform to the requirements of Specification Sections 02920 and 02921.

3.02 EXCAVATION

A. All excavation performed under this Section including trench excavation, structure excavation, and channel excavation, but excluding undercut excavation, will be considered unclassified excavation despite the nature of the material and objects excavated and will not be measured or paid for separately except as specifically noted. Pavement removal and replacement will be accomplished as specified in Specification Section 02950.

B. Trench Excavation

1. All trenches will be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking may be allowed by written permission of the Engineer.

2. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material will be hand excavated so that the pipe is bedded on a firm, undisturbed subgrade.

3. No more than 300 feet of trench will be opened ahead of the completed sanitary sewer, nor will more than 100 feet be left unfilled except by written permission from the Engineer. In special cases the Engineer may limit the distance to which the trench may be opened by notifying the Contractor in writing.

4. The width of trenches below a level 1 foot above the outside top of pipe will be at least 6 inches but not more than 12 inches on each side of the outside of the pipe for all sizes up to and including 16 inches in diameter. A maximum trench width dimension for these pipe sizes will be 36 inches. For 18-inch diameter pipes, the width of trenches below a level 1 foot above the outside top of pipes will be at least 6 inches on each side of the pipe, with a maximum trench width of 42 inches. For pipe sizes more than 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe will be at least 12 inches but no more than 15 inches on each side of the outside of the pipe. If the trench width at or below 1 foot above the top of pipe exceeds the width specified, provisions will be made at the Contractor's expense to compensate for the additional load upon the pipe.

5. The sides of the trench will be as nearly vertical as possible. The bottom of the trench will be carefully graded, formed, and aligned according to City of Memphis Standard SST-3 and to the satisfaction of the Engineer before sanitary sewers are laid.

C. Other Excavation

1. Undercut Excavation:
Undercut excavation will consist of removing and disposing of unsatisfactory material below the grade established on the Plans for sanitary sewers, structures, and manholes. No undercut excavation will be done without prior authorization of the Engineer. The limits of undercut excavation will be determined by the Engineer who will be present during the undercut operations.

2. Undercut areas will be backfilled with No. 67 limestone or other aggregate approved by the Engineer to the grade established on the Plans. The backfill will be placed in 6 inch maximum lifts and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) or a minimum relative density of 0.75. Undercut backfill will be encapsulated in geotextile fabric conforming to Specification Section 02370 2.01.C.

3. Unauthorized Excavation Below Subgrade or Outside Limits:
Any unauthorized excavation and subsequent removal and backfilling beyond the lines and grades shown on the plans will be at the Contractor's expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Plans will be backfilled according to Specification Section 02530 Paragraph 3.02.C.2.

D. Change in Location and Grade

1. If the Engineer orders in writing that the location or grade of a proposed sanitary sewer facility be changed from that shown on the Plans, the following provisions will apply. If the change is made before excavation work has begun and the item being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications, the appropriate pay item will apply. If the facility being constructed is not covered in the Proposal Sheet(s) and if the average excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work. If the average excavation per linear foot at the changed location varies more than 10 percent above or below original Plan quantities, a Change Order will be prepared to cover the new work. For purposes of comparing changed quantities with Plan quantities, a 1-foot long strip will be calculated from natural ground line to invert along both the revised and original locations. These calculations will then be multiplied by the proper lengths to determine the total cost.

2. If the change is made after excavation has already begun on the original Plan location, the procedures described above will apply to payment for work along the changed location. If abandonment of an existing excavation is required due to a change by the Engineer, a Change Order will be prepared covering the backfilling and restoration of the abandoned excavation. Backfilling and restoration of the abandoned excavation will be accomplished according to the appropriate section of these Specifications.

3. Filling a portion of existing excavation to meet changed grades will be accomplished according to Specification Section 02530 Paragraph 3.11.

4. If a change in a location and/or grade is authorized in writing by the Engineer at the written request of the Contractor, the Contractor will not receive any additional compensation for the changed work. Backfilling and restoration of abandoned excavation work will be accomplished totally at the Contractor's expense. If changes requested by the Contractor result in reduced lengths and/or depth of excavation, the revised quantities using Proposal unit prices or Change Orders as appropriate will be used to develop payment.

E. Disposition of Excavated Material

1. Excavated material suitable for backfill will be stored no closer than 2 feet from the edge of the excavation. Excavated material will not obstruct crosswalks, sidewalks, driveways, street intersections, nor interfere unreasonably with travel on streets. Gutters or other surface drainage facilities will not be obstructed. The Contractor must provide access to fire hydrants, mail boxes, sewer and conduit manholes and similar utility or municipal service facility as required. Excavated material intended for backfill will be stored in a way that minimizes loss of excavated material due to erosion. The Contractor shall comply with all applicable OSHA regulations and City of Memphis Storm Water Ordinances.

2. Unless otherwise directed, all excavated material that will not be used for backfilling or restoration will be removed from the site and disposed of by the Contractor. If the Contractor proposes to store or place such excess excavated material upon any private property, written consent of the property owner or owners must be obtained by the Contractor in advance. A

certified copy will be given to the Engineer. No surplus or excess material will be deposited in any stream channel nor anywhere that would change preconstruction surface drainage.

F. Control of Water

1. The Contractor will keep all excavations free of water. If the trench subgrade consists of good soil in good condition at the time of excavation, it will be the Contractor's responsibility to maintain it in suitable condition. Dams, flumes, channels, sumps, or other work and equipment necessary to keep the excavation clear of water will be provided by the contractor. Dewatering of trenches, will be incidental to trench excavation. The Contractor will avoid producing mud in the trench bottom by his operations. If necessary or so ordered by the Engineer, the Contractor will remove any soil that becomes unacceptable and replace it with limestone or other approved aggregate at his own expense to maintain a firm, dry base.

2. Pipe bedding, laying, jointing, and the placing of concrete or masonry will be done in a water free trench or excavation. Trenches will be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water will be disposed of in a manner acceptable to the Engineer.

3. All gutters, pipes, drains, conduits, culverts, catch basins, storm water inlets, ditches, creeks, and other storm water facilities will be kept in operation, or their flows will be satisfactorily diverted and provided for during construction. Any facilities disturbed during construction will be restored to the satisfaction of the Engineer.

G. Excavation Around Obstructions

1. The Contractor will perform all excavation by hand where excavation by machinery would endanger trees, structures, or utilities that otherwise might be saved by hand excavation.

2. The Contractor will cautiously excavate test holes to find the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, other sanitary sewer, storm drain, or similar utility comes within the limits of the trench, such facilities will be properly supported.

H. Excavation for Manholes and Special Structures

1. The Contractor will be responsible for performing the Work according to the lines and elevations shown on the Plans or as directed by the Engineer. The Contractor will excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.

2. The outside dimensions of excavations for manholes and special structure will be at least 12 inches greater than the outside of the masonry or concrete work to permit backfilling around the structure.

3. Where structures are to be built in street rights-of-way or paved areas, the excavation will not exceed 2 feet from the outside of the masonry or concrete work. If the excavation exceeds this limit, the Contractor will be required to backfill the entire space around the structure with pit run gravel compacted as specified in Specification Section 02530 Paragraph 3.11.B.

I. Special Protection

1. Treacherous Ground:
When running sand, quicksand, or other treacherous ground is encountered, the work will be

carried on with the utmost urgency and will continue day and night should the Engineer so direct.

2. Sheeting and Shoring:
The Contractor will furnish, place, and maintain sheeting and shoring as required to support the sides of any excavation to prevent earth movement that could endanger the workers or public and to prevent damage to the excavation, adjacent utilities or property. The Contractor will place the sheeting and shoring without the Engineer's instructions.

3. Sheeting will extend below structure invert a sufficient depth to assure adequate support. In the installation of sheeting, the use of vibratory type pile drivers (as opposed to impact type) will be limited to sheeting driven no greater than 5 feet below the invert. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, will not exceed the maximum width of a trench per Specification Section 02530 Paragraph 3.02.B. Walers and struts will be designed and installed to present no obstructions to proper placement of the pipe, bedding, cradle or encasement, and they will not interfere with the satisfactory installation of the pipe.

4. Sheeting, bracing, and shoring will be withdrawn and removed as the backfilling is being done, except where the Engineer permits the material to be left in place. The Contractor will cut off sheeting left in place at least 2 feet below the surface and will remove the cut off material from the excavation.

5. All sheeting, bracing, and shoring which is not left in place under this provision will be removed in a way that will not endanger the completed work or other structures, utilities, storm drains, sewers, or property. The Contractor will be careful to prevent the opening of voids during the extraction process.

6. If sheeting and shoring are not specifically required on the Plans or in the Specifications, steel drag shields or trench boxes may be used subject to the authorization of the Engineer. Voids left by the advancement of the shield will be carefully backfilled and compacted following trench backfill requirements.

7. Excess Width of Trench:
If the Contractor is permitted to use equipment that results in wider trenches than specified, approved methods will be used around the pipe to resist the additional load caused by the extra width. The dimensions of the cradle or other methods will be specified by the Engineer. The contractor is responsible for meeting all applicable OSHA requirements. No extra compensation will be allowed for the additional material or work. Excess width trenches for semi-rigid and flexible pipe will be backfilled and compacted according to ASTM D 2321, and no concrete cradle will be used.

8. Blasting:
Blasting will be undertaken only after the Contractor has received written authorization from the Engineer. With respect to the use of explosives in blasting, the Contractor will obtain all necessary permits and comply with all laws, rules, and regulations of the federal, state, City, and the insurer governing the keeping, storage, use, manufacture, sale, handling, transportation, or other disposition of explosives. The Contractor will obtain additional insurance covering the use of explosives with limits and coverage as specified by the Engineer. All operations involving the handling, storage, and use of explosives will be conducted with every precaution under the supervision of a properly licensed individual. The Contractor will take special precautions for the proper use of explosives to prevent harm to human life and damage to surface structures, utilities, storm drains, sewers, or other subsurface structures. The Contractor will advise the Engineer in advance when charges are to be detonated. Blasts will not be fired until all persons in the vicinity have had ample notice and have reached positions of safety.

9. Sanitary sewer construction will be carefully protected from all blasts, and all excavations requiring blasting will be fully completed at least 30 feet ahead of the laying of the pipe. The mouth of the pipe will always be covered with a board or other plug carefully fitted to the pipe to prevent earth or other substances from entering.

10. After a blast is fired, the Contractor will thoroughly scale the excavation. All loose, shattered rock or other loose material that may be dangerous to the workers, pipe, or structure will be removed and the excavation made safe before proceeding with the work. The fact that the removal of loose, shattered rock or other loose material may enlarge the excavation beyond the required width will not relieve the Contractor from making such removal and filling the extra space. The Contractor will not be entitled to extra compensation therefore.

11. Underpinning:
When excavations require underpinning of existing structures, the Contractor will submit shop drawings of underpinning details to the Engineer for review before commencement of excavation below the foundation of the structure. Review of underpinning details by the Engineer will not relieve the Contractor of his responsibilityfor protection of the structure and its contents.

J. Existing Utilities

1. Location:
The Plans show the readily available record of location of existing structures and facilities both above and below the ground, but the City assumes no responsibility for the accuracy or completeness of this information. Utility service connections are not shown on the Plans, but can be expected in built-up areas, and if relocating them is necessary, it will be the Contractor's responsibility to arrange for the relocation with the owner or owners of theutilities.

2. Protection
The Contractor will protect any storm drain, sewer, or utility within the limits of the construction. The Contractor will proceed with caution and will use every means to establish the exact location of underground structures and facilities before excavating in the vicinity. The City will not be responsible for the cost of protection or repair or replacement of any structure, pipe line, conduit, service connection, or similar facility broken or damaged by the Contractor's operations. All water and gas pipes and other conduits near or crossing the excavation will be properly supported and protected by the Contractor.

3. If the construction requires the removal and replacement of any overhead wires or poles, underground pipes, conduits, structures or other facilities, the Contractor will arrange for such work with the Owner or Owners of the facilities. No additional payment will be made by the City for this work.

4. Service Connections:
Sewer and utility services between mains and buildings will be maintained and adjusted as necessary by the Contractor to provide as nearly a continuous operation as can be expected. This will be accomplished in any way that the Contractor chooses, provided the individual service is not interrupted for more than two consecutive hours. The occupants will be notified by the Contractor at least six hours before such service interruptions. When a break occurs, the Contractor will notify the affected occupant(s) of the probable length of time that the service will be interrupted.

5. If existing underground facilities or utilities require removal and replacement for the performance of this work, all replacements will be made with new material conforming to the requirements of these Specifications. If not specified, the material will be as approved by the Owner.

6. The removal and replacement of water services to adapt to new construction will be the

Contractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade.

7. The removal and replacement of sewer house connections to adapt to new construction will be the Contractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched.

8. The Contractor will be responsible for any damage to the sewer house connection because of his operations. The Engineer does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

3.03 SEWER PIPE INSTALLATION

A. General

1. Sewer pipe and bedding will be constructed as shown on the Plans. It will be the Contractor's responsibility to find all underground utilities before construction to insure there are no conflicts with the proposed line and grade. The Contractor's surveyor shall verify the base information on the City's plans prior to commencement of construction. Any discrepancies in the plans shall be reported to the Engineer immediately. If approved by the Engineer, minor changes in the alignment or grade will be permitted to avoid underground facilities, if straight alignment can be maintained between manholes. If minor changes in line or grade cannot avoid a conflict with the existing utility, the Contractor will arrange with the owner of said utility to have it adjusted as required to accommodate the proposed sewer at no additional expense to the City.

B. Modifications of Existing Sanitary Sewer Facilities

1. Maintenance of Flow:
Where existing sewer lines are being modified, the Contractor will arrange his work so that sewage flow will be maintained during the construction period with no discharge of sewage into the open trench, and no back up of sewage in the existing line. The contractor will provide necessary bypass pumping capacity to carry flow downstream of the section to be modified.

2. Abandonment of Sewer Pipe:
Sewer pipe called for in the Specifications or Plans to be abandoned will be sealed at each end for a minimum distance of 18 inches, or one-half the diameter of the pipe, whichever is greater. Unless otherwise specified, the pipe will be sealed with a brick bulkhead and/or acceptable cement grout to form a solid watertight plug completely bonded to the pipe. Any sewer manholes to be abandoned will be abandoned per Specification Section 02531 Paragraph 3.03.B.

3. The Contractor will be allowed to remove pipe to be abandoned if wanted. If the Contractor elects the removal method, all associated costs will be included in the cost for other Pay items.

4. Connection to Existing Manholes:
The Contractor will core suitable openings into existing manholes or remove existing pipe to accommodate the sewer pipe at the proper elevation, location, and direction, as indicated on the Plans. Care will be used to avoid unnecessary damage to the existing manhole.

5. All loose material will be removed from the cut surfaces that will be completely coated with nonshrinking grout before setting the pipe. Before inserting the pipe, a sufficient thickness of grout will be placed at the bottom and sides of the opening for proper bedding of the pipe. For semi-rigid and flexible pipe installations a water stop as approved by the pipe supplier will be installed on the pipe according to the manufacturer's recommendations. After setting, all spaces around the pipe will be solidly filled with nonshrinking grout and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions on the existing

manhole invert will be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. Plaster on the exterior of brick manholes will be repaired with nonshrinking grout. Particular care will be given to ensure that the earth sub-base and bedding next to the manhole will provide firm solid support to the pipe.

6. Removal of Sewer Pipe:
Existing pipes and manholes to be removed and their locations will be shown on the Plans. Existing sewer pipe and manholes that must be removed to excavate for the proposed sewer will be included in the cost of the proposed sewer pipe and no additional compensation will be made to the Contractor. The City reserves the right to retain or reject salvage of any material encountered. All remaining material becomes the property of the Contractor who will be responsible for properly disposing of the same.

C. Tracer Wire Installation

Tracer Wire

1. Tracer wire must be installed per manufacturer recommendations, and all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point. Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures. Tracer wire must be fastened on all pipe (mainline and service connections) with plastic zip ties at 5-foot intervals. Tracer wire on all sanitary service laterals must terminate at an approved at-grade, two-terminal access box color coded green and located directly above the service lateral at the road right of way.
1. Service connection tracer wire shall be a single wire, connected to the mainline tracer wire using a lug connector, installed without cutting/splicing the mainline tracer wire.
2. New tracer wire being extended or tied into an existing tracer wire shall be connected using approved splice connectors, and shall be grounded at the splice location specified.
3. Tracer wire must be properly grounded at all dead-ends/stubs. Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 feet of HDPE copper clad wire connected to anode specifically manufactured for this purpose, and buried at the same elevation as the sewer line.
4. In case of occurring damage to the wire during installation, an immediate repair is required by removing the damaged wire and installing a new section of wire with approved connectors.

Connectors

1. All mainline trace wires shall be interconnected at intersections, at mainline tees, and mainline crosses. At tees Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground tracer installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner to prevent any uninsulated wire exposure. Non-locking, friction fit, twist on, or taped connectors are prohibited.

3.04 PIPE BEDDING

A. Bedding will be defined as that material supporting, surrounding and extending to one foot above the top of the pipe. Bedding for sewer pipe will conform to the requirements given below for Class A, B.1, or B.2, whichever is shown on the Plans. If the class of bedding is not shown, a minimum of Class B.1 or B.2 bedding will be provided as specified below. At the direction of the engineer or as shown on the plans, sewer pipe and Class B.1 or B.2 bedding will be encapsulated in geotextile fabric as specified in Section 02370 2.01.C.

B. Class A - Concrete Cradle

1. Class A bedding for sewer pipe will consist of a continuous concrete cradle constructed in conformity with the details shown on the plans or as directed by the Engineer. Class A bedding will only be used for rigid pipe.

C. Class B.1-Crushed Limestone

1. Class B.1 bedding will be number 67 crushed limestone. Pipe 4 inches to 24 inches in diameter will be bedded on 4 inches of bedding material. Pipe 27 inches to 48 inches in diameter will be bedded on 6 inches of bedding material. Bedding for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches continuing in layers not more than 6 inches in loose thickness around the pipe to the spring line. The remainder of the installation will be as outlined in Specification Section 02530 Paragraph 3.11. Unless otherwise instructed, concrete and ductile iron pipe will be bedded in Class B.1 bedding.

D. Class B.2-Crushed Limestone

1. Class B.2 bedding will be number 67 crushed limestone. Pipe 4 inches to 24 inches in diameter will be bedded on 4 inches of number 67 crushed limestone Pipe 27 inches to 48 inches in diameter will be bedded on 6 inches of bedding material. Bedding for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches and continued in layers not more than 6 inches in loose thickness around and above the pipe to a level 6 inches above the outside top of the pipe. The remainder of the installation will be as outlined in Specification 02530 Paragraph 3.11. Class B.2 bedding will be used for all flexible pipe including fiberglass reinforced polymer mortar pipe, PVC and HDPE.

E. Deleted

3.05 PIPE LAYING

A. Inspection Before Laying

1. All pipe will be inspected on delivery. Pipe that does not conform to the requirements of these Specifications or is not suitable for use will be rejected and immediately removed from the work site.

B. Preparation of Pipe Ends

1. All surfaces of the pipe to be joined will be clean and dry. All necessary lubricants, primer, adhesives, and similar material will be used as recommended by the pipe or joint manufacturer's specifications.

C. Care During Hoisting, Placing, And Pushing Home

1. Equipment used to handle, lay, and join pipe will be equipped and used as to prevent damage to the pipe. All pipe and fittings will be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be installed.

D. Direction of Work

1. The laying of pipe will be commenced at the lowest point. The bell or grooved end will be laid upgrade. All pipe will be laid with ends abutting and true to line and grade. They will be carefully centered so that when laid they will form a sewer with a uniform invert.

E. Uniform Pipe Bearing

1. Special care will be taken to insure that the pipe is solidly and uniformly bedded, cradled, or encased according to the Plans. For pipe with a bell that is larger than the barrel of the pipe the bedding material will be removed to a depth that will provide continuous support for the bell and barrel. No pipe will be brought into position for joining until the preceding length has been bedded, joined, and secured in place. Where a concrete cradle is required, the pipe will be supported at no more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

F. Alignment and Grade

1. Each piece of pipe will be checked for vertical and horizontal alignment immediately after being laid. All adjustments to alignment and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe or striking the pipe to drive it down. Curved alignments will not be allowed except as directed by the Engineer.

G. Backfilling to Secure Pipe

When the joint is made, sufficient backfill material will be simultaneously placed along each side of the pipe to prevent moving the pipe off line and grade. Particular care will be used to prevent disturbance or damage to the pipe and the joints during backfilling.

H. Flotation and Water in the Trench

1. The Contractor will take all necessary precautions to prevent flotation of the pipe in the trench. Water will not be allowed to rise in the trench. The Contractor will use well points, sump pumps, or another approved method of dewatering as required to lower the water table below the bottom of the excavation while minimizing the migration of fines from the surrounding area. The Contractor will make a request to the Engineer and receive approval prior to the use of special dewatering equipment other than well points or sump pumps. Dewatering operations are considered incidental to the work and no additional compensation will be made to the Contractor.

I. Open Ends

1. Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end will be protected from damage and a temporary tight fitting plug or bulkhead will be placed in the exposed ends of the pipe to keep soil or other debris from entering the pipe.

J. Concrete Cradle Section next to Manhole

1. The pipe will be supported from the manhole wall to the limits of the manhole excavation in a normal sewer trench with a concrete cradle, structurally continuous with the manhole base slab or footing. Cost for this work is incidental to the cost of the pipe installation.

K. Cutting Pipe

1. Cutting will be in a neat workmanlike manner at right angles to the pipe axis without damage to the pipe. Observe specifications regarding joint locations. Smooth the cut end by power grinding or filing to remove burrs and sharp edges. Repair lining of the pipe asrequired.

L. Wyes and Special Fittings

1. Wyes, stubs, reducers, fittings, or other special pipes will be installed as shown on the Plans or where ordered by the Engineer. The fittings and special pipes will be made of a compatible material, type, and class and/or strength designation as the pipe and installed as required by the Plans and Specifications. The cost for providing and installing the above items is incidental to the cost of the pipes.

M. Valves

1. Valves and appurtenant fittings will be installed as shown on the Plans or where directed by the Engineer.

2. Check valves and gate valves will be installed on either flanged or mechanical joint ductile iron pipe.

3. Air release, vacuum relief and combination air valves larger than 3 inches in diameter will be installed on either flanged or mechanical joint ductile iron pipe. A gate valve conforming to Specification Section 02530 2.01.Q shall be installed to isolate these air valves from the force main.

4. Air release, vacuum relief and combination air valves 3 inches in diameter and smaller will be installed on a ductile iron tap 'T' fitting. A ball valve conforming to Specification Section 02530 2.01.Q shall be installed on a 6" threaded nipple between the 'T' and the air valve.

3.06 PIPE JOINTS

A. General

1. Pipe will be jointed immediately following the laying of each section. No pipe section will be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.

2. The following provisions will apply to insure tight and sound joints:

a. The joint will be placed with special care to avoid breaking joints and to leave gasket, if required, in proper position.

b. All pipe 12 inches in diameter or larger will have dead weight held by crane while being lined up and pushed home.

c. Pipe will be pushed home with a constant and even force and not jarred home by the momentum of a moving force that will place an impact load on pipe.

d. Cement and lubricant will be used as recommended by the manufacturer and designated by the Engineer.

B. Compression Joints

1. The two ends to be joined will be thoroughly cleaned and a compression gasket compatible with the type of pipe to be joined will be at the position recommended by the pipe manufacturer.

2. Lubricant recommended by the gasket manufacturer will be liberally applied to the gasket and both ends immediately before pipe ends are joined. The upstream pipe will be positioned such that the spigot may enter the bell squarely. The pipe being laid will be pushed home and the gasket position checked with a feeler gauge before installation of the next section. Flat, unconfined gaskets on concrete pipe will be cemented to the spigot at the position recommended by the pipe manufacturer.

C. Mechanical Joints

1. The two ends to be joined will be thoroughly cleaned with a wire brush and the plain end, socket end, and gasket will be brushed with soapy water. The end will be centered in the socket and adequate anchorage will be provided to hold the pipe in position until the joint can be completed. When deflecting pipe from a straight line is necessary, the deflection will be made after joint assembly and before tightening bolts. Pipe deflection will not exceed that specified by ANSI C 600.

2. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. All bolts will be torqued to the required range recommended by the pipe manufacturer. Over stressing of bolts will be avoided. Gauge lines on the spigot end will be checked following assembly to ensure proper positioning of bell and spigot has been accomplished.

3. Any joints not properly positioned will be disassembled, cleaned, and reassembled as previously indicated.

D. Flanged Joints

1. The two ends to be joined will be thoroughly cleaned with a wire brush. Bolt holes on each pipe flange to be joined will be aligned and bolts inserted. Bolts will be torqued evenly by alternating tightening of bolts opposite one another until all bolts are torqued to the recommended pressure.

E. Solvent Cement Joints

1. The two ends to be joined will be thoroughly cleaned and primer liberally applied to the outside of the spigot within the joint insertion limits and inside the bell in conformance with the manufacturer's recommendations. Cement will be applied immediately to the same surfaces as the primer and the pipe joined within one minute. A sufficient quantity of cement will be applied to form a bead of excess cement around the full circumference of the joint when the spigot is fully inserted. The spigot end will be inserted to the insertion stop mark and rotated one-fourth turn. Avoid disturbing the joint until cement has had ample time to set.

F. Restrained Joints

1. Restrained push-on joints are to be used as specified on the plans or by the Engineer. These special joints will be installed as specified by the manufacturer. The length of the pipe to be restrained will be determined by the Engineer based on pipe size, internal pressure, depth of cover, and soil characteristics around the pipe.

3.07 PIPE CAPS AND PLUGS

A. Wyes, stubs, or other fittings installed in the pipe for future connections will be closed at the open end. For pipes 21 inches in diameter or smaller, an approved cap or plug will be installed in the bell or socket using the same type joint or jointing material as required for the sewer. For pipes larger than 21 inches in diameter, temporary approved masonry bulkheads of the thickness required by the Plans and Specifications to close the open end may be substituted for stoppers. Care in backfilling will be used so that such closure and its seal will not be disturbed. This stopper will be jointed so that it may be removed later without injury to the pipe itself. Work and material is incidental to the cost of the pipe installation.

3.08 SERVICE CONNECTIONS

A. All service connections on new pipe up to and including 12-inch diameter will be 6-inch diameter either Schedule 40 or SDR 26 in-line wye connections unless indicated otherwise on the Plans. Service connections on pipes larger than 12 inches in diameter will not be allowed. Saddles will not be used on new construction.

B. All service connections on existing pipe up to and including 12-inch diameter will be 6 inch diameter Inserta Tee, or approved equal, or saddle wye connections.

C. Although the general location of connections may be shown on the drawings, the actual location will be determined by the Contractor, subject to approval by the Engineer. Connections for undeveloped property will generally be at the center of the lot. Connection locations for developed property will be coordinated with the property owner. The quantities shown on the proposal sheet are only approximate and are subject to change. The depth of connections at the property line will be determined by the Engineer. Service connections will be laid on no less than a 1 percent gradefor 6-inch diameter connections unless otherwise directed by the Engineer. Each building connection will be accurately recorded by station offset and depth on the as-built drawings and will be furnished to the Engineer. Unless authorized by the Engineer in writing, or shown on the drawings, building connections will not be tied into new or existing manholes. When service connections are tied into manholes at an elevation greater than 2 feet above the manhole invert, the service will be constructed as a drop construction as specified in Specification Section 02531 Paragraph 3.08.

D. Service connections will be laid in open trenches except where tunneling may be necessary under existing curbs, sidewalks, or pavements. In all such instances, a shaft must be excavated at the end of the connection for inspection purposes and measurement of length and depth. All service connections will extend to the right-of-way or easement limits. The service connection will be installed in conformance to the City of Memphis Standard No. SST-16.

3.09 PIPE ENCASEMENT, COLLARS, AND THRUST BLOCKS

A. General

1. Concrete will be Class "C" Concrete as specified in Specification Section 03050. All concrete will be placed, cured, and protected according to the applicable paragraphs of Specification Sections 03050 and 03310. Pipe alignment will be inspected immediately following concrete placement and any misalignment caused by the placement of concrete will be corrected before the initial set. Concrete will be protected against water until completelycured.

B. Pipe Encasement

1. Concrete encasement for pipes is to be used at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced as required. All pipe requiring encasement will be blocked at each joint using masonry supports of a minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete. Concrete will be placed on either side of the pipe in approximately equal amounts to prevent movement of the pipe. Concrete encasement is to be rectangular in section with a thickness of ½ the pipe diameter between the outside edge of pipe and the outside of encasement at the closest point unless shown otherwise on the Plans. The absolute minimum thickness for concrete encasement shall be 6 inches regardless of pipe size.

C. Pipe Collars

1. Concrete pipe collars are to be used to join pipe ends that cannot be joined with prefabricated joints. Concrete will be Class C and will be reinforced when shown on the Plans. Concrete pipe collars will be constructed at the locations and to the dimensions shown on the Plans or as directed by the Engineer. Pipes being joined will be blocked and supported laterally to prevent movement during placing or curing of concrete. Rubber water stops will be placed on each pipe before pouring the concrete collar. Fernco or equal mechanical coupling will be used for pipe connectors 16 inches and smaller.

D. Thrust Blocks

1. Concrete thrust blocks are to be used to resist internal thrust pressures at bends and fittings in force mains at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced when shown on the Plans. Thrust blocks will conform to the dimensions shown on the Plans or City of Memphis Standard SST-12. Load distribution type thrust blocks will be poured continuously from the force main to the undisturbed trench face. Backfill will not be placed as backing material for load distribution type thrust blocks.

2. All concrete will be poured in a way that leaves the pipe joint accessible for caulking or tightening of bolts. Care will be taken to permit the concrete to cure long enough to develop sufficient strength before the concrete is required to withstand the thrust. The area of the concrete bearing on the main or the restraining mass must be large enough to prevent over stressing the concrete.

3. If a concrete mass is used, a form may be necessary to contain the mass to provide access to joints or to insure the required bearing area. Generally, some form work is required for the mass of concrete necessary for blocking on mains sized 12 inches and larger. In poor soil, forming the concrete mass to construct the necessary bearing surface will be necessary. Instead of this construction, a restrained joint may be used.

4. Thrust blocks will be included in the linear foot price for the force main.

3.10 INVERTED SIPHONS

A. Each siphon will include inlet, outlet, and any intermediate manholes where shown on the Plans with all foundations, pipes, and pipe encasement and other appurtenances. Pipe to be included in the cost of the siphon is to be all pipe, fittings and specials between the center of the inlet manhole and the center of the outlet manhole.

B. The Contractor will construct cofferdams, temporary bulkheads, perform all pumping and other work necessary to protect the siphon during construction. The Contractor will be required to maintain a dry trench during construction, and will never be permitted to lay pipe or place concrete with water in the trench. Trenches will be kept free from water until the material in the joints and masonry has sufficiently hardened per Specification Section 02530 3.02 F Control of Water

C. Unless otherwise specified, inverted siphon pipe will be lined ductile iron Class 50 pipe and fittings as specified in Specification Section 02530 Paragraph 2.01.H fabricated for push-on type joints or HDPE conforming to Specification Section 02530 Paragraph 2.01.M. The siphon pipes will be encased in concrete at the locations and to the dimensions shown on the Plans or Details. The excavation, bedding, laying, jointing, pipe encasement, and backfill operations will conform to the applicable sections of this Specification.

D. When shown on the Plans, flexible joint ductile iron pipe will be used instead of push-on joint pipe as shown on Design Standards. Flexible joint pipe will be laid such that the maximum joint deflection as specified by the pipe manufacturer for each joint is not exceeded.

E. The inlet, outlet, and any intermediate manholes will be constructed according to the requirements of Specification Section 02531.

F. The inlet and outlet manhole inverts will be carefully shaped to conform to the inlet and outlet pipes and cause the least possible resistance to flow. The inlet manhole will have an invert weir constructed to contain low flows to a single siphon pipe. The invert weir will be level across the top and constructed to the elevation shown on the Plans. The outlet manhole invert will be formed to reduce backflow into the inactive siphon pipes.

3.11 BACKFILLING

A. General

1. After sanitary sewer facilities have been bedded and installed according to these Specifications and upon permission of the Engineer, the backfill may be placed. Backfilling operations will continue following as closely behind pipe installation as practical. All backfill will be placed in uniform horizontal layers. Pushing backfill material down a ramp into excavated areas will not be permitted. No trash will be allowed to accumulate in the space to be backfilled. Particular care will be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.

2. The Contractor will be responsible for the condition of the trenches and filled areas during the contract and warranty period. The Contractor will maintain frequent inspection of the same. Anytime during the 12-month warranty period the trenches or filled areas settle and sunken places appear, the Contractor will be required to refill these sunken places when they are discovered with suitable material and will replace all damaged curb, gutter, and sidewalk. All soft or dangerous trenches will be marked, barricaded and caution lighted for the protection of the public.

3. Property with an existing dwelling located on it or lots within a developed subdivision or planned development are considered improved property.

B. Street Right-of-Way and Improved Property

1. Backfill Material:

a. Backfill for manhole and pipe trench excavations through pavements in street or highway right-of-way or where the Engineer orders, will be made with pit run gravel or other acceptable material as approved by the Engineer. The backfill will be from the top of the bedding material or foundation to the subgrade elevation of the pavement. Pea gravel or similar granular material approximately uniform in size and without bonding properties will not be used.

b. Backfill for manhole and pipe trench excavations beyond pavements in street or highway right-of-way or outside public right-of-way will be made with select earth from the top level of the bedding material or foundation to the subgrade elevation in paved area, or within 1 inch of the surface in areas to be sodded, or to the surface in all other areas.

c. Select material will be free from debris, organic matter, perishable compressible material and contain no stones or lumps larger than 6 inches. Rocks and lumps smaller than 6 inches will not exceed an amount that will interfere with the consolidating properties of the fill material. Care will be taken that stones and lumps are kept separated and well distributed, and that all voids are completely filled with fine material. No rocks or lumps will come in direct contact with the pipe. The upper 3 feet of backfill in sodded or planted areas will be free of rocks or lumps larger than 1 inch in diameter.

2. Placement and Compaction:

a. Sanitary Sewer Trenches:
Backfill material will be placed by hand in 6 inch loose layers and tamped to a point 2 feet above the outside top of the pipe. Backfill will be compacted with suitable mechanical tamping equipment with special care being taken not to damage the pipe or joints. Use of compaction equipment directly above semi-rigid and flexible pipe should be avoided until sufficient backfill has been placed to ensure that the equipment will not damage the pipe. A minimum of 36 inches of compacted backfill above the top of semi-rigid and flexible pipe will

be in place before wheel loading and a minimum of 48 inches of compacted backfill before use of pneumatic tampers. From these elevations to the subgrade elevation of the pavement, bottom of the sod, or to the original ground surface, suitable backfill will be mechanically placed in 9 inch, maximum, loose layers. All backfill material will be compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).

b. Manholes and Special Structures:
When the masonry or concrete work has set sufficiently to withstand compaction, and the Engineer authorizes, backfill material will be placed in 6 inch loose layers and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfill will be placed in this manner from the foundation of the structure to the subgrade elevation of the pavement, the bottom of the sod or to the original ground surface.

C. Open Areas and Unimproved Property

1. Backfill Material:

Backfill of excavations on unimproved property will be made with select material from the top level of bedding material or foundation to the surface. Non-granular select material to be used for backfill will be free from debris, organic matter and perishable compressible material, and will contain no stones, lumps or rock fragments larger than 6 inches. Rocks or lumps smaller than 6 inches in diameter will not exceed an amount that will interfere with the consolidating properties of the fill material. No rocks or lumps will come in direct contact with the pipe. Stones and lumps will be kept separated and well distributed, and all voids will be completely filled with fine material.

2. Placement of Backfill:

Backfill procedures specified in Specification Section 02530 Paragraph 3.11.B will apply from the trench bottom to a point 2 feet above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be placed by bulldozer or other mechanical means.

D. Sanitary Sewer Facilities Placed on Fill

1. All sanitary sewer pipe laid on fill will be ductile iron pipe. Fill material placed in areas over which sanitary sewer facilities will be constructed will be select, job-excavated earth from the original ground to the subgrade elevation of the facility.

2. The fill material will be placed in 6 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) up to a point at least 2 feet above the outside top of the pipe or to the foundation of manholes or special structures. If compaction standards for the sanitary sewer exceed that of the adjoining fill, the width of compaction for a sanitary sewer will be not less than the outside diameter of pipe plus 10 feet. If compaction standards for the sanitary manhole or special structure exceed that of adjoining fill, the limits of compaction for the structure will be not less than 5 feet outside the structure base slab.

E. Removal of Excess Material

1. After the trench or excavation has been properly backfilled, all excess dirt will be removed from the streets, roadways and improved private property so pavements or turfed areas may be replaced and properties cleaned.

2. In open areas and unimproved property, the excess material may be used to fill low spots on property next to the right-of-way/easement. Before spreading excess soil, the Contractor will obtain written permission from the property owner for the spreading of excess soil, and a copy of the written permission will be submitted to the Engineer. Such spreading or filling will not obstruct surface drainage and be to the satisfaction of the property owner. Excess material will be disposed of by the Contractor.

3.12 TUNNELING, BORING, AND JACKING

A. General

1. Sewer pipe will be constructed by tunneling, boring, or jacking only at those locations shown on the plans or directed by the Engineer. Carrier pipe for these applications will be of the type specified in the Plans and Specifications. Grade and alignment will be maintained through all liner pipes. The Contractor will submit shop drawings detailing the method, equipment and material to be used for tunneling, boring and jacking operations to the Engineer for review and approval. The approval by the Engineer of any drawings or plans will not in any way be deemed to release the Contractor from full responsibility for complete and accurate performance of the Work according to the Contract Drawings and Specifications.

2. When tunneling, boring, or jacking is required under railroads, highways, streets, or other facilities, construction will not interfere with the operation of the railroad, street, highway, or other facility and will not weaken or damage any embankment or structure. No water shall be introduced into any tunneling, boring or jacking excavation that lies within City, State or Rail Road right-of-way. A boring that uses a bentonite slurry may be allowed at the discretion of the Engineer and the owner of the right-of-way.

3. The Contractor will be responsible for protection of utilities and sewers against damage by his work. If any utility above or near the tunnel is endangered or has been damaged because of the construction operations, the utility owner will be notified immediately and will be given access to the area to carry out all necessary repairs to such utilities. If any sewers are damaged, it will be the responsibility of the Contractor to make the necessary repairs. If any public or private property is endangered or has been damaged due to tunneling, boring, or jacking operations, it will be repaired at the Contractor's expense. All cost and expense to the Contractor of carrying out the above requirements will be considered included in his bid prices for the completed sewer installation.

4. Access pits will be of sufficient size to provide ample working space for the jacking or boring equipment, reaction blocks, bracing, liner plates, spoil removal, and 2 sections of pipe. Provisions will be made for the erection of guide rails in the bottom of the pit where applicable. If drainage is to be discharged from the jacking pit, a collection sump will be provided. Wherever end trenches are cut in the sides of the embankment or beyond it, such work will be sheeted securely and braced satisfactorily to prevent earth caving.

5. The Contractor will furnish and operate all necessary pumping equipment of ample capacity and arrange to keep tunnels and shafts free of water during construction and to dispose of water satisfactorily. During placement of concrete, drainage and pumping will be arranged so concrete is placed in dry conditions. No water will flow over the concrete until it has set and will not be damaged.

B. Tunneling

1. The Contractor will carry out the work of tunneling so there will be no cave-in or heaving of earth or other material into the tunnel excavation. If there should be any fall or movement of earth into the tunnel, the Contractor will proceed with the work with all necessary precautions to insure the safety of life and of sewers, utilities and public and private property above and near the tunnel.

2. The Contractor will furnish, place, and maintain all sheeting, bracing, lining or casing required to support the tunnel until the pipe and its bedding, jointing, encasement, and backfilling have been completed. All liners will remain in place.

3. Care will be used in trimming the surfaces of the excavated section and in placing the liners or sheeting and bracing so that the required minimum clearance between the outside of the pipe and the final position of the liners, sheeting and bracing in the tunnel will be attained without any deviation in sewer alignment. Sheeting or lining must be placed and held tightly against the trimmed earth surface of the excavated section so that there will be no voids between the earth and the lining or sheeting.

4. No part of the lining, bracing, or flanges of steel liner plates will project closer to the outside of the pipe or pipe bells than the clearance limits shown on the Plans, or a minimum of two inches, if not shown on the Plans.

5. If timber is used for lining and bracing instead of steel liner plates, invert struts will be placed at the required intervals but in such manner that the pipe and its bedding will be supported entirely by the original earth floor of the tunnel and not on timber lining or bracing. All timbers, when placed for the support of the roof and sides of the tunnel, will be properly fitted and wedged in place. Timber sets in tunnels will be abutting. All voids behind timbers will be filled with blocking or other suitable material.

6. Timbering will be designed and placed to allow the filling of voids. All excavated material not required for backfilling abandoned shafts will be removed from the site and disposed of by the Contractor at his expense.

7. Shafts will be constructed at the location shown on the Plans. Temporary construction shafts will be of adequate size and properly constructed and equipped to meet all safety requirements. All shafts will be barricaded, lighted, fenced, and properly guarded from the beginning of the excavation until the completion of the construction requiring the shaft.

8. Provision will be made at all shafts so that plumb lines suspended on the centerline of the sewer at each end of the shaft will hang freely from the surface.

9. A ladder meeting OSHA requirements will be provided in each shaft and will be kept in safe, good repair, clean and clear of debris.

10. Cavities between the surfaces of excavation and the tunnel liner plates or sheeting will be completely filled with a uniform sand cement grout consisting of 1 part portland cement and 7 parts sand and the minimum amount of water necessary for proper placement. Grout will be placed under pressure through grout holes in the steel liner plates or sheeting. The grout holes will be located and the grout placed in such sequence to insure the complete filling of all cavities and to transfer the load from the undisturbed material to the tunnel lining or sheeting uniformly.

11. After the tunnel section is excavated, lined, and braced, the pipe will be placed on and supported by steel rails or other approved supports. The supporting system will assure line and grade and will allow space below the pipe for concrete grout. Care will be used to avoid damage to the pipe and the liner plates.

12. The space between the pipe and the tunnel will be completely grouted with a mixture of sand and portland cement, mixed in the proportions of 1 part cement to 7 parts sand by volume and a minimum amount of water necessary for proper placement whether placed under pressure or by hand.

13. Temporary shafts will be completely abandoned. Unless otherwise specified in the Plans or Contract Documents all sheeting, bracing, and similar items may be removed unless the Contractor requests and receives authorization from the Engineer to leave it in place. No payment will be made for items left in place at the Contractor's option. If the Plans or the Engineer requires leaving the sheeting, bracing, and similar items in place, measurement will be made as provided in Specification Section 02530 Part 5 and payment will be made as provided in

C. Boring

1. When required by the Plans, sewers will be installed in bored holes. The holes will be bored from the downstream end, unless site conditions dictate otherwise and the Engineer approves.

2. The boring machine to be used will be in good condition and capable of drilling the bore hole within the required limits of accuracy. A smooth liner of sufficient strength will be forced into the bored hole to give a tight fit against the earth sides of the bore hole and still provide a uniform clearance of at least two inches around the pipe flange to permit pressure grouting. The liner pipe will be carefully inspected to insure that the carrier pipe can be properly placed.

3. All carrier pipe shall be mechanical joint or restrained joint pipe. Manholes at the ends of a section of bored pipe will not be constructed until the bored section is completed.

4. The following procedures will be used for carrier pipe 18 inches and larger in diameter. The assembled pipe will be placed in the bored hole with approved, non-metallic, casing spacers attached. Casing spacers will be attached in accordance with the manufacturer's recommendations and with a casing spacer installed within 6 inches of each end of the bore. The assembled pipe will be placed in the bored hole only by such method that will keep the joints in compression. Any method that disjoints the pipe while being placed will not be permitted.

5. The ends of the bore shall be sealed with an approved, flexible end seal. The end seals shall be attached in accordance with the manufacturer's recommendations using stainless steel hardware.

6. When unforeseen obstructions or conditions require abandonment of a partially completed bore hole, and the starting of a new hole, the Contractor will grout the abandoned bore hole solid. The Contractor will receive no compensation for any expenses incurred by any unsuccessful attempt.

D. Jacking

1. The Contractor will furnish for the Engineer's review, a plan showing his proposed method of jacking, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, and similar items in the assembled position. The review of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

2. Heavy duty jacks suitable for forcing the pipe through the embankment will be provided by the Contractor. In operating jacks even pressure will be applied to all jacks used. A suitable jacking head and bracing between jacks and jacking head will be provided so that pressure will be applied to the pipe uniformly around the circumference of the pipe. A suitable jacking frame or backstop capable of resisting the jacking forces will be provided. The pipe to be jacked will be set on guides, properly braced together to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly will be placed to line up with the direction and grade of the pipe. The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with the inside angles or lugs to keep the cutting edge from slipping back onto pipe.

3. The pipe will be jacked from the downstream end. Manholes at the ends of a section of jacked pipe will not be constructed until jacked section is completed.

4. Any pipe damaged in jacking operations will be removed and replaced by the Contractor at his own expense. Embankment material will be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

5. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, will conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

6. The distance that the excavation will extend beyond the end of the pipe depends on the character of the material, but it will not exceed 2 feet in any case. This distance will be decreased if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

7. A cushion material will be placed in the joints between each pipe section adequate to distribute the jacking forces around the entire periphery of the pipe uniformly.

8. When jacking of pipe is begun, the operation will be carried on without interruption, as much as practicable, to prevent the pipe from becoming firmly set in the embankment.

9. The pits or trenches excavated to allow jacking operations will be backfilled immediately after the jacking of the pipe has been completed according to Specification Section 02530 Paragraph 3.11.

10. When unforeseen obstructions or conditions require abandonment of a partially completed pipe jack, the Contractor will grout the abandoned pipe solid. The Contractor will receive no compensation for any expenses incurred by any unsuccessful attempt.

E. Sewer Pipe in Jacked Liner

1. When required by the Plans or Contract Documents, a sewer pipe will be installed by jacking a pipe as a liner and inserting a carrier pipe of required size, type, and class. When using jacking for liners, the steel liner will be welded steel, 35,000 psi yield strength, and of the diameter and wall thickness required on the Plans and Specifications. The Contractor will provide, at his own expense, thicker walled pipe if necessary to withstand the forces of jacking. In any case, the Contractor will retain full responsibility for the adequacy of this jacking operation, equipment and material.

F. Reserved.

3.13 DELETED

3.14 FINAL GRADING

A. Final grading around sanitary sewer facilities will conform to the elevation of adjacent undisturbed ground or as shown on the Plans. Sufficient grading will be done to provide adequate drainage.

3.15 CLEANING

A. All necessary precautions will be taken to prevent the entrance of mud, sand, or other obstructing material into the pipelines. As the work progresses, the interior of the sewer will be cleaned of all dirt, jointing material and extraneous material. On small pipe where cleaning after laying may be difficult, a squeegee will be kept in the pipeline and pulled forward past each joint immediately after its completion. Before final inspection the Contractor will remove all debris and foreign material.

PART 4 - FINAL TESTING AND ACCEPTANCE

4.01 VISUAL INSPECTION

A. All work will be subject to visual inspection for faults or defects and any such deviation or omission will be corrected at once. All tests will be made by the Contractor who will provide necessary equipment for testing and lamping the system in the presence of and under the supervision and instructions of the Engineer. Lamp tests will be observed first hand by the Engineer. Each section of sewer line will show a full circle of light when lamped between manholes. All defects located will be corrected before conducting leakage tests.

4.02 LEAKAGE TESTS

A. Leakage tests will be performed on the full length of all sewer lines and manholes in the presence of the Engineer before acceptance. The cost of all testing will be included in the unit price for the item being tested.

B. Exfiltration Leakage Test

1. This section will only apply to pipe larger than 24 inches and smaller than 48 inches in diameter. All pipe over 48 inches in diameter will have individual joint testing according to Specification Section 02530 Paragraph 4.02.E. The method of testing used by the Contractor will be subject to approval by the Engineer. The Contractor will provide all required testing apparatus. The method adopted must exert a minimum internal water pressure of four feet. This hydrostatic head will be measured from the inside top of the pipe at the high end of the section being tested. The height of the water level at the beginning of the test must be high enough so that the 4-foot head will be standing at the end of the test. The maximum hydrostatic head is limited to 15 feet. The exfiltration test will be maintained for at least two hours on each reach between manholes as necessary to find all leaks. The trench and backfill are intended to be free of excess water.

2. In areas where groundwater is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches long will be installed through the manhole wall on top of the lowest sewer line entering the manhole. This will be done at the time the sewer line is installed. Immediately before the performance of the leakage test, the groundwater level will be determined by removing pipe cap, blowing air through pipe nipples into the ground to clear it, and then connecting a clear plastic tube to the nipple. The tube will be held vertically and a measurement of height in feet of water will be taken after the water stops rising in this plastic tube. The height in feet will be divided by 2.3 to establish the pounds of pressure that will be added to all readings. In the event there is water present in the trench or backfill at the time of the test, the required head producing the pressure inside the pipe must be raised to offset the counteracting pressure outside of the pipe. The test will not be considered satisfactory until an acceptable method of measurement shows that the exfiltration rate does not exceed 0 gallons per inch of internal diameter per mile of pipe per day for each reach tested.

3. An initial test must be arranged by the Contractor so that the first reach of each size laid by each crew at the beginning of the work day can be tested before the backfill has been completed, but the pipe will be backfilled to a point 2 feet above the outside top of the pipe. This test reach is intended to extend only to the next proposed manhole location. However, if conditions justify, the length of the test reach may be reduced but never will this reach be less than 100 feet. No further pipe laying will be permitted by this crew until the above described test has been satisfied. All remaining pipe will be subject to the exfiltration test after manholes have been constructed and backfill placed. Manholes are to be included in this test and will be considered as sections of pipe equal to the diameter of the manhole.

4. If anytime the exfiltration observed and measured by the Engineer exceeds 0 gallons per inch of internal diameter per mile of sewer per day, the Contractor will find the point(s) of leakage and will make necessary repairs and then retest the same reach. The Contractor will submit his plans for repair to the Engineer for his review.

5. Water used for testing will be removed from the test reach following acceptance and will be disposed of properly. Water used for testing will not be discharged in such a manner to damage other construction or public or private property. The cost of providing the test water will be borne by the Contractor.

C. Air Leakage Test for 6-24 inch Diameter Pipe

1. Upon completion of construction, or earlier if the Engineer deems advisable, the Contractor will provide the necessary equipment and labor to perform low pressure air tests according to ASTM F1417. This test will be performed in the presence of the Engineer and will be for all types of gravity sewer pipe. This test will also include service lines from manholes.

2. The pressure test gauge will meet the following minimum specifications:

Size (diameter)	4 ½ inches
Pressure Range	0-15 PSI
Figure Intervals	1 PSI Increments
Minor Subdivisions	0.05 PSI
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	Plus or minus 0.25% of Maximum scale reading
Dial	White coated aluminum with black lettering, 270□ arc and mirror edges
Pipe Connection	Low male ½ inch NPT

3. Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are done.

4. Air leakage tests will be performed on each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trenches. The test time will be determined from the following table. If air tests fail to meet the following requirements, repeat tests as necessary after all leaks and defects have been repaired. Before acceptance, the same sewer reach will pass the low pressure air test.

Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated [1]

Pipe Diameter (in.)	Minimum Time (min:sec)	Test Time for Length of Sewer Tested (min)
6	5:40	.854 X L(ft)/60
8	7:34	1.52 X L(ft)/60
10	9:26	2.374 X L(ft)/60
12	11:20	3.418 X L(ft)/60
15	14:10	5.342 X L(ft)/60
18	17:00	7.692 X L(ft)/60
21	19:50	10.47 X L(ft)/60
24	22:47	13.674 X L(ft)/60

1. Establish the test time for the sewer length from the formula or the minimum time, whichever is greater.

D. Infiltration Test

1. Infiltration tests may be required for the complete line or any portion of it. Failure of any part of the line to pass an infiltration test will be sufficient reason to require additional work by the Contractor to reduce the infiltration in such portions of the line tested. The passing of an infiltration test will in no way relieve the Contractor of any responsibility to repair visible leaks found during the visual inspection.

2. Maximum allowable infiltration will be 0 gallons per mile per inch of diameter of sewer per 24-hour day at a time. The joints will be tight, and visible leakage in the joints of leakage greater than that specified above will be repaired at the Contractor's expense by any means necessary.

E. Joint Acceptance Testing

1. Individual joints will be tested for pipe diameters of 48 inches and greater. Testing will be performed according to ASTM C 1103.

4.03 DEFLECTION TEST - SEMIRIGID AND FLEXIBLE PIPE

A. All polyvinyl chloride (PVC) pipe and glass fiber reinforced polymer mortar pipe will be tested for deflection. All testing will take place after backfill has been in place at least 30 days. All lines will be thoroughly cleaned before testing to assure accuracy.

B. Tests will be run using a rigid ball or nine arm mandrel having a diameter of 95% of the inside diameter of the pipe for PVC and 96% of the inside diameter of the pipe for glass fiber reinforced polymer mortar pipe. The mandrel will be pulled freely by hand through the pipe from manhole to manhole. No pipe deflection will exceed 5% for PVC and 4% for glass fiber reinforced polymer mortar pipe. Any section failing the test will be repaired by re-bedding or pipe replacement and retested to the satisfaction of the Engineer.

C. The cost of this service will be included in the unit price bid for the pipe.

4.04 SEWAGE FORCE MAINS

A. The Contractor will perform hydrostatic pressure and leakage tests concurrently conforming to AWWA C 600, AWWA C 605, ASTM D 2774 or ASTM F 2164 procedures as applicable and as modified herein. Tests will apply to all sewage force mains after backfilling.

B. Force mains will be tested separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Select test segments such that adjustable seated valves are isolated for individual checking. The Contractor will furnish and install test plugs at no additional cost, including all anchors, braces and other devices to withstand hydrostatic pressure on plugs. The Contractor will be responsible for any damage to public or private property caused by failure of plugs. Limit water fill rates of line to available venting capacity.

C. Hydrostatic Pressure Test
Conduct tests at 1.5 times maximum operating pressure determined by following

$P_{pt} = 0.650\ (OP-GE)$, in which

P_{pt} = test pressure in psi at gauge elevation
OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line
GE = elevation in feet at center line of gauge

D. Hydrostatic Leakage Test
Conduct tests conforming to AWWA C 600, AWWA C 605, ASTM D 2774 or ASTM F 2164 procedures, as applicable, at maximum operating pressure determined by following formula:

$P_{lt} = 0.433\ (OP-GE)$, in which

P_{lt} = test pressure in psi at gauge elevation
OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line
GE = elevation in feet at center line of gauge

E. Satisfactorily complete previously defined pressure tests before determining the amount of leakage. Maximum allowable leakage will be determined by the following formula:

$$L = ND\frac{\sqrt{p}}{7400}$$

L = Allowable leakage in gallons/hour
N = Number of joints in length of pipeline tested
D = Nominal diameter of the pipe, in inches
P = Average test pressure during leakage test, in pounds per square inch, gauge

4.05 FINAL ACCEPTANCE

A. When all work required by the Contract has been completed, the Contractor shall submit to the Engineer written certification from a registered land surveyor that the centerline of each structure is within 2.0 feet of the centerline of the sewer easement or the location designated on the plans. After receiving the surveyor's certification from the Contractor, the Engineer will make a final inspection of

the Work, including any tests for operation. After completion of this inspection the Engineer will, if all things are satisfactory to him, issue to the Contractor a Certificate of Completion certifying that the Work required by the Contract has been completed according to the Contract Drawings and Specifications. However, the Certificate will not operate to release the Contractor or his sureties from any guarantees under the Contract or the Performance Bond. Upon receipt of the Certificate of Completion the Contractor will clean the premises and see that they are in an orderly condition.

4.06 Tracer Wire

A. All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the contractor, and engineer, prior to acceptance of ownership. The verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

PART 5 - MEASUREMENT

5.01 SITE PREPARATION AND RESTORATION

A. The area to be considered for measurement will be the limit of the construction area in acres unless otherwise directed by the Engineer.

B. When the Proposal Sheet(s) do(es) not contain an item for Site Preparation and Restoration, this work will be required within the construction limits and will not be paid for directly but will be considered as a subsidiary obligation of the Contractor under other contract items.

5.02 UNDERCUT BACKFILL

A. Undercut backfill will be measured by the ton of limestone in place.

5.03 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

A. Sheeting and shoring directed to remain in place will be measured by the 1,000 board feet, in place, after being cut off below grade. Sheeting and shoring placed and removed by the Contractor or left in place at the request of the Contractor will not be measured for payment.

5.04 PAVEMENT BACKFILL

A. Pit run gravel or other acceptable material used for backfill under pavements or other areas directed by the Engineer will be measured by the ton of material in place.

5.05 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Service connection removal and replacement for construction of sewer facilities will be measured per each, complete in place. Service connections damaged by the Contractor that do not require removal and replacement for construction of sewer facilities will not be measured for payment.

5.06 EXCAVATION

A. All work for excavation, blasting, drainage of trenches and dewatering, backfilling of excavation, compaction, grading, protection of existing utilities, disposal of excess material, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered obligations of the Contractor under other Pay Items of the Contract.

5.07 SEWER PIPE

A. Sewer pipe length will be measured per linear foot along the centerline of the pipe from center of manhole to center of manhole. When there are special structures, sewer pipe will be measured from inside face to inside face for the various sizes, types, classes or wall thicknesses. No measurement of pipe depth will be made unless changed field conditions result in a change in the Plans by the Engineer.

B. Sewer pipe length measurement will include the length of wyes as measured along the primary axis for all sizes of sewer pipe.

5.08 PIPE WYES

A. Pipe wyes on sewer lines will not be measured for payment, but are incidental to the cost of furnishing and installing sewer pipe.

5.09 SEWAGE FORCE MAIN

A. Sewage force main length will be measured per linear foot along the centerline of the pipe from the point of measurement at the pumping station or valve box shown on the Plans to the end of the force main at its discharge location. Shut-off and relief valves, valve boxes, and thrust blocks are incidental to the construction of the force main and/or pump station and will not be measured for payment.

5.10 DUCTILE IRON PIPE FITTINGS

A. Ductile iron pipe fittings will not be measured for payment, but are incidental to the cost of furnishing and installing ductile iron sewer pipe or inverted siphons.

5.11 SERVICE CONNECTIONS

A. Service connections between sewer main and right-of-way or easement line will be measured per linear foot to the nearest whole foot, along the centerline of the pipe from the outside face of the wye to the end of the reducer, for the various sizes and types constructed.

B. Service connections between a manhole and the right-of-way or easement line will be measured per linear foot horizontally from the inside face of the manhole to the end of the reducer. Drop service connections will be measured per vertical foot from the flow line of the service connection in the manhole wall to the end of the building connection inside the manhole to the nearest whole foot, along the centerline of the pipe for the various sizes constructed. No measurement of service connection depth will be made. Service connection length will include the length of fitting, reducers, and specials as measured along their centerline.

5.12 NON-SHRINKING GROUT

A. Non-shrinking grout for general use as indicated on the plans or as directed by the Engineer will be measured by the cubic yard, complete in place for each type used.

5.13 PLAIN CONCRETE FOR GENERAL USE

A. Concrete for general use including but not limited to pipe bedding, encasement and collars at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place for each class used.

5.14 REINFORCED CONCRETE

A. Reinforced concrete including but not limited to pipe encasement and collars at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place.

5.15 Tracer Wire

A. Tracer wire and/or appurtenances will not be measured for payment.

5.16 INVERTED SIPHON

A. Inverted siphons constructed according to Plans and Specifications will be measured per lump sum, for each siphon complete in place.

5.17 SEWER IN EARTH TUNNEL

A. Sewers constructed in earth tunnels will be measured by the centerline length for tunnels with liner plate or without liner plate.

B. Measurements will be from the face of the pit to the face of the pit.

5.18 SEWER IN BORED HOLE

A. Sewers constructed in a bored hole will be measured by the centerline length for bored holes with or without liner pipe.

B. If Contractor has requested and has obtained approval to use a bored hole instead of the construction required by the Plans, no measurement of sewers in bored holes will be made.

C. Reserved.

5.19 JACKED SEWER

A. Jacked sewers will be measured by the centerline length from the face of the pit to the face of the pit. If the Contractor has requested and has obtained approval to jack a sewer instead of the construction required by the Plans, no measurement of jacked sewers will be made.

5.20 SEWER IN JACKED LINER

A. Sewers in jacked liner will be measured by the centerline length from the face of the pit to the face of the pit. If the Contractor has requested and has obtained approval to construct a sewer in a jacked liner instead of the construction required by the Plans, no measurement of sewers in jacked liner will be made.

5.21 DELETED

5.22 ABANDONMENT OF EXISTING PIPE

A. Abandonment of existing pipe will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

5.23 REMOVAL OF EXISTING PIPE

A. Removal of existing pipe will be measured per linear foot, to the nearest whole foot, along the centerline of the pipe to be removed regardless of size, type, or depth. No measurement of existing pipe removal within the limits of excavation for new sewers will be made

PART 6 - PAYMENT

6.01 SITE PREPARATION AND RESTORATION

Payment will be made for Site Preparation and Restoration at the contract lump sum price, which will be full compensation for removal of trees, shrubs, plants, brush, rubbish, fences, manmade obstructions including but not limited to structures, abandoned cars and appliances, building foundations, and all other obstructions as may be directed by the Engineer; the disposal of debris, removing of obstructions, and the restoration of fences, turfed areas, and all other items will be as specified in the Plans and Contract Documents or as directed by the Engineer.

6.02 UNDERCUT BACKFILL

A. Accepted quantities of undercut backfill will be paid for at the contract unit price per ton of limestone furnished and placed, which will be full compensation for undercut excavation, special protection, protection of existing utilities, and backfilling to bottom of facility subgrade elevations, complete in place.

6.03 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

A. Accepted quantities of sheeting and shoring directed by the Engineer to remain in place will be paid for at the contract unit price per 1,000 board feet in place after being cut off below grade, which will be full compensation for material only. The cost of placing sheeting and shoring to remain in place will be included in the unit cost of other items. No payment will be made for sheeting and shoring placed and removed by the Contractor or left in place upon request of the Contractor.

6.04 PAVEMENT BACKFILL

A. Accepted quantities of pit run gravel or other acceptable material used for backfill under pavements or other areas designated by the Engineer will be paid for at the contract unit price per ton furnished and placed, which will be full compensation for furnishing, placing and compacting the selected material.

6.05 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Accepted quantities of service connections removed and replaced will be paid for at the contract unit price per each for various types of service connections, which will be full compensation for excavation, removal of old service line and appurtenances, furnishing and construction of new service lines, connections to existing service line and appurtenances to remain, and backfilling, complete in place.

B. All pipeline material will be generically the same throughout the project except solid wall PVC pipe service connected to truss pipe mainlines.

6.06 OMITTED

6.07 SEWER PIPE

A. The accepted quantities of all sewer pipe will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types, classes, or wall thicknesses of pipe, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, maintenance of sewage flow, bedding, laying, jointing, cleaning and inspection, conducting acceptance tests, installation of pipe wyes, connection to manholes, adapters and couplings, stoppers, and removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside pavement areas. All pipeline material will be generically the same throughout the project except connecting solid wall PVC pipe service connections to truss pipe mainlines.

6.08 OMITTED

6.09 SEWAGE FORCE MAIN

A. The accepted quantities of sewage force main will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types and classes or wall thicknesses, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, bedding, laying, jointing, fittings, shut-off valves, relief valves, valve pits, thrust blocks, cleaning and inspection, conducting acceptance tests, connection to existing sewer manholes or structures, removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside pavement areas.

6.10 OMITTED

6.11 SERVICE CONNECTIONS

A. The accepted quantities of service connections will be paid for at the contract unit price per linear foot furnished and laid for the various sizes and types. The accepted quantities of drop service connection will be paid for at the contract unit price per vertical foot furnished and installed. The contract unit price will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, bedding, laying, jointing, adapters and couplings, stoppers, reducers, marking reducer, removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside of pavement areas.

6.12 NON-SHRINKING GROUT

A. The accepted quantities of non-shrinking grout for general use will be paid for at the contract unit price per cubic yard, complete in place for each type used, which will be full compensation for material, testing, etc. necessary for the satisfactory completion of the work.

6.13 PLAIN CONCRETE FOR GENERAL USE

A. The accepted quantities of plain concrete for general use including but not limited to pipe bedding, encasement and collars will be paid for at the contract unit price per cubic yard complete in place, which will be full compensation for material, testing, excavation, pipe support, form work, removal of forms, and curing and protection of concrete.

6.14 REINFORCED CONCRETE

A. The accepted quantities of reinforced concrete including but not limited to pipe encasement and collars will be paid for at the contract unit price per cubic yard, complete in place that will be full compensation for material, testing, excavation, pipe support, form work, reinforcing steel, removal of forms, and curing and protection of concrete.

6.15 INVERTED SIPHON

A. Payment will be made for Inverted Siphon at the contract lump sum price, which price will be full compensation for material and material testing, excavation, special protection, cofferdams, temporary bulkheads, maintenance of sewage flow during construction, protection of existing utilities, inlet manhole and outlet manhole with rims and covers, intermediate manholes, siphon pipe and fittings, concrete encasement, conducting acceptance test, removal and/or abandonment of existing pipe within the limits of excavation and backfilling.

6.16 SEWER IN EARTH TUNNEL

A. The accepted quantities of sewers in earth tunnels will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes, which price will be full compensation for material and material testing, pit excavation, sheeting, timber bracing, liner if required, excavation, temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance tests and backfilling of pits and shafts.

6.17 SEWER IN BORED HOLE

A. The accepted quantities of sewers in a bored hole will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes, which will be full compensation for material and material testing, pit excavation, sheeting, timber bracing, liner if required, excavation, boring temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, casing spacers, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance test, and backfilling of pits and shafts.

B. Reserved.

6.18 JACKED SEWER

A. The accepted quantities of jacked sewers will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes; the price will be full compensation for material and material testing, pit excavation, jacking equipment and concrete slab foundation, jacking back stop, temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, jacking pipe, making pipe joint cushions, cleaning and inspection, conducting acceptance tests, and backfilling of pits and shafts.

6.19 SEWER IN JACKED LINER

A. The accepted quantities of sewers in jacked liner will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes; the price will be full compensation for material and material testing, pit excavation, jacking equipment and concrete slab foundation, jacking back stop, temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe liner, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance tests, and backfilling of pits and shafts.

6.20 DELETED

6.21 OMITTED

6.22 REMOVAL OF EXISTING PIPE

A. The accepted quantities of existing pipe removal will be paid for at the contract unit price per linear foot regardless of pipe size or type which price will be full compensation for excavation, special protection, protection of existing utilities, pipe removal, salvage or disposal, backfilling and site restoration.

6.23 Tracer Wire

No separate payment shall be made for tracer wire or appurtenances. Tracer wire and appurtenances shall be considered incidental to the sewer and/or service connection installation.

6.24 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02530-6.01	SITE PREPARATION AND RESTORATION	Lump Sum
02530-6.02	UNDERCUT BACKFILL	Ton
02530-6.03	SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE	1,000 Board Feet
02530-6.04	PAVEMENT BACKFILL	Ton
02530-6.04.01	DELETED	
02530-6.04.02	Pit Run Gravel Backfill	Ton
02530-6.05	SERVICE CONNECTION REMOVAL AND REPLACEMENT	EA
02530-6.05._____	Type Service Connection	EA
02530-6.07	SEWER PIPE	Linear Foot
02530-6.07.01._____"	Prestressed Concrete Cylinder Pipe	LF
02530-6.07.02._____"	Reinforced Concrete Pipe, Class II	LF
02530-6.07.03._____"	Reinforced Concrete Pipe, Class III	LF
02530-6.07.04.___ ___"	Reinforced Concrete Pipe, Class IV	LF
02530-6.07.05.___ ___"	Reinforced Concrete Pipe, Class V	LF
02530-6.07.06.___ ___"	Ductile Iron Pipe, Class 50	LF
02530-6.07.07.___ ___"	Ductile Iron Pipe, Class 51	LF
02530-6.07.08.___ ___"	Ductile Iron Pipe, Class 52	LF
02530-6.07.09.___ ___"	Ductile Iron Pipe, Class 53	LF
02530-6.07.10.___ ___"	Ductile Iron Pipe, Class 54	LF
02530-6.07.11.___ ___"	Ductile Iron Pipe, Class 55	LF
02530-6.07.12.___ ___"	Ductile Iron Pipe, Class 56	LF
02530-6.07.13	DELETED	
02530-6.07.14.	DELETED	
02530-6.07.15.___ ___"	Polyvinyl Chloride (PVC) Pipe	LF
02530-6.07.16.___ ___"	Glass Fiber Reinforced Polymer Mortar Pipe	LF
02530-6.09	FORCE MAIN	LF
02530-6.09.01.___ ___"	Ductile Iron Force Main, Class 50	LF
02530-6.09.02.___ ___"	Ductile Iron Force Main, Class 51	LF
02530-6.09.03.___ ___"	Ductile Iron Force Main, Class 52	LF
02530-6.09.04.___ ___"	Ductile Iron Force Main, Class 53	LF
02530-6.09.05.___ ___"	Ductile Iron Force Main, Class 54	LF
02530-6.09.06.___ ___"	Ductile Iron Force Main, Class 55	LF
02530-6.09.07.___ ___"	Ductile Iron Force Main, Class 56	LF
02530-6.09.08.___ ___"	Polyvinyl Chloride (PVC) Force Main, Class 200	LF
02530-6.09.09.___ ___"	High Density Polyethylene Force Main	LF
02530-6.11	SERVICE CONNECTION	LF
02530-6.12	NON-SHRINKING GROUT	CY
02530-6.12.01	Non-shrinking grout, Type I	CY
02530-6.12.02	Non-shrinking, fast setting grout, Type II	CY
02530-6.13	PLAIN CONCRETE FOR GENERAL USE	CY
02530-6.13.01	Plain concrete for general use, Class A	CY
02530-6.13.02	Plain concrete for general use, Class C	CY
02530-6.14	REINFORCED CONCRETE FOR GENERAL USE	CY
02530-6.15	INVERTED SIPHON	Lump Sum
02530-6.16	SEWER IN EARTH TUNNEL	LF
02530-6.16.01._____	"Sewer in Earth Tunnel With Liner Plate"	LF
02530-6.16.02._____	"Sewer in Earth Tunnel Without Liner Plate"	LF
02530-6.17	SEWER IN BORED HOLE	LF
02530-6.17.01._____	"Sewer in Bored Hole With Liner Pipe"	LF
02530-6.17.02._____	"Sewer in Bored Hole Without Liner Pipe"	LF
02530-6.17.03.	Reserved	
02530-6.18	JACKED SEWER	LF
02530-6.18.01_____	"Jacked Sewer"	LF

02530-6.19 SEWER IN JACKED LINER	LF
02530-6.19.01_____"Sewer in Jacked Liner"	LF
02530-6.22 REMOVAL OF EXISTING PIPE	LF

Examples of Pay Item Numbering System for Sewer Pipes

02530-6.07.03.48	Pay Item Number
02530-6	Section of Specification
.07	Last digit(s) of applicable paragraphs for payment
.03	Type of Pipe: e.g., Reinforced Concrete, Class III
.48	Size of Pipe; e.g., 48" diameter

END OF SECTION 0253

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02531 MANHOLES AND SPECIAL STRUCTURES

PART 1 - SCOPE

1.01 This work consists of the construction of manholes and special structures for sanitary sewers of the type and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished according to these Specifications and Plans or as established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Unless otherwise provided, the Contractor is required to furnish all labor, material, equipment and other items necessary to complete the manholes and structures as shown on the Plans.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. Construction Material

1. All material furnished by the Contractor will be new, high quality and free from defects. Previously used material in acceptable condition is allowed for bracing, forms, false work, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

B. Qualifications of Manufacturers

1. Manholes for sanitary sewers will be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Contractor are subject to the approval of the Engineer. No material will be delivered until the manufacturer and product have been approved by the Engineer.

C. Material Inspection and Testing

1. Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested. All material to be used in the work will be sampled, inspected, and tested by current ASTM specifications, or other standard specifications. The Contractor will furnish the Engineer with three copies of certified reports from an accredited testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each structure delivered to the project will show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Contractor.

2. The Contractor will notify the Engineer before any deliveries of material and will make whatever provisions are necessary to aid the Engineer in the inspection and culling of the material before installation.

D. Storage

1. The contractor will provide storage facilities and exercise measures that will maintain the specified quality and fitness of materials to be incorporated in the work.

E. Portland Cement Concrete

1. Portland cement concrete will be as designated in Specification Section 02530 Paragraph 2.01.V.

F. Steel Reinforcement

1. Deformed steel reinforcing bars and welded wire fabric will be as shown on the Plans or as directed by the Engineer. All steel reinforcement will be as specified in Specification Section 03310.

G. Mortar

1. Mortar will be as designated in Specification Section 02530 Paragraph 2.01.Y.

H. Brick

1. All brick will be as designated in Specification Section 02530 Paragraph 2.01.BB.

2. No new brick manholes are to be allowed in the City of Memphis system. This specification is included for repair of existing brick manholes and incidental use of brick for leveling courses in new construction.

I. Gray Iron Castings

1. Castings will be of the standard Memphis type as detailed on the Plans and Design Standards. Castings will be made of good quality, even grained cast iron and will be smooth and free from scale, lumps, blisters, sand-holes, and defects of any nature that would render them unfit for the service for which they are intended. They will be thoroughly cleaned and subjected to a careful hammer inspection.

2. Castings will meet the requirements of ASTM A 48, Class No. 35, or Grade 65-45-12 ductile iron meeting the requirements of ASTM A 536. Manhole rims and covers will be designed to withstand HS-20-44 loading defined in the AASHTO Specifications. Rims and covers will be machined or ground at touching surfaces to seat firmly and prevent rocking. Any set not matching will be removed and replaced at no additional cost.

J. Manhole Steps

1. Steps are not allowed in sewer structures.

K. Precast Concrete Manhole Sections, Bases and Other Structures

1. All precast reinforced concrete manhole risers, cones, grade rings, and flat slab tops will conform to the requirements of ASTM C 478 for the specified diameter and strength class. All cone sections and transition sections will be eccentric. Barrel sections will be custom made with openings to meet indicated pipe alignment and invert elevations. The Contractor will submit shop drawings for each typical structure shown on the Plans for approval by the Engineer. After approval by the Engineer, the Contractor can place the order for structures. The bottom manhole section and pipe(s) will be in place (supported by concrete blocks) before pouring the cast-in-place manhole base. The bottom of all precast base slabs 4 feet in diameter will extend a minimum of 6 inches beyond the outside wall of the manhole riser. The bottom of all precast base slabs 5 feet in diameter will extend a minimum of 7 inches beyond the outside wall of the manhole riser. The bottom of all precast base slabs 6 feet and larger in diameter will extend a minimum of 8 inches beyond the outside wall of the manhole riser. All poured in place bases will extend 12 inches beyond the outside wall of the manhole riser.

2. For sewer manholes four (4) to six (6) feet in diameter and less than twenty (20) feet deep, precast reinforced concrete manhole base sections shall be a minimum of 8 inches thick. For sewer manholes greater than six (6) feet in diameter or more than twenty (20) feet deep, precast reinforced concrete manhole base sections shall be a minimum of 12 inches thick. All precast manhole base sections shall be reinforced with Number 4 steel reinforcing bars placed 6 inches on center each way and at mid depth of the slab, unless shown otherwise on the plans. Steel reinforcement shall conform to Specification Section 03310.

3. The interior of the manhole sections will be a smooth, cylindrical surface. Lifting holes, when provided, will be filled with expanding grout, or other approved material.

4. Gaskets between manhole sections will be a flexible material meeting the requirements of Federal Specification SS-S-00219 for Type I gaskets and AASHTO M 198 for Type B gaskets unless otherwise specified on the Plans. Joint contact surfaces will be formed with machined castings. Joints between a manhole section and precast concrete flat tops will be mortar joints conforming to the requirements of this Specification. All sewer manholes must pass the Negative Air Pressure (Vacuum) Test as required in Specification Section 02531 Paragraph 4.02.A.

5. All pump station wet wells and siphon structures shall be lined or coated with a material conforming to either Section 02530 paragraph 2.01.DD or Section 02531 paragraph 2.01.R.

6. All manholes and structures on pipe 36 inches in diameter and larger shall be lined or coated with a material conforming to either Section 02530 paragraph 2.01.DD or Section 02531 paragraph 2.01.R.

7. Manhole manufacturer shall install plastic liner as recommended by lining manufacturer.

L. Sand

1. Sand for structure abandonment will consist of sand or a natural sandy soil, all of which passes a 3/8 inch sieve and not more than 10 percent passes a No. 200 sieve.

M. Pit Run Gravel

1. Pit run gravel will be as designated in Specification Section 02530 Paragraph 2.01.AA.

N. Non-Shrinking Grout

1. Non-shrinking grout will be as designated in Specification Section 02530 Paragraph 2.01.CC.

O. Waterproofing

1. Waterproofing for manhole exteriors will consist of two coats of asphalt or coal tar pitch. Asphalt will conform to the requirements of ASTM D 449. Coal tar pitch will conform to the requirements of ASTM D 450.

P. Vent Stack

1. Vent stack pipe will be a 4-inch diameter galvanized steel pipe conforming to the requirements of ASTM A 53 with a minimum wall thickness of standard weight pipe. One end of the vent stack pipe will have a 180-degree bend fabricated by either shop welding a manufactured 180 degree elbow or fitting the pipe with a manufactured 180 degree threaded elbow and coupling. The opposite end of the pipe will be plain end. The maximum height for vent stacks for this specification shall be 20 vertical feet.

2. Vent stack supports will be fabricated from steel shapes conforming to ASTM A 36, and to the dimensions and details shown on the Plans. The vent stack supports will be welded to the vent stack pipe and to the vent stack support bottom ring around the entire contact surface.

3. The vent stack support bottom ring will be shop fabricated with bolt holes at the spacing shown on the plans for anchorage to the manhole top. All welding will be according to the American Welding Society Structural Welding Code.

4. A vent stack support ring with threaded coupling may be cast in the flat top for installation of the vent stack.

5. All surfaces of the completed vent stack and welds will be cleaned and painted. The color of the finish coat will be silver.

Q. Flexible Pipe Connectors to Manholes

1. All connections of pipe to manhole sidewalls will be made with flexible connectors. Openings in the manhole sidewall for the pipe will be precast or cored to provide required size and location. The hole will be manufactured to allow for lateral and vertical movement, and angular adjustments through 20□. A connector between manholes and pipes such as Press-Seal, Kor-N-Seal, or Z-LOK will be installed in the precast or cored opening. The connector will meet the requirements set forth in the latest revision of ASTM C 923. A corrosion resistant, stainless steel external band will be used around the flexible connector to create the external seal around the pipe.

2. Any void between the pipe and connector will be filled with an approved flexible gasket material.

3. Flexible connectors will be considered an integral part of the manhole sidewall, and no separate payment will be allowed.

R. Protective Linings and Coatings

1. All poly vinyl chloride (PVC) protective lining for concrete structures shall conform to Section 02530 Paragraph 2.01.DD.

2. Protective coating properties:

Product Type	Polymer based Polyurethane or Solid Epoxy
Color	Light
Compressive Strength	4,000 psi (minimum)
Tensile Strength	1,500 psi (minimum)
Hardness Type D	60
Bond Strength-Concrete	> than 750 psi
Dry Film Thickness	125 mils

3. Warranty: The COATINGS MANUFACTURER shall warranty the entire project to include any and all aspects of the surface preparation, base material installation and protective coating applications for a period of TEN (10) YEARS from the date of acceptance by the City of Memphis. The warranty shall make no distinction between installation practices and material performance and shall not be prorated with respect to elapsed time for the entire warranty period. Manufacturer shall, within a reasonable period of time after receipt of written notice thereof by the City of Memphis [period not to exceed sixty (60) calendar days], repair defects in materials or workmanship during said TEN (10) year period, and any damage to other work caused by such defects or repairing of same at his own expense and without cost to the City of Memphis.

4. Protective coatings for concrete structures will be SpectraShield® Liner System Products, Structure-Guard as manufactured by Quadex Rehabilitation Products, or as approved.

S. Grade Adapter Rings

1. Grade adapter rings shall be the standard Memphis type, compatible with City of Memphis standard rings and covers. Grade adapter rings shall be gray iron castings conforming to paragraph 2.01.I in these specifications.

T. Repair Materials

1. Repair materials are to be used in the rehabilitation of existing sewer manholes and structures. Repair materials shall be used to fill voids and to structurally reinforce and/or rebuild substrate surfaces as deemed necessary by the Engineer.

2. Quick blending, rapid setting, high early strength, fiber-reinforced, non-shrink repair mortar that can be trowelled or spray applied must be compatible with the specified protective coating.

3. Material properties:

Product Type	Fused Calcium Aluminate or Cementitious Fiberglass
Cure Time	<48 hours
Curing Gasses	Non-Toxic
Compressive Strength	5,000 psi (minimum)
Tensile Strength	500 psi (minimum)
Flexural Strength	600 psi (minimum)
Shrinkage	0% at 90% Relative Humidity

4. Repair materials for concrete structures will be QM-1s Restore as manufactured by Quadex Rehabilitation Products, or as approved.

2.02 EQUIPMENT

A. The Contractor will furnish and maintain in good condition all equipment and facilities as required for the proper execution and inspection of the Work. All equipment and facilities will be on site and approved by the Engineer before work will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 SITE PREPARATION AND RESTORATION

A. Site preparation and restoration for sewer manhole and structure construction will be performed per Specification Section 02530 Paragraph 3.01.

3.02 EARTHWORK

A. Earthwork for sewer manholes and structures will be performed per Specification Section 02530 Paragraph 3.02.

3.03 REMOVAL OR ABANDONMENT OF EXISTING MANHOLES AND STRUCTURES

A. Removal

1. Existing manholes and structures to be removed will be shown on the Plans or as directed by the Engineer. The City reserves the right to retain or reject salvage of any materials encountered. Unless otherwise specified, salvaged rims and covers remain the property of the City and will be delivered by the Contractor to a City yard as directed by the Engineer. All remaining materials become the property of the Contractor who will be responsible for disposal.

2. The excavation will be backfilled per Specification Section 02530 Paragraph 3.11.

B. Abandonment

1. Existing manholes and structures to be abandoned in place will be shown on the Plans or as identified by the Engineer.

2. After removing manhole and structure rims, covers, and similar items, all pipes will be bulkheaded. The walls will be lowered to 2 feet below final grade if in earth or to 12 inches below subgrade if in a proposed pavement area. The remaining manhole or structure will be filled with sand to the limits previously mentioned.

3. The sand will be placed in approximately 12 inch layers and each layer compacted to 75 percent relative density or 95 percent of maximum density (standard proctor) as applicable. A 12 inch thick plain concrete slab will be installed over the manhole top extending 12 inches beyond the outside face of the manhole.

4. The City reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for disposing of same.

5. All manholes that must be removed to perform excavation for the proposed sewer pipe and/or structures will be removed as part of the sewer excavation and no additional payment will be due the Contractor.

3.04 GENERAL CONSTRUCTION REQUIREMENTS

A. New manholes and structures will be constructed of plain or reinforced concrete. Work may include the repairing of brick masonry manholes or structures. Where the top elevation is not shown on the Plans, the manhole or structure will be built to conform to the elevation ordered by the Engineer. Standard depth manholes are those having a depth of 6'-0" from rim to invert of the sewer. Manholes and special structures will be built as the pipe laying progresses. The Engineer, at his discretion may stop the laying of pipe or the building of other manholes until the manhole just passed has been completed. Completion of the manhole will include the installation of fittings, connections to pipes, placing of castings, testing, and other construction as shown on the Plans.

B. Inlet and outlet pipes will extend through the walls of manholes and special structures to allow for water tight connections with the manhole walls. The ends will be cut off flush with the inside surface of the wall as shown on the Plans, Details, or otherwise directed. The pipes will intersect at the structures so the inlet pipe will be aligned in the direction of outlet pipe such that counterflow is prevented. Water stops will be installed around pipes as they pass through the sanitary manhole wall.

C. Inverts will be of Class A concrete poured to conform to the shapes shown on the Plans or otherwise directed. The inverts will be so constructed as to cause the least possible resistance to flow. The shape of the inverts will conform uniformly to inlet and outlet pipes. A smooth and uniform finish will be required.

D. All castings, rims, covers and fittings will be placed in the positions shown in the Plans or as directed by the Engineer. Rims on manhole cones will be set concentrically with the top of the cone in a full bed of mortar so that the space between the top of the manhole cone and the bottom flanges of the rim will be filled and made watertight. A ring of mortar at least 1 inch thick and pitched to shed water away from the rim will be placed around the outside of the bottom flange. Mortar will extend to the outer edge of the cone and will be finished smooth and flush with the top of the flange. If rim fittings are to be bolted or anchored in concrete or brick masonry, all anchors or bolts will be set and held in place before the concrete or mortar is placed. The unit will not be disturbed until the mortar or concrete has hardened to adequate strength. Bolt-down manhole covers will be installed at the locations shown on the Plans and all bolts securely tightened following acceptance of the manhole to provide a watertight seal.

E. Vent stacks will be installed on manholes at locations and to the elevations shown on the Plans or as directed by the Engineer. Vent stacks will be installed on flat top manholes only. The vent stack pipe will be positioned in the hole provided in the manhole top and the vent stack support bottom ring

will be attached to the concrete manhole top with anchor bolts in drilled holes with expansion sleeves. A vent stack support ring with threaded coupling may be cast in the flat top for installation of the vent stack.

F. Protective Linings and Coatings

1. The contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.

2. Wherever a pipe lateral (not of plastic lined concrete) is installed through a lined concrete manhole, the lining shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches. This protecting cap may be molded or fabricated from the lining material but needs not be locked into the pipe.

3. All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer.

4. Welding shall fuse both sheets and weld strip together to provide a continuous joint equal in corrosion resistance and impermeability to the liner plate.

5. Hot-air welding guns shall provide effluent air to the sheets to be joined at a temperature between 500□ and 600□F. Welding guns shall be held approximately 0.5 inch from and moved back and forth over the junction of the two materials to be joined. The gun shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip. All welders shall be certified by the manufacturer.

6. Protective coatings shall be installed in strict conformance with the manufacturer's recommendations.

3.05 REPAIRING OF BRICK MANHOLES AND STRUCTURES

A. Where shown on the Plans or directed by the Engineer, the Contractor will repair brick manholes or structures. The work will conform to the applicable portions of Specification Section 02640 Paragraph 3.02.B.1.

3.06 PRECAST CONCRETE CONSTRUCTION

A. Precast concrete manholes will be neatly and accurately built according to the Plans or as directed by the Engineer. All precast manholes will use either a concrete slab constructed of Class A concrete on a 12 inch thick crushed stone foundation and which will be cast integrally with the base section and the inlet and outlet pipes as shown on the Plans or the precast manhole will use a precast base section conforming to Specification Section 02531 Paragraph 2.01.K.

1. Precast concrete manhole base sections shall be placed on a 12 inch minimum thickness No. 67 crushed limestone base. The stone base will be fully encapsulated in a geotextile fabric as indicated on the plans or as directed by the Engineer. Geotextile fabric shall conform to Section 02370 paragraph 2.01.C, and grade No. 67 stone shall conform to Section 02530 paragraph 2.01.W.

B. Precast concrete sections will be set so the structure will be vertical and with sections in true alignment. Joint surfaces of the base or previously installed section will have a flexible rubber gasket installed in the recess after being primed with an asphaltic cement material recommended by the manufacturer. Flexible rubber gaskets and primers will not be applied to wet or damp surfaces. Each joint will be completely filled with nonshrinking grout on the inside and outside of the manhole after sections have been placed.

C. All holes in precast sections used for their handling will be thoroughly plugged with nonshrinking grout. The grout will be finished smooth and flush with the interior and exterior manhole wall surfaces.

D. All precast concrete manhole cones will be of eccentric construction as shown on the Plans or Details.

E. If brick masonry is used to adjust manhole rims to grade, the masonry work will be performed according to Specification Section 02640 Paragraph 3.02.B.1.

F. All flat top manhole slabs will be steel reinforced with a minimum thickness of 6 inches. The manhole rim and cover will be placed eccentrically in the slab as shown on the Plans or Details. Waterproofing will be applied per Specification Section 02531 Paragraph 3.09.

3.07 CAST-IN-PLACE CONCRETE CONSTRUCTION

A. All cast-in-place manholes and structures will be built of Class A concrete as shown on the Plans. The manholes and structures will be built on an undisturbed earth foundation and conform to the dimensions, shapes and details shown on the Plans. Concrete construction will conform to the methods, forms, mixture, placement, protection, and curing for concrete per Specification Section 03310.

B. Cast-in-place manholes will be neatly and accurately built according to the Plans or as directed by the Engineer. Wall thicknesses will be as detailed on the Plans but not less than 6 inches thick.

C. All cast-in-place manholes will be of eccentric construction as shown on the Plans. Any required reinforcement will be of the kind, type, and size and will be spaced, bent, and fastened as shown on the Plans.

D. Connection of inlet and outlet pipes will conform to the sizes, alignments, and elevations shown on the Plans. Concrete reinforcement and inlet and outlet pipes will be in place and approved by the Engineer before any concrete is placed. If concrete placement is not continuous, a rubber water stop gasket will be required at each construction joint.

E. The inside and outside surfaces of the manhole or structure walls will receive a Class 1, Ordinary Surface Finish as defined by Specification Section 03310 Paragraph 3.11. Waterproofing will be applied per Specification Section 02531 Paragraph 3.09.

3.08 MANHOLE DROP CONSTRUCTION

A. Drop Construction for New Manholes

1. Drop construction will be installed for new manholes at the locations shown on the plans and/or as directed by the Engineer. Drop construction will conform to the details shown on the plans and Details SST-2 for outside drop construction. If precast manhole construction is used, the manhole sections will be custom made with openings for both the upper and lower inlet pipes. The pipe connections to the manhole sidewalls shall be made with flexible connectors conforming to Specification Section 02531 Paragraph 2.01.Q. Water stops will be installed around pipes as they pass through the sanitary manhole wall. Grout will be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces. If cast-in-place manhole construction is used, the upper and lower inlet pipes will be in place and approved by the Engineer before any concrete being placed. All drop construction will be constructed of either ductile iron pipe with push-on or mechanical joints or PVC pipe conforming to the appropriate section of these Specifications. PVC pipe for drop construction at new manholes will be used only on improved property as defined in Specification Section 02530 Paragraph 3.11.A. On unimproved property the section of inlet pipe making the connection to the manhole at the higher

elevation and all fittings and drop pipe shall be ductile iron pipe. Solvent cement joints may be used on PVC for drop construction. Encasement of the outside drop pipe will be constructed of Class C concrete.

B. Drop Construction for Existing Manholes

1. Drop construction will be installed in existing manholes at the locations shown on the plans and/or as directed by the Engineer. Drop construction will conform to the details shown on the plans and Detail SST-2 for inside drop construction. The Contractor will core a hole in the manhole wall to permit installation of a flexible connector as specified in Specification Section 02531 2.01 Q Flexible Pipe Connectors to Manholes and the inlet pipe at the required flow line elevation, horizontal angle, and slope. Care will be used to avoid unnecessary damage to the existing masonry or concrete.

2. All loose material will be removed from the cut surfaces, which will be completely coated with grout before setting the pipe. Before inserting the pipe and flexible connector, a sufficient thickness of grout will be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe will be solidly filled with grout and neatly pointed up on the inside to present a smooth joint, flush with the inner and outer wall surface. Any necessary modifications to the existing invert will be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. All drop construction will be constructed of either ductile iron pipe with push-on or mechanical joints or PVC pipe conforming to the appropriate section of these Specifications. Solvent cement joints may be used on PVC for drop construction. The vertical drop construction will have the dead weight held by suitable means until the steel support straps are secured in place and tightened. The pipe mechanical joint bolts, if used, will not be positioned against the manhole wall. The steel support straps will be fastened to the manhole wall with two bolts per strap set in expansion sleeves in drilled holes.

3.09 WATERPROOFING

A. After the manhole masonry and concrete construction are complete, the exterior surface of each manhole wall within the limits shown on the Plans will be given two coats of approved waterproofing material. Total minimum dry film thickness will be 12 mils. Each coat will be applied at a rate not to exceed one gallon per 100 square feet. The waterproofing materials will be applied by brush or low pressure sprayer and according to the instructions of the manufacturer. Time will be allowed between coats to permit sufficient drying so that the application of the second coat does not affect the first coat.

B. Care will be exercised during backfilling to prevent damage to the waterproofing. Any waterproof coating damaged during backfill operations will be cleaned of all dirt and two coats of waterproofing reapplied as previously specified.

3.10 DEWATERING

A. Contractor shall furnish, install and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to remove any groundwater encountered in the excavation. Contractor shall conduct said groundwater away from the construction site in an approved manner. Generally, dewatering is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, dewatering may be measured and paid for as defined in Specification Section 02531 Parts 5 and 6.

3.11 BYPASS PUMPING

Contractor shall furnish, install and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to maintain sewage flow around the work area. Contractor shall conduct

said bypass pumping in an approved manner. Generally, bypass pumping is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, bypass pumping may be measured and paid for as defined in Specification Section 02531 Parts 5 and 6.

3.11. ADJUSTMENT OF RIMS AND COVERS

A. Standard adjustment method:

1. Any manhole covers not adjusted and set at final grade by others shall be adjusted by the Contractor. If the cover requires lowering, the manhole rim shall be removed, sufficient upper courses of brick removed, and the rim reset at proper grade by use of cement mortar over the top course of brick remaining.

2. If the cover requires raising, all defective courses of brick shall be removed and the manhole rebuilt to proper grade and the rim reset as described above. The maximum finished collar height as measured from the top of the manhole rim to the beginning of the conical section shall be 18 inches. If the adjustment would require a collar of greater than 18 inches in height, then the existing collar and conical section of the manhole shall be removed, the riser section raised the required amount, the conical section and collar rebuilt and the rim reset at the proper grade.

3. Any changes in grade for manhole covers of precast or poured-in-place manholes shall be as shown on the plans or as directed by the Engineer.

B. Manhole adjustment with adapter rings:

1. For manhole covers to be raised less than or equal to 5 inches and where the total collar height would not exceed 18 inches, manhole adapter rings may be used if approved by the Engineer. Adapter rings may be up to a maximum of 5 inches utilizing no more than one ring. Adapter rings shall be tack welded to the existing rim at a minimum of 4 locations.

C. Alternate adjustment method:

1. For manhole covers requiring adjustment where Cement Stabilized Aggregate Base (Specification Section 02710.1) or Soil Cement Base (Specification Section 02710.2) is being placed, the Contractor may, at his option, remove manhole rims and covers and adequately seal off the top of the existing manholes below the bottom of the base course prior to the aggregate or soil cementing operations. If this option is exercised, the Contractor shall reference the location of all manholes so sealed off and aggregate or soil cementing operations shall then continue over the entire street. Within 24 hours after the final compaction of a section of roadway or paved area, all manholes located within this section shall be raised to grade by removing a section of the soil or aggregate base a minimum 3 feet square directly over each manhole. The manhole rims and covers shall then be replaced with Class A concrete to the subgrade. If, in the process of adjusting the manhole rims, the Contractor removed a larger section than specified, he shall replace the entire area so removed with Class A concrete at this expense.

3.13 PUMPING STATIONS

A. Pumping stations and force mains will conform to the latest edition of the State of Tennessee Department of Environment and Conservation Division of Water Pollution Control Specification "Design Criteria for Sewage Works." The City will be responsible for providing the secondary electrical service to the top of the utility pole installed by the contractor. The City will also be responsible for any necessary extension of MLG&W water mains necessary to serve the pump stations. The Contractor will be responsible for providing the water service connection from the MLG&W main or meter box to the pump station.

PART 4 - ACCEPTANCE TEST FOR MANHOLES AND STRUCTURES

4.01 VISUAL INSPECTION

A. All work constructed will be subject to visual inspection for faults, defects, or deviations from the Plans and any such deviation or omission will be corrected at once. All tests will be made by the Contractor who will provide necessary equipment for testing and lamping the manhole or structure in the presence of and under the supervision and instructions of the Engineer. Lamp tests will be observed first hand by the Engineer. All defects found will be corrected before conducting leakage tests. Repair methods must be approved by the Engineer.

4.02 MANHOLE LEAKAGE TEST

A. All manholes and special structures will be subjected to a vacuum test as outlined in ASTM C 1244 or as specified. The manhole, including the frame, will be placed under a vacuum of 10 inches Hg (4.9 psig). The manhole will be considered acceptable if the time measured for the vacuum to drop to 9 inches Hg (4.4 psig) is greater than that shown in the table on the following page. Manholes not meeting the vacuum test requirements will be repaired and retested or replaced.

Minimum Test Times for Various Manhole Diameters

	Manhole Diameter (ft)				
	4	5	6	7	8
Depth (ft)			Test Time (sec)		
8	20	26	33	42	55
10	25	33	41	51	64
12	30	39	49	66	86
14	35	46	57	74	96
16	40	52	67	87	113
18	45	59	73	95	123
20	50	65	81	105	137
22	55	72	89	116	150
24	59	78	97	126	164
26	64	85	105	137	177
28	69	91	113	147	191
30	74	98	121	157	205

B. The Contractor will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs and operating personnel. The cost of this work is to be included in the unit bid price for manholes.

4.03 PROTECTIVE LININGS AND COATINGS

A. After the manhole or other structure is installed, all surfaces covered with lining, including welds, shall be tested with an approved electrical hole detector (Tinker & Rasor Model No. AP-W with power pack) with the instrument set at 20,000 volts minimum. All welds shall be physically tested by a nondestructive probing method. All patches over holes, or repairs to the liner or coating wherever damage has occurred, shall be accomplished in accordance with manufacturer's recommendations.

B. Defective welds will be retested after repairs have been made. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection. Inspection shall be made within 2 days after joint has been completed in order to prevent tearing the projecting weld strip and consequent damage to the liner from equipment and materials used in or taken through the work.

PART 5 - MEASUREMENT

5.01 STANDARD DEPTH SEWER MANHOLE

A. Standard depth manholes will be measured per each, for the various diameters and types less manhole rim and cover. Standard depth is a manhole depth less than or equal to 6 feet as measured vertically from the top of the manhole cone or slab to the invert of the manhole. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of sewer manholes. No measurement shall be made for any transition slab to switch to 4 feet diameter riser sections from larger diameter bases. No measurement shall be made for flat tops. Transition slabs and flat tops, if used, shall be incidental to the construction of the sewer manhole.

5.02 EXTRA DEPTH SEWER MANHOLE

A. Extra depth manholes will be measured per vertical foot along the vertical centerline of the manhole from a point 6.0 feet above the invert of the manhole to the top of the manhole cone or slab for the various diameters and types. Only manholes deeper than 6.0 feet will be considered for extra depth measurement. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of extra depth sewer manholes. No measurement shall be made for any transition slab to switch to 4 feet diameter riser sections from larger diameter bases. No measurement shall be made for flat tops. Transition slabs and flat tops, if used, shall be incidental to the construction of the extra depth sewer manhole.

5.03 SEWER MANHOLE DROP CONSTRUCTION

A. Drop construction in new or existing manholes will be measured per vertical foot as measured from the upper inlet pipe flowline to the flowline of drop pipe elbows at the bottom of the drop construction. Payment for drop construction for new manholes will be in addition to payment for standard depth manhole and extra depth construction (if required).

5.04 REPAIR BRICK SEWER MANHOLE AND STRUCTURE

A. Repair of brick manholes and structures will be measured per each.

5.05 SPECIAL SEWER STRUCTURE

A. Special structures will be measured per each including access shafts, but less manhole rim and cover. No measurement of depth will be made. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of the special structure.

5.06 SEWER MANHOLE RIM AND COVER

A. Manhole rims and covers will be measured per each set consisting of one rim and one cover for the various types.

5.07 VENT STACK

A. Vent stacks will be measured per each set consisting of stack pipe, 180° bend and support. No measurement of height will be made.

5.08 SEWER MANHOLE AND STRUCTURE REMOVAL

A. Removal of existing manholes and structures will be measured per each. Removal of existing manholes and structures within the limits of excavation for new sewer facilities will not be measured or paid for separately but will be included in the price of the new sewerfacility.

5.09 SEWER MANHOLE AND STRUCTURE ABANDONMENT

A. Manholes and other sewer structures to be abandoned will be measured for payment per each. Material for backfilling abandoned structures will not be measured.

5.10 DEWATERING

A. Generally, dewatering is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, dewatering may be measured for payment. If measured for payment, dewatering will be measured by the day, each day thatthe pumps are in operation and that the contractor is actively working within the excavation being dewatered. If the contractor is not actively working within the excavation, no measurement will be made for dewatering. The actual quantities used will be jointly agreed upon between the City and the Contractor.

5.11 BYPASS PUMPING

A. Generally, bypass pumping is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, bypass pumping may be measured for payment. If measured for payment, bypass pumping will be measured by the day, each day that the pumps are in operation and the contractor is working on the sewer downstream of the bypass. If the contractor is not actively working on the sewer downstream of the bypass, no measurement will be made for bypass pumping. The actual quantities used will be jointly agreed upon between the City and the Contractor.

5.12 ADJUSTMENT OF RIMS AND COVERS

A. Standard adjustment method:

1. Standard manhole adjustments will be measured per each manhole rim adjusted to grade.

B. Manhole adjustment with adapter rings:

1. Manhole adjustment with adapter rings will be measured per each manhole rim adjusted to grade.

5.13 PUMPING STATION

A. Pumping station(s) constructed according to Plans and Specifications will be measured per lump sum for each pumping station, complete in place and operational. Included as a part of the pumping

station is the water service connection from the MLG&W main shown on the Plans to the pump station(s). The power pole set by the Contractor to receive MLG&W secondary service and all electrical service from the top of the pole to pumping station equipment are included in the lump sum measurement.

5.14 PROTECTIVE COATINGS

A. Generally, protective coatings are considered to be an incidental to the construction of sewer manholes and special structures. In some cases, at the City's discretion, protective coatings may be measured for payment. If measured for payment, protective coatings will be measured by square foot of surface area covered. No measurement shall be made for repair materials.

PART 6 - PAYMENT

6.01 STANDARD DEPTH SEWER MANHOLE

A. The accepted quantities of standard depth sewer manholes will be paid for at the contract unit price per each, complete in place for the various diameters and types less rim and cover, which will be full compensation for materials and materials testing, excavation, special protection, and curing of concrete, placing and jointing precast sections, transition slabs, flat tops, construction of base slabs, inverts, connection of inlet and outlet pipes, waterproofing, linings or coatings, cleaning and inspection, conducting acceptance tests, removal and/or abandonment of existing pipe, manholes, or structures within the limits of manhole excavation, and backfilling outside of pavement areas.

6.02 EXTRA DEPTH SEWER MANHOLE

A. The accepted quantities of extra depth sewer manholes will be paid for at the contract unit price per vertical foot, complete in place for the various diameters and types, which will be full compensation for materials and materials testing, excavation, special protection, placing, protection, and curing of concrete, placing and jointing precast sections, construction and installation of base slab, transition slab, flat top, invert, connection of inlet and outlet pipes, waterproofing, lining or coating, cleaning and inspection, conducting acceptance tests, removal and/or abandonment of existing pipe, manholes or structures within the limits of excavation, and backfilling outside of pavement areas.

6.03 SEWER MANHOLE DROP CONSTRUCTION

A. The accepted quantities of sewer manhole drop construction will be paid for at the contract unit price per vertical foot, complete in place for drop construction in new manholes or drop construction in existing manholes, which will be full compensation for materials and materials testing, excavation, special protection, maintenance of sewage flow during construction, construction of drop pipe, pipe fitting and connections, installation of steel support straps, placement, curing, and protection of concrete from the manhole base to the top of drop construction, cleaning and inspection, and backfilling outside of pavement areas. Payment for drop construction for new manholes will be in addition to payment for standard depth manhole and extra depth construction (if required).

6.04 REPAIR BRICK SEWER MANHOLE AND STRUCTURE

A. The accepted quantities of repair brick sewer manholes and structures will be paid for at the contract unit price per each, complete according to detail, which will be full compensation for materials and materials testing, excavation, special protection, maintenance of sewage flow during construction, masonry work, plastering, waterproofing, cleaning and inspection, conducting acceptance test, and backfilling outside of pavement areas.

6.05 SPECIAL SEWER STRUCTURE

A. The accepted quantities of special sewer structures will be paid for at the contract unit price per each, complete in place according to detail, which will be full compensation for materials and materials' testing, excavation, special protection, maintenance of sewage flow during construction, placement, curing, and protection of concrete, cleaning and inspection, waterproofing, linings or coatings, conducting acceptance test, and backfilling outside pavement areas.

6.06 SEWER MANHOLE RIM AND COVER

A. The accepted quantities of sewer manhole rim and cover set will be paid for at the contract unit price per each set complete in place for various types which price will be full compensation for materials and materials' testing, setting rim and cover, placing gaskets and bolts, protection and curing of mortar, cleaning and inspection.

6.07 VENT STACK

A. The accepted quantities of vent stacks will be paid for at the contract unit price per each, complete in place, which will be full compensation for materials and materials' testing, fabrication, painting, and installation of vent stacks.

6.08 SEWER MANHOLE AND STRUCTURE REMOVAL

A. The accepted quantities of sewer manhole and structure removal will be paid for at the contract unit price per each, which price will be full compensation for excavation, special protection, protection of existing utilities, structure removal, disposal of debris, and backfill.

6.09 SEWER MANHOLE AND STRUCTURE ABANDONMENT

A. Sewer structures to be abandoned will be paid for at the contract unit price per each, which price will be full compensation for preparing the structure for abandonment, sealing connecting pipes, furnishing and placing backfill material, compaction, handling of salvageable material, and disposal of debris.

6.10 DEWATERING

A. If measured for payment, the accepted quantities shall be paid for at the contract unit price per day, which shall be full compensation for material, installation, and operation of pumps, pipes, appurtenances, and all equipment of sufficient capacity required to conduct the groundwater away form the construction site and to satisfactorily complete the work.

6.11 BYPASS PUMPING

A. If measured for payment, the accepted quantities of bypass pumping shall be paid for at the contract unit price per day, which shall be full compensation for material, installation, and operation of pumps, pipes, appurtenances, and all equipment of sufficient capacity required to maintain sewage flow around the work area and to satisfactorily complete the work.

6.12 ADJUSTMENT OF RIMS AND COVERS

A. Standard adjustment method:

1. The accepted quantities of manholes adjusted will be paid for at the contract unit price per each for raising or lowering the manhole cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the covers to the satisfaction of the Engineer.

B Manhole adjustment with adapter rings:

1. The accepted quantities of manholes adjusted by the adapter ring method will be paid for at the contract unit price per each for raising the manhole to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the cover to the satisfaction of the Engineer.

6.13 PUMPING STATION

A. Payment will be made for pumping station at the contract lump sum price, which will be full compensation for material, structures (i.e., wet and dry wells), equipment and controls, excavation, special protection, maintenance of sewage flow, protection of existing utilities, provision of the water service connection from the MLG&W water main (valve box) to the pumping station, connection to the source of power on the site, connecting a power supply to the pumping station from top of the pole set by the Contractor at pump site, conducting acceptance tests, backfilling, and all items incidental to the construction of a complete, operational pumping station.

6.14 PROTECTIVE COATINGS

A. If measured for payment, the accepted quantities of protective coatings shall be paid for atthe contract unit price square foot, which shall be full compensation for material, surface preparation, installation, testing, and all equipment required to satisfactorily complete the work. No separate payment shall be made for repair materials.

6.15 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item Pay Unit	
02531-6.01	STANDARD DEPTH SEWER MANHOLE	EA
02531-6.01.01_____Ft.	Diameter Standard Depth Precast Concrete Manhole	EA
02531-6.01.02_____Ft.	Diameter Standard Depth Poured-in-Place Concrete Manhole	EA
02531-6.02	EXTRA DEPTH SEWER MANHOLE	VF
02531-6.02.01_____Ft.	Diameter Extra Depth Precast Concrete Manhole Vertical Foot	VF
02531-6.02.02_____Ft.	Diameter Extra Depth Poured-in-Place Concrete Manhole	VF
02531-6.03	SEWER MANHOLE DROP CONSTRUCTION	VF
02531-6.03.01_____In.	Diameter Drop Construction in New Manhole	VF
02531-6.03.02_____In.	Diameter Drop Construction in Existing Manhole	VF
02531-6.04	REPAIR BRICK SEWER MANHOLE AND STRUCTURES	EA
02531-6.05	SPECIAL STRUCTURE	EA
02531-6.06	SEWER MANHOLE RIM AND COVER	EA
02531-6.06.01	No. 7 Manhole Rim and Cover	EA
02531-6.06.02	Bolted Down Manhole Rim and Cover	EA
02531-6.06.03	No. 6 Manhole Rim and Cover	EA
02531-6.07	VENT STACK	EA
02531-6.08	SEWER MANHOLE AND STRUCTURE REMOVAL	EA
02531-6.09	SEWER MANHOLE AND STRUCTURE ABANDONMENT	EA
02531-6.10	DEWATERING	DAY
02531-6.11	BYPASS PUMPING	DAY
02531-6.12	ADJUSTMENT OF RIMS AND COVERS	EA

02531-6.12.01	Adjustment of rim and cover by standard method	EA
02531-6.12.02	Adjustment of rim and cover with adapter rings	EA
02531-6.13	PUMPING STATION	LS
02531-6.14	PROTECTIVE COATING	SF

END OF SECTION 02531

SECTION 02541
CLOSED CIRCUIT TELEVISION INSPECTION OF SEWER MAINS & CONNECTIONS

PART 1 General

1.01 SCOPE

A. This Work will consist of cleaning and Pipeline Assessment Certification Program (PACP) internal closed circuit television (CCTV) surveys to digitally inspect and record conditions of existing sanitary sewer mains and connections. Sewer pipes and connections to be inspected are located in both improved streets, arterial and primary roads, backyards and unimproved easements.

B. The Work covered by this section includes furnishing all labor, competent PACP certified technicians, equipment, tools, accessories, and materials required to clean and inspect the designated sanitary sewer lines.

1.02 SUBMITTALS

A. PACP Requirements

1. PACP compliant inspections, logs, data, and photos shall be delivered to the Program Manager (from hereon Program Manager shall be interpreted as “Program Manager or his designee”) on external hard drive(s) which will become property of the Program Manager. Data files shall be formatted to facilitate upload into a PACP compliant Exchange database or internet uploads formats to an FTP site approved by the Program Manager.

B. Unless otherwise specified all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.

C. For rehabilitation work, only Post-Rehabilitation PACP submittals will be required by the Purchaser. All CCTV done prior to rehabilitation shall be at the expense of the Subcontractor to ensure conformance with the Specifications.

D. Traffic Control

1. Traffic Control Plan shall be submitted to the Program Manager, including the following items:

a. Outline of permit acquisition procedure for lane closures.

b. Methods for proper signing and barricades, which comply with City of Memphis requirements.

c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires two-week lead time for permit processing.

i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.

ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be

required to modify the sample Traffic Control Plan to obtain a permit from the City.

d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a traffic control plan for all mobile operations in accordance with standard MUTCD specifications.

E. Permits

1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits as required to perform this work.

2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way the Subcontractor shall contact the Program Manager 48 hours in advance who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.

3. Permit required confined space entry plans in compliance with the Loss Control Manual.

F. Copies of National Association of Sewer Service Companies (NASSCO) certification for all field staff conducting PACP inspections.

G. Sample of PACP compliant television survey log in MS Access format.

H. Sample of PACP compliant video inspection in MP-4 (Web optimized) format.

I. Cleaning and CCTV vehicle, equipment, and cleaning supplies list.

J. Disposal site(s) and appropriate landfill permits for appropriate disposal of all waste materials removed from the sewer during the light and heavy cleaning operations.

1.03 DELIVERABLES

A. Records

1. Pipe Cleaning Record

a. The Subcontractor shall provide a dated manifest of the volume or weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. Each waste load manifest shall be associated with a list of corresponding sewer segments from where the waste originated.

2. Digital Inspection Record

a. In the digital PACP V.6.0.1 compliant format, the Subcontractor shall provide the following information:

i. Digital CCTV survey inspection which shall be recorded and shall be continuous as the inspection proceeds through the manholes and sewer pipes. Inspection videos should be delivered in an MP-4 (Web optimized) format.

ii. Digital Recordings: The digital recording shall document the visual and audio record of the manhole and sewer pipe inspection and shall be the basis of measurement and payment. Digital recording playback shall be at the same

speed that it was recorded. Original digital recordings for the Project shall be forwarded to the Program Manager on clearly labeled external hard drive(s) in PACP ACCESS format with final report submittals and shall become the property of the Program Manager. Data for a single facility asset will not be split across multiple hard drives. Digital recordings shall be available to the Program Manager by the close of business on the Monday following a week after data acquisition. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

(1) Picture Quality: The sewer inspection digital record shall be free of steam, fog, vapor, or other headspace distortion that degrades the quality of the picture from the intended purpose of evaluating the sewer for structural and watertight integrity. If necessary, the Subcontractor shall provide positive ventilation or other means through the sewer pipe to draw out steam, fog, and vapor that will degrade the recorded image of the pipe.

3. Inspection Documentation Logs

a. Observations made during television inspection shall be documented in an unmodified PACP compliant manner within an electronic inspection log form, supported by accompanying audio, digital photographs and MP-4 (Web optimized) format recording written to an external hard drive and submitted to the Program Manager. Hard copies of completed inspection log photographs shall be furnished to the Program Manager with invoicing.

4. Electronic & Hard Copy Records

a. Reports:

i. The Subcontractor shall prepare printed inspection log reports for each associated sewer pipes inspected during the actual field inspection activities. These field logs shall then be reviewed by the Subcontractor's technical staff, along with reviewing the associated digital video record, as a means of ensuring that no defects or entries are omitted or incorrect. Edited field logs shall then be used in the final project reports and submitted in pdf format.

b. Draft Report and Final Report:

i. The Draft Final Report will contain electronic and hard copies of each of the PACP CCTV log pipe segment inspection logs. Digital recordings of the inspections written to an external hard drive and the PACP compliant database of the inspections in ACCESS format shall also be submitted in electronic and pdf format.

ii. Draft Report shall be delivered to the Program Manager within fifteen working days the last or final inspection. The Program Manager will have two work weeks to review and comment. Subcontractor shall address all comments provided and submit a Final Report within one work week upon receipt of comments. At the Program Manager’s discretion a meeting will be held so the Subcontractor can explain the processes used to address the comments.

5. Quality

a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7)

calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. General

1. All equipment used for PACP compliant CCTV sewer segment inspections of existing sanitary sewer mains and connections shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defects and recorded observations must be Version 6.0.1NASSCO PACP compliant.

2. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite within 72 hours.

3. The Subcontractor shall provide equipment to perform inspections of sewer mains located in streets, street rights-of-way, backyards, easements and rights-of way that are off-road.

    a. Including but not limited to portable CCTV equipment, vehicles capable of transporting TV equipment and accessing remote easements, and adequate cleaning equipment rights of way or easement applications.

B. PACP Compliant Software & Data Logger Requirements

1. Data logger

    a. Internal inspection logs created and captured electronically during the television inspection through the use of commercially available electronic data loggers in the truck are required. NASSCO PACP protocols Version 6.0.1 shall be used for capturing and recording the observations. Audio commentary made during the inspection and captured on the digital video shall correspond with the PACP observations on the log.

    b. The data logger equipment and software shall allow the Program Manager access directly to the captured electronic data and provide for a non-proprietary export of the data into MS ACCESS databases in accordance with PACP standards for standalone database review.

2. Software must be compliant with the NASSCO PACP V.6.0.1 standards. Follow PACP protocol for recording of observations and defects for sewer mains.

    a. All software shall be capable of providing complete survey reports in compliance with PACP, and the software shall be the V.6.0.1 of the PACP compliant software.

    b. The Program Manager has no intent to specify which software the Subcontractor shall use, but requires the software and the submitted database to be fully compliant with PACP V.6.0.1 and capable of being exported to ACCESS databases. No payment will be rendered for improperly formatted data.

    c. Software and data logger must be capable of capturing sewer main and sewer lateral observations by PACP descriptions, record travel footage along pipeline, and video

time stamp the recorded observations to support hyper linking from the digital record to the event point or location within the digital inspection record. The same requirements apply to still photo images (if provided) which shall follow PACP guidelines and be hyperlinked to the inspection log.

C. Sewer Main CCTV

1. Sewer Main Digital Color Video Camera

a. All cameras used shall be digital format color CCTV units specifically designed and constructed for use in sewer pipe inspection work. The cameras shall be operable in 100 percent humidity conditions. The camera shall have a high-resolution, 360-degree pan and tilt or rotating head with a wide viewing angle lens and either automatic or remote focus and iris controls. Camera lighting shall be sufficient for use with digital color inspection cameras and for the manhole and pipe diameters identified in the contract.

i. Camera, Television Monitor, and Other Components shall be capable of producing a high resolution color digital inspection record.

ii. Video file to be in MP-4 (Web optimized) format

b. In all cases, the complete digital inspection system (camera, lens, lighting, cables, monitors, and recorders) shall be capable of providing a digital picture and digital video quality acceptable to the Program Manager. Inadequate lighting, image distortions, blurry or murky images, and dirty lenses will be a cause for rejection. No payment will be made for unsatisfactory inspections and the Subcontractor shall perform work until deliverable is of acceptable quality. Digital video cameras/digital recorders not specifically intended for use for internal television inspection of manholes and sewer lines shall not be permitted.

c. Pan and tilt type camera, capable of turning at right angles to pipe’s axis over an entire pipe wall perimeter shall be used.

i. The camera lens shall be capable of self-righting itself after a lateral view or connection view with a return view down the pipe with a “home" capability for the lens.

d. Lighting shall be suitable to allow clear picture of entire inner pipe wall extending at least 10 feet in front, including black High Density Polyethylene (HDPE) pipe.

e. Document header and observations shall be in accordance with PACP V.6.0.1protocols.

D. Cleaning Equipment

1. Hydraulic sewer pipe cleaners or combination hydraulic/vacuum cleaners shall be specifically designed and constructed for such cleaning.

2. Mechanical sewer pipe cleaners shall be specifically designed and constructed for such cleaning.

3. The Subcontractor shall possess equipment capable of hydraulically or mechanically cleaning a minimum of 1,000 linear feet of pipe from one direction and have a minimum 1,000 linear feet of hose or cable on-site during the cleaning execution.

4. Hydraulic sewer pipe cleaners shall be specifically designed and constructed for such cleaning. The sewer cleaner shall have a minimum usable water capacity of 600 gallons and a pump capable of delivering at least 30 gallons per minute at 1,500 psi at the nozzle.

    a. The hydraulic cleaning equipment shall have multiple hydraulic cleaner hose nozzles for a variety of sewer cleaning conditions, including grease, roots, debris and granular materials.

    b. Vacuum equipment shall be capable of lifting debris removed from the segment from the downstream manhole.

5. Mechanical sewer pipe cleaners (cable machines with buckets, brushes, swabs, root cutters, and power rodders with similar capability) shall be capable of controlled forward and reverse travel through the sewers without inflicting damage to the existing pipe in removing rocks, grit and other heavy debris and roots.

PART 3 EXECUTION

3.01 INSPECTIONS

A. CCTV Inspection of Sewer Mains

1. Cleaning

    a. Sewer pipe cleaners or combination hydraulic-vacuum cleaners must accompany CCTV units at all times. Ideally, sewers lines are to be cleaned and then followed immediately by CCTV inspection. All sewers must be cleaned in advance of CCTV during the same calendar day they are inspected.

    b. Light Cleaning

        i. Before CCTV work, the Subcontractor shall light clean the sewer line from manhole to manhole, from upstream to downstream direction unless an obstruction is encountered, one sewer section at a time and performed as efficiently as possible at the Subcontractor’s discretion.

        ii. Materials shall not be passed from one sewer segment to another but must be trapped and removed from each sewer segment prior to CCTV inspection.

    c. Heavy Cleaning

        i. If a camera is inserted and additional debris or impediments to inspection are observed following the required light cleaning, heavy cleaning shall be approved by the Program Manager. Sections of pipe containing significant roots, large areas of debris, and/or several inches of depth of sands and gravels that will require the use of additional hydraulic nozzles, cable/bucket machine, power rodders and root cutters is considered heavy cleaning.

        ii. Heavy cleaning will be proposed by the Subcontractor and approved by the Program Manager. The Subcontractor must obtain prior approval for heavy cleaning in each sewer segment in order to receive payment for heavy cleaning.

d. Cleaning Execution

i. No roots, grease or debris from light or heavy cleaning shall be passed from sewer segment to sewer segment during the cleaning operation. All debris flushed from the sewer must be collected, captured, and removed from the sewer at the downstream manhole.

ii. Roots shall be removed in the sections where root intrusion is a problem. Special precautions shall be exercised during the cleaning operation to assure complete removal of visible roots from the joint area and so as not to incur further damage to the pipe. Any visible roots that may impact rehabilitation efforts shall be removed. Fine roots are allowed if the Subcontractor made a heavy cleaning attempt to remove roots with proper root removal means. Procedures may include the use of mechanical devices such as rodding machines, expanding root cutters and porcupines, and hydraulic procedures such as high-pressure jet cleaners.

iii. The Subcontractor is responsible for safe, responsible and legal handling and disposal of all material and debris removed from the sewers. The Subcontractor is responsible for all permits and landfill fees associated with the disposal of debris collected and removed from the sewer.

i. Proper disposal arrangements are the exclusive responsibility of the Subcontractor. The Subcontractor shall provide a dated manifest of the volume and weight of the dewatered sewer cleaning loads taken and dumped at the permitted landfill. The Subcontractor shall not dispose of debris at a City of Memphis Wastewater Treatment Plant. Each waste load manifest shall be associated with a list of corresponding sewer segments from where the waste originated.

2. Sewer Flow Levels During Inspection Operations

a. Maintain low sewer flow during inspection by using sandbags or flow-through plugs or by inspecting during low flow times of day, evening, or early morning hours while camera is moving and recording observations in the sewer segment. Any items used to restrict flow shall be removed immediately after intended use.

i. Flow-through Plugs: If used, secure the plugs so as to remain in place during inspection. Use a fail-safe device at the downstream pipe connection to ensure the plug is not lost in the downstream sewer segment if it becomes dislodged from the upstream pipe connection.

ii. Conduct all cleaning and CCTV operations to prevent building backups and sewer overflows.

iii. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the cleaning and inspection operations.

b. Allowable Depth of Flow For Inspection Operations

i. For effective inspection, all flow shall be minimized in the segment being inspected. However, the depth of flow at the upstream manhole of the interceptor section being worked shall be within the specified limits provided herein.

c. Maximum Allowable Depth of Flow for CCTV Inspection

i. 6 - 10 inch diameter Pipe - 20% of pipe diameter

ii. 12 - 18 inch diameter Pipe - 25% of pipe diameter

iii. 24-inch diameter and Larger Pipe - 30% of pipe diameter

iv. Exceptions to these guidelines shall result in rejection, and non-payment, of the CCTV inspection unless approved in advance by the Program Manager.

3. Camera Operations

a. Using the pan/tilt feature, pan the interior of the manhole for record purposes in accordance with V.6.0.1 PACP protocols and begin and terminate the inspection in the starting and ending manholes.

i. Capture the inside of manhole walls, manhole channel, and pipe connection to wall at both upstream and downstream manhole and lateral connections using the digital mainline sewer camera and the pan/tilt feature.

b. Place the camera at center of manhole and commence video before entering pipe.

i. Start footage counter at manhole wall/pipe connection or at a short pre-measured distance down the pipe for the sewer segment inspection.

c. Connections: The digital camera shall be used to look at connections and up laterals from the connection in the main sewer pipe being inspected. The camera shall pause, pan, and record all connections. Conditions noted in these sidelines and laterals shall be noted on the inspection logs.

d. Mainline camera operations:

i. Move through line at speed no greater than 30 feet per minute stopping for minimum 10 seconds to record lateral connections, mainline connections, defects, and features and points of interest.

ii. Do not float camera.

iii. Maintain technical quality, sharp focus, and distortion free picture with the camera lens centered in the pipe for the different diameters inspected.

(1) Eliminate steam in line for duration of inspection.

(2) Utilize blower as needed to defog sewer line.

iv. Digitally record a complete sewer segment in its entirety with no breaks, “blink-outs,” or interruptions from manhole to manhole according to PACP V.6.0.1 formats.

v. Pan, tilt, and rotate as necessary to best view and evaluate lateral connections, pipe defects, features, obstructions, and points of interest.

vi. Use power winches, powered rewinds, self-propelled tractors, or other devices that do not obstruct camera view or interfere with proper documentation of sewer conditions to move camera through sewer.

(1) Whenever non-remote powered and controlled winches are used, set up telephones or other suitable means of communication between manholes to insure good communication.

vii. Use hydraulic jet nozzle pressure and flow to remove standing water from depressions or sags in the sewer, if necessary, for complete inspection of the sag portion of the sewer segment.

viii. Measurement for location of defects and service laterals:

(1) At ground level by means of Program Manager-approved footage counter or metering device.

(2) Electronic display measurement meters: Accurate to PACP standards over length of section being televised.

(3) Do not pull unnecessary length of slack camera cable if it impacts the footage counter.

ix. Stop camera at service connections and inspect lateral with pan and tilt camera.

(1) Identify building connection in PACP compliant terms as active, capped, or abandoned.

(2) If no wastewater flows are being discharged from building, consider steady, clear observed flow as infiltration/inflow.

x. Identification of Defects

(1) If roots, sludge, or sediment material impedes inspection after the light cleaning, withdraw camera and perform heavy cleaning at the direction of the Program Manager.

(2) Upon completion of heavy cleaning operation, resume internal inspection.

(3) Furnish media confirmation for heavy cleaning (more than three passes with jet cleaner) to Program Manager.

(4) If protruding tap impedes inspection trim protruding tap to 1/2 inch.

xi. If obstructions are not passable and cannot be removed by sewer cleaning, withdraw CCTV equipment and perform a reverse inspection from opposite end of the sewer segment in accordance with PACP protocols.

(1) Subcontractor shall be responsible for costs associated for reverse set-ups when an obstruction is encountered that cannot be passed.

(2) Subcontractor shall be responsible for all judgments and impacts as to whether an obstruction in the sewer main can be passed. Costs involved in extracting a stuck camera in the sewer main will be borne by the Subcontractor and at no additional cost to the Program Manager.

(3) When additional obstructions are encountered after reversal of equipment and no means are available for passing a second obstruction in order to complete the sewer main inspection, remand the segment inspection to the

Program Manager for resolution. The portion of the main inspected will be paid for as prescribed.

xii. Undocumented facilities

(1) If undocumented manholes or sewer mains (facilities not on the field updated GIS sewer maps) are encountered during the inspection, the Subcontractor needs to complete the documentation requirements per PACP requirements and capture on the video the following:

(a) Approximate horizontal distance from the upstream or reference manhole.

(b) Approximate depth of the undocumented manhole by turning the pan/tilt camera vertically and estimating the height of the cover from the invert.

(c) A provisional manhole asset ID number shall be used by the Subcontractor by adding a dash and two-character number to the closest upstream manhole ID.

xiii. Retrieval of Stuck Equipment

(1) The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment/foreign objects that get stuck in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor's own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor's equipment in the line shall be the responsibility of the Subcontractor. Subcontractor shall follow SARP10 sewer point repair specifications outlined in "Section 02540 Sanitary Sewer Point Repairs" and "Section 02950 Removal and Replacement of Pavements and Incidentals" during retrieval of equipment. Also per "00585.2.2 Safety, Health, and Accident Prevention Program," Purchaser must approve sub-tier Subcontractors prior to mobilization to the jobsite.

4. Quality Assurance

a. With each monthly invoice the Subcontractor shall provide a QA/QC memo documenting that 10% of the previous month's CCTV data has undergone a random, independent review by a PACP certified reviewer using NASSCO standards for Television Inspection of Main Sewer and PACP Quality control as the basis for the QA/QC procedures. The independent reviewer shall be a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Each line segment which has been randomly reviewed shall be identified in the QA/QC memo as well as any subsequent findings or recommendations. Internal independent QA/QC is acceptable, as long as the person is a Tennessee P.E. or is a P.E. in another state and has a Tennessee P.E. license pending. Failure to submit the QA/QC memo shall delay payment of the current month's invoice.

b. For all new Subcontractors and Operators who begin PACP coding, an initial review of CCTV data will consist of reviewing, at a minimum, 20 of the first 100 PACP inspection records submitted. Subsequent reviews will be based on the results of the initial reviews as explained below.

c. Auditing Procedures:

i. Header Information: As explained in the NASSCO PACP Quality Control Standards each audited inspection record is given an accuracy level for the header information and the detailed observation records. It is expected that the accuracy of the header record exceed 90% because the majority of the contents are based upon facts and not subject to operator judgment. To assess the accuracy level of the header, record the number of errors as compared to the total number of header fields using the following formula:

(1) **100% - (error count/total header fields)*100% = Header Accuracy**

ii. Detailed Observations: Determining the accuracy level for the detailed observation records is similar to the method for assessing the header record. The main difference being that a defect observation has multiple data entries that must also be counted towards the total number of entry fields. In the event that a defect is not coded all of the required entries for coding the missed defect are counted towards the total error count. The following formula is used to calculate the accuracy level of the detailed observation records:

(1) **100% - (error count/total entries) * 100% = Detail Accuracy**

iii. Review Scoring and Results

(1) Satisfactory Review, No changes required. Accuracy Level of 90% or above for both the Header Record and Observation Detail with no major errors or omissions found.

(2) Unsatisfactory Review (below levels of acceptance) will not be accepted by the Program Manager and will not be considered payable items in the Subcontractor's Request for Payment.

5. Deliverable Documentation

a. Mainline Sewer

i. Submit V.6.0.1 PACP compliant records, logs, and electronic inspection data for sewer line inspection to Program Manager by the close of business on the Monday following a week after data acquisition.

ii. Monthly QA/QC memo submittal listing which segments have been randomly reviewed, as well as any subsequent findings or recommendations.

iii. Digital videos, data, and photos shall be delivered to the Program Manager on external hard drives which will become property of the Program Manager.

iv. Data files shall be formatted to facilitate upload into a PACP Exchange Database with the approval of the Program Manager.

v. Inspections displaying poor digital video/audio quality will be rejected. Quality refers to, but is not limited to, grease or debris on lens, camera under water, image too dark or light, image washed-out, distorted image, out of focus images, lines improperly cleaned, and poor/no audio.

vi. Subcontractor will re-televise rejected inspections and resubmit inspections at no additional cost to the Program Manager.

b. Map changes/undocumented manholes:

i. For map changes identifying undocumented manholes and network changes which were found as a result of field inspections or observations, a Map Edit Form shall also be prepared and supplied by the Subcontractor with a drawing or sketch and shall indicate special details, field measurement or distances, or locations about an observed undocumented manhole or a change to the sewer network. The Map Edit Form should also identify buried manholes and siphons that have been encountered.

ii. Subcontractor shall indicate all buried manholes identified in the field via CCTV using the provided Buried Manhole Form. Any additional manholes that have not been located or verified via CCTV but are impeding the completion of required CCTV work should be designated as unable to locate (UTL) and be included on the form.

c. Incident observation and data collection:

i. The Subcontractor shall report all buried manholes, pipe collapses, large void, utility conflicts, Unable to Complete line segments, and heavy cleaning requests to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. At least one picture shall be included showing the incident or condition of the sewer line encountered that required it to be recorded. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.

6. Easement or Turf Operation

a. The Subcontractor will restore the work area to its original condition as quickly as possible after the inspection is complete. The Subcontractor will not be allowed to postpone restoration of the site until the end of the project.

PART 4 MEASUREMENT & PAYMENT

4.01 MEASUREMENT

A. Light Cleaning & CCTV Inspection

1. Light cleaning and mainline CCTV inspection shall be measured by linear foot by each diameter of mainline sewer inspected and documented in accordance with the specification.

B. Heavy Cleaning

1. Heavy cleaning shall be measured by linear foot of each diameter of heavy cleaning approved by the Program Manager and documented.

C. Remote Trimming of Protruding Service Lateral

1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

4.02 PAYMENT

A. Mainline CCTV Inspection

1. Light cleaning and mainline CCTV inspection shall be paid for at the unit price for each linear foot of each diameter inspected and documented in accordance with the specification.

2. The unit price for Light Cleaning and Mainline CCTV inspection shall cover the entire cost of the required light cleaning and CCTV inspection and reporting in accordance with PACP V 6.0.1 format, including but not limited to labor, mobilization and access, CCTV equipment, recording media, traffic control, light cleaning of mainline sewer, documenting results in PACP records and logs, digital format recordings, photo equipment, power supply for equipment, interim and final reports and all other appurtenant work.

3. No additional payment will be made for:

   a. Re-inspection due to rejected inspection and/or records for any reason.

   b. Reversals.

   c. Performing excavation and associated sewer point repair to retrieve a stuck CCTV camera or hydraulic cleaning hose/nozzle.

   d. Incomplete electronic logs.

   e. Unapproved duplication of inspections: The Subcontractor is responsible to ensure duplications do not occur.

B. Heavy Cleaning

1. Heavy Cleaning shall be paid for at the unit price for each linear foot of each diameter of heavy cleaned sewers at the direction of the Program Manager and in accordance with the specification.

2. The unit price for Heavy Cleaning shall include the entire cost including but not limited to labor, mobilization and access, traffic control, appropriate disposal of sewer debris removed from sewer at permitted site and all other appurtenant work. Payment includes non-hydraulic jet efforts such as porcupines, cutters, power rodding, clam buckets, and other mechanical means, traffic control, and re-cleaning with hydraulic jet, labor, materials, and equipment necessary to clean mainline sufficiently to allow video reviewers a clear picture of pipe conditions.

3. No additional payment will be made for:

   a. Additional passes of heavy cleaning if the inspection observation reveals roots, grease or other debris remaining in the sewer after the heavy cleaning passes.

C. Remote Trimming of Protruding Service Lateral

1. Remote trimming of protruding service lateral that prevent a thorough inspection of the pipe will be measured per each.

4.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02541-4.02.A	LIGHT CLEANING & MAINLINE CCTV INSPECTION FOR EACH DIAMETER	LINEAR FEET
02541-4.02.B	HEAVY CLEANING FOR EACH DIAMETER	LINEAR FEET
02541-4.02.C	REMOTE TRIMMING OF PROTRUDING LATERAL	EACH

END OF SECTION 02541

SECTION 02544
MANHOLE GPS & MACP INSPECTION

PART 1 GENERAL

1.01 SCOPE

A. This Work shall consist of locating sanitary sewer system facilities, gathering sub-meter grade GPS coordinates of manhole (including lamphole) covers, Manhole Assessment Certification Program (MACP) protocol Level 1 and Level 2 manhole inspections using the National Association of Sewer Service Companies (NASSCO) MACP Version 6.0.1 protocols, associated photographs, camera inspection of manholes and the associated pipe connections, and documentation of manholes not found, not on grade and/or not showing. The work shall also consist of completing an internal 3D manhole scan for each manhole with a depth greater than 25 feet or associated with large-diameter sanitary sewer interceptors (36-inch diameter and larger). Manholes to be located, documented and inspected are in both improved streets, arterial and primary roads, backyards and unimproved easements. Manholes may be elevated significantly above the existing ground level. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work, in addition to any equipment necessary to access all elevated manholes while remaining in compliance with The Loss Control Manual. Once new manhole coordinates are obtained, the updated source GIS map data shall be delivered to Program Manager in order to reflect the actual sewer system network.

B. The Work covered by this section includes furnishing all labor, competent MACP certified technicians/crew leads, equipment, tools, accessories, and materials required to GPS, perform MACP Level 1 and Level 2 inspections, conduct 3D scan camera inspections where applicable and document the specified manholes.

C. Selected Subcontractor(s) will be provided two Geo-databases; one will have supporting records (aerial photo overlays, outfall and block maps and as-builts, as available), and a maiden database which will include the asset ID for each manhole.

1.02 SUBMITTALS

A. GPS Requirements

1. Sub-meter GPS coordinates, updated GIS map data, Levels 1 and 2 MACP data and records, and camera inspection photos and 3D scan of the manholes shall be delivered to the Program Manager on clearly labeled external hard drive(s) which will become property of the Program Manager. Inspection data for any one asset shall not be delivered on multiple drives. MACP data files shall be formatted to facilitate upload into a MACP Exchange Database or internet upload to an FTP site as approved by the Program Manager.

B. Unless otherwise specified, all sample submittals shall be delivered to the Program Manager within two weeks of the NTP.

C. For rehabilitation jobs, only Post-Rehabilitation MACP submittals will be required by the Purchaser.

D. Traffic Control

1. A Traffic Control Plan shall be submitted to the Program Manager, including the following items:

a. Outline of permit acquisition procedure for lane closures.

b. Methods for proper signing and barricades, which comply with local requirements and the City.

c. Major streets (e.g. Shelby County Principal Arterial & Minor Arterial) requiring a City approved permit if taking a lane for mobile operations, secured through Traffic Control Plan submittal to the City and signed by a TN P.E. The City requires a two-week lead time for permit processing.

i. The Subcontractor will be required to deliver a sample primary/arterial road Traffic Control Plan for review by the City.

ii. If the City determines that the nature of the work operation or the type of road in which the Subcontractor is working requires a permit, the Subcontractor will be required to modify the sample Traffic Control Plan to obtain a permit from the City.

d. For everywhere else where a permit is not required, the Subcontractor shall develop, provide, and implement a Traffic Control Plan for all mobile operations in accordance with standard MUTCD specifications.

E. Permits

1. The Subcontractor is also responsible for acquiring all necessary disposal and/or landfill site permits required to perform this work.

2. Railroad Rights of Way: The Subcontractor shall notify the Program Manager when work or access to manholes and sanitary sewers lie within the 25 feet railroad easement, as measured by 25 feet outside the nearest rail of the tracks. To access sewer facilities within the 25 feet of the railroad right of way, the Subcontractor shall contact 48 hours in advance the Program Manager, who will alert the City's Zone Construction Inspector to coordinate individual railroad direction and guidance.

3. Permit required confined space entry plans in compliance with the Loss Control Manual.

F. GPS calibration standards, including frequency, are to be followed in the field; specify which available base stations will be used for the work.

G. Sample of sub-meter GPS coordinates delivered in electronic and pdf format.

H. Copies of NASSCO certifications for all field staff conducting MACP Levels 1 and 2 inspections.

I. Sample of MACP Level 1 and Level 2 documentation logs (with photo documentation comments and photos properly referenced) in MACP formats, in both electronic and pdf format.

J. Equipment list, including GPS and 3D camera manufacturer and model equipment to be used.

K. Sample of the GPS coordinate delivery in an ESRI ArcPAD .axf file format.

L. Sample of the digital inspection data delivery in MS ACCESS database format.

M. Sample of 3D manhole inspection and all software necessary to view inspections.

1.03 DELIVERABLES

A. Records

1. GPS Manhole Cover Coordinates

a. Subcontractor's Level 1 Lamphole and Level 2 Manhole GPS coordinate delivery to the Program Manager shall be in an ESRI ArcPAD .axf file format. The updated GIS source map data reflecting the actual sewer system network shall also be delivered. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition. Subsequent data will not be accepted if GPS data is not obtained and delivered at the same time as inspection is conducted. The requested GPS control check file (MS EXCEL) shall also be delivered at this time.

2. Level 1 and Level 2 Inspection Documentation

a. Deliver complete MACP Level 1 for lampholes and Level 2 inspections for manholes in MACP electronic database and pdf electronic formats on an external hard drive. Delivery will be in MS ACCESS database format unless otherwise preapproved by the Program Manager. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.

3. 3D Camera Inspection

a. For manholes greater than 25-feet in depth or associated with lines 36-inches or greater in diameter, the Subcontractor shall provide the Program Team with the software required to view the digital film file in the way the Subcontractor can view it, including full control of the virtual pan and tilt. The digital files must include the following:

i. An unfolded view of the manhole with a minimum of 3,000 lines of vertical resolution.

ii. The capability to produce three-dimensional representation of the manhole structure.

iii. A distortion-free virtual pan and tilt allowing the review of the manhole structure from any angle at any depth. The virtual pan and tilt must consist of view from the bottom and top camera, any virtual pan and tilt that artificially creates this view from a single camera will be deemed unacceptable due to distorted images on the direct side view.

2. Camera Inspection Documentation

a. Include specified camera photo documentation of defects, leaks and pipe connections in the MACP Image reference field as appropriate, for the Level 2 documentation. Inspection data is to be delivered to the Program Manager by the close of business on the Monday following a week after data acquisition.

3. Manhole Reports

a. Deliver a summary report in PDF format of each manhole inspected. The report will include all MACP Level 1 & Level 2 data collected for the manhole. The report shall include the surface view photo of the manhole with the outlet pipe facing 6 o'clock as

well as a downhole photo of the channel with the outlet pipe at 6 o'clock. Any defects noted in the manhole shall also have an accompanying photo in the report.

4. Draft Report and Final Report

    a. In addition to the electronic database and pdf format reports, three copies of the Draft Report will contain hard copies of each of the MACP inspections with camera manhole defect and pipe connection photographs. The MACP compliant database of the inspections in ACCESS format shall also be submitted to the Program Manager electronically on an external hard drive.

    b. Draft Report shall be delivered to Program Manager within fifteen working days of the last or final inspection. The Program Manager will have a two workweek period to review and provide comments to the Subcontractor. The Subcontractor shall address all comments and submit the Final Report within one workweek from receipt of comments. At the Program Manager's discretion, a meeting will be held upon submittal of the Final Report to have the Subcontractor go over the processes used to address comments.

5. Quality

    a. Rejection of deliverables will be submitted to the Subcontractor via the Program Team in a written communication discussing issues that must be addressed. The Subcontractor will be required to follow up with a response within three business days upon receipt of the written communication. Subcontractors will have seven (7) calendar days from the rejection notice date to make the necessary corrections and resubmit the data deliverable in its entirety.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Subcontractor shall have appropriate all-terrain vehicles necessary to access the work. Expected terrain may require the use of four-wheel drive vehicles, ATVs, tracked vehicles, or other appropriate off-road vehicles. Additionally, the Subcontractor shall have all equipment necessary to access elevated manholes in accordance with the Loss Control Manual.

B. All equipment used for the gathering of GPS coordinates, collection of condition assessment information, and digital 3D camera inspection of manholes shall be specifically designed and manufactured for the purpose intended under this Contract. The software and hardware for the electronic capture of the inspection defect observations must be consistent with NASSCO's MACP Level 1 and Level 2 requirements for the collection of data. ESRI ArcPad 10.1 is required for GPS data collection and GIS map updates for manhole / lamphole facility locations. Export of the electronic inspection data to an MACP format Microsoft ACCESS database for analysis is required.

C. The Subcontractor shall submit an equipment list to the Program Manager for approval before the commencement of the Work and shall certify that back-up equipment is available and can be delivered to the worksite in 72 hours.

1. GPS Equipment

    a. GPS Equipment shall be sub-meter grade, Trimble Pro Series Receivers with Floodlight technology capability, Top Con GRS-1 Series equipment or equal (to be approved by Program Manager prior to mobilization). GPS coordinates to be real-time or post-processed to achieve sub-meter accuracy. Equipment must have ESRI ArcPad 10.1 installed for use in data acquisition.

2. Camera

   a. All camera systems used shall be digital format. The camera must have two independently or simultaneously controlled digital cameras, one facing in the downward direction and one facing in the upward direction. Each camera must have a minimum of 185 degree field of view. The inspection camera system must illuminate the interior of the manhole using a xenon strobe light. The light shall be positioned 360 degrees around the camera lens to distribute the light evenly onto the structure walls. The lighting must be able to illuminate manholes up to 120” in diameter without the need of any auxiliary lighting.

   b. A camera must also be able to obtain still images of the following specified pictures: Photo 1- surface view photos taken of the manhole should include a whiteboard (or similar) with the manhole ID number identified on it. The photographer should be standing with the outlet pipe facing their 6 o’clock position. Photo 2 - the downhole photo of the manhole channel should be taken with the outlet pipe facing their 6 o’clock position. Additional photos as specified by MACP guidance. The camera used for these images must be minimum 5 megapixel .jpg format for sufficient clarity and detail in the photos, and photos of at least 2 MB shall be submitted. If the 3D scan camera system cannot obtain photos of sufficient quality, a pole-mounted digital camera with lighting shall be used for the specified pictures in this paragraph.

   c. The 3D camera system shall produce individual images or frames with no more than 0.001 inches of movement during image or frame exposure to produce crisp, clear images. The inspection camera must provide a minimum of 3,000 lines of vertical resolution in the side view and a minimum of 500 lines in the perspective view.

   d. Inadequate lighting, image distortions, blurry or murky images, low resolution, dirty lens and/or other quality issues will be a cause for rejection. If unsatisfactory, Subcontractor shall perform work until deliverable is of acceptable quality. No payment will be made for unsatisfactory inspections or until submittal is accepted.

3. Data Logger and Software

   a. MACP inspections and logs created and captured electronically during the MACP inspection of the manhole through the use of commercially available electronic data loggers are required. Paper records for data collection in the field shall not be used. NASSCO MACP protocols shall be used for capturing and recording the observations.

   b. The data logger equipment and software shall allow Program Manager direct access to the captured electronic data, and provide for export of the data in accordance with MACP formats and standards.

4. Retrieval of Stuck Equipment

   a. The Subcontractor is responsible for hiring a licensed sub-Subcontractor to retrieve any equipment that becomes lodged in the sewer system through the execution of the scope of work (fallen cameras, jet nozzles, inflatable plugs, sandbags etc.) at the Subcontractor’s own cost. Such retrieval by an appropriately licensed sub-Subcontractor shall be made within 72 hours to avoid interfering with the City of Memphis sewer system operations. Any and all impacts and related costs due to the Subcontractor’s equipment in the line shall be the responsibility of the Subcontractor.

PART 3 EXECUTION

3.01 INSPECTION

A. GPS Coordinates of Manhole Cover

1. Program Manager will provide Subcontractor with a digital copy of the original GIS source map indicating the sewer system network compiled from existing City records.

2. The Subcontractor shall capture and record sub-meter grade x, y and z coordinates of each manhole cover identified in the original GIS maiden data map provided with a unique asset identification (ID) number. Additional sanitary sewer lamphole and manholes found in the field in the course of the inspection work that are not provided in current mapping nor identified with a current unique asset ID shall be documented and GPS coordinates shall be recorded. A provisional manhole asset ID number shall be used by the Subcontractor by adding a dash and a two-character number to the closest upstream manhole ID.

3. Record sub-meter GPS coordinates in NAD83 TN State Plane Coordinates horizontal, NAVD88 vertical in US Survey feet using properly-calibrated GPS equipment. If GPS coordinates cannot be obtained due to buildings, trees or cloud cover, Subcontractor shall note this on the inspection form and return at least one additional time at a different time of day or under different sky cover. If both attempts fail at securing the sub-meter coordinates, this is to be documented and reported in the submittal. Land surveying shall not be required where GPS is not available.

4. The Subcontractor shall be expected to use all reasonable means to locate the lampholes and manholes in the field. This includes walking the pipeline alignment, using measuring tapes or wheels from the last found manhole, using metal detectors, or other means. If manholes are not able to be found and documented or unknown manholes are found, record the reasons for not locating or not opening the manhole or the specifics of the new manhole found, and submit with supporting MACP documentation to the Program Manager daily.

5. Once GPS coordinates are obtained for known and newly discovered facilities, the original GIS map data shall be delivered to the Program Manager to reflect the actual sewer system network for the assigned inspection area.

6. The Subcontractor shall revisit predefined GPS control locations near project area at least one time per day per each GPS unit used as a quality control check on GPS accuracy. Subcontractor is to document these checks on a single log, which shall be kept on file for the duration of the project, and shall be released to Program Manager on a weekly basis.

B. MACP MH Inspection

1. The Subcontractor shall document and record each sanitary sewer manhole inspection in MACP Level 1 format for lampholes and Level 2 format for manholes with supporting completed MACP format database. The complete NASSCO MACP Levels 1 and Level 2 protocols must be utilized for the lamphole and manhole inspections respectively, and must be associated in the electronic database and pdf documentation with the unique asset ID provided.

2. The Subcontractor shall mark the direction of wastewater flow (one arrow per pipe) in and out of the manhole around the perimeter of the manhole cover on the street with discrete

green arrows spray painted onto the road surface using a guide or template for the arrows. The arrows shall be a minimum of 12 inches and a maximum of 18 inches in length.

3. The Subcontractor shall follow the prescribed MACP Level 1 and Level 2 procedures and use the required nomenclature and formats to document the manhole interior and exterior conditions and defects.

4. Subcontractor shall be responsible for cleanup, repair, fines, property damage costs, and claims for any sewage backup, spillage or sanitary sewer overflow during or as a result of the field operations.

C. Camera Inspection of Manholes and Associated Pipe Connections

1. For manholes greater than 25-feet in depth and manholes associated with lines 36-inches and larger in diameter, a 3D manhole scan shall be completed in conjunction with Level 2 manhole inspections of defects and include each sewer pipe connection in the manhole. The photo record of the inspection shall document defects and leaks and shall include a photo record of the connecting pipes in each manhole. Abbreviations, naming conventions, and numbering conventions shall be documented in MACP formats.

2. File naming must be consistent. Additional instructions, naming conventions, file structures, etc. will be provided after contract award.

D. Incident Observation and Data Collection

1. The Subcontractor shall report all Unable to Complete and surcharged manholes to the Program Manager through the program-defined reporting application (Teamworx) and shall fill out all required fields and attach picture documentation as necessary. For a surcharged manhole, at least one picture shall be included to document the level of surcharge. All reported incident observations will be monitored by the Program Manager and inadequate reporting will result in a meeting between the Program Manager and Subcontractor.

PART 4 MEASUREMENT and PAYMENT

4.01 MEASUREMENT

A. GPS Coordinates of Manhole Cover

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each lamphole and manhole cover will be measured for payment per each lamphole and manhole located by GPS and its coordinates recorded in accordance with the specification, provided that documentation meets QA/QC standards.

B. MACP Level 1 for Lamphole Inspections

1. The inspection and recording of all lamphole observations in a MACP compliant fashion will be measured for payment per each lamphole inspected in accordance with the specification.

C. MACP Level 2 for Manhole Inspections

1. The inspection and recording of all manhole observations in a MACP compliant fashion will be measured for payment per each manhole inspected in accordance with the specification. For manholes greater than 25-feet in depth or associated with lines 36-

inches in diameter or greater, a 3D manhole scan shall be included as part of the MACP Level 2 inspection.

4.02 PAYMENT

A. GPS Coordinates of Manhole Cover

1. The capture and associated documentation of sub-meter GPS x, y and z coordinates for each manhole cover shall be paid for at the unit price bid for each lamphole and manhole cover coordinates documented and recorded in accordance with the specification provided that QA/QC standards are met.

2. The unit price for each manhole cover GPS set of coordinates shall cover the entire cost of the GPS equipment and time necessary to gather the coordinates, including but not limited to calibrating the equipment; setup and access; traffic control; documenting results in prescribed MACP electronic formats, records and logs; power supply for equipment; interim and final reports; and all other appurtenant work.

3. No additional payment will be made for:

   a. Location or re-inspection due to cars parked over manholes or other impediments to on grade and showing manhole covers.

   b. Additional visit(s) to secure the proper GPS coordinates due to lack of adequate satellite coverage or reception.

B. MACP Level 1 for Lamphole Inspections

1. The inspection and recording of all lamphole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 1 inspection performed in accordance with the specification, provided that QA/QC standards are met.

2. The unit price for each MACP lamphole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, power supply for equipment, interim and final reports and all other appurtenant work.

C. MACP Level 2 for Manhole Inspections

1. The inspection and recording of all manhole observations in a MACP format shall be paid for at the unit price bid per each MACP Level 2 inspection performed in accordance with the specification, provided that QA/QC standards are met.

2. The unit price for each MACP manhole inspection shall cover the entire cost of the inspection and reporting, including but not limited to setup and access, documenting results in records and logs, digital photos, power supply for equipment, interim and final reports, and all other appurtenant work. This also includes the materials and labor to complete 3D scan of the manhole with all associated deliverables where applicable.

4.03 PAYMENT WILL BE MADE UNDER

Item No.	Pay Item	Pay Unit
02544-4.02.A	GPS COORDINATES OF MANHOLE COVER	EACH
02544-4.02.B	MACP LEVEL 1 LAMPHOLE INSPECTIONS	EACH
02544-4.02.C-1	MACP LEVEL 2 MANHOLE INSPECTIONS-	

	NO 3D SCAN	EACH
02544-4.02.C-2	MACP LEVEL 2 MANHOLE INSPECTIONS WITH 3D SCAN	EACH

END OF SECTION 02544

CONSTRUCTION SPECIFICATION

SECTION 02599 - PILOT TUBE GUIDED BORING METHOD (PTGBM)

PART 1 – SCOPE

1.01 This Work will consist of the construction of sanitary sewers utilizing vitrified clay jacking pipe as shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished by these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Without specifications that state the quality of any work, the Contractor is required to perform such items using first-quality construction. Unless otherwise provided, the Contractor will furnish all material, equipment, tools, labor, and incidentals necessary to complete the Work.

1.02 The Engineer may change the Plans, Specifications, character of work, or quantity of work, provided the cost of the changes does not exceed 10% of the Contract price.

1.03 The Pilot Tube Method is a two or three stage system, which allows both trenchless guided sewer installations as well as accurate direct jacking of smaller diameter collection sewer pipes without the use of permanent steel casing.

1.04 *Pilot Tube Method Process* – Pilot Tube will be required on this project for sizes 4" through 42" ID due to the limited work area as well as the grade control and accuracy. The system shall utilize a two or three phase system as described below.

a) Three Pass System

i) Phase 1 – A rigid steel pilot tube in approximately one-meter lengths shall be installed through the ground from the drive shaft to the reception shaft by earth displacement with the jacking frame. The alignment of the pilot tube shall be established with a theodolite mounted at the rear of the drive shaft and accurately set to the desired line and grade. The theodolite shall view a lighted target in the lead or steering pilot tube. A camera shall be fitted to the theodolite and shall transmit the image of the crosshair and the target onto a monitor screen to be viewed in the drive shaft by the operator. As the operator advances the pilot tube through the earth the center of the target will drift from the crosshair as a result of the biased or slanted leading tip of the pilot tube. The operator shall rotate the pilot tube as required to orient the slanted steering tip toward the crosshair and continue to advance the pilot tube until it reaches the reception shaft.

ii) Phase 2 – An enlargement casing shall be rigidly connected to the final pilot tube and advanced into the earth behind the pilot tube. An auger shall be used inside the enlargement casing to remove the material being excavated. The auger shall be contained inside the limits of the enlargement casing as it progresses along the proposed alignment. A train of temporary steel casings, with an outside diameter very similar to the enlargement casing, is used to move the enlargement casing

from the drive shaft to the reception shaft. The enlargement casing will cut a bore hole from the drive shaft to the reception shaft and the temporary casings will case the hole as it is cut. Each temporary casing shall be fitted with an internal auger to transport the excavated material to the drive shaft where it shall be removed from the shaft and disposed of at an approved location. The pilot tubes shall be recovered in the reception shaft as the temporary casings are installed.

iii) Phase 3 – The product pipe shall then be installed directly behind the final temporary casing pipe with the jacking frame. The casing pipes and augers shall be recovered in the reception shaft as the product pipes are installed.

iii) Phase 3 Optional – Should the product pipe size be larger than the casing OD used in phase 2, a powered open face reaming or cutter head shall be used to increase the size of the bore. This powered head shall have an overcut OD sized approximately 1" larger than the product pipe OD and be connected to the final temporary casing and internal auger at the drive shaft location. This reaming head shall allow excavated material into the face of the reaming head and funnel said material through the previously installed augers and casings. The powered head will reverse auger direction and direct excavated material toward reception shaft where it shall be removed and disposed of at an approved location. Product pipe shall be lowered into the drive shaft and installed directly behind the powered cutting head. The product pipe shall be jacked, advancing the powered head and auger casings toward the reception shaft. The casings and augers shall be recovered in the reception shaft as the product pipes are installed.

b) Two Pass System

i) Phase 1 – The pilot tube shall be installed in the same manner described above.

ii) Phase 2 – The enlargement casing shall be installed in the same manner described in Phase 2 of the Three-Phase System. Each product pipe shall be fitted with an internal protective-casing pipe to house the auger and prevent damage to the product pipe. The product pipe shall be installed directly behind the enlargement casing with the internal casing rigidly connected to the auger chamber of the enlargement casing. The internal casing shall be manufactured such that the excavated material does not leak excessively into the product pipe. The internal casing shall be fitted with a protective shoe to protect the product pipe from damage and to support the casing and auger at the centerline of the pipe. The product pipe shall be advanced along the proposed alignment with the jacking frame thus progressing the enlargement casing from the drive shaft to the receiver shaft with the pilot tubes being recovered in the receiver shaft. The excavated material shall be funneled into and conveyed through the internal casing to the drive shaft where it shall be removed from the shaft and disposed of at an approved location. Upon reaching the receiving shaft the enlargement casing shall be removed and the internal casings and augers retracted and recovered at the drive shaft.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. General – Carrier Pipes used for direct jacking are specialized. They must be capable of withstanding all forces imposed upon them during the construction phase as well as the final in-place loading conditions. All pipes must be able to withstand a compressive loading greater than the jacking load anticipated on the project

B. The driving ends of the pipe and intermediate points must be protected against damage. The detailed method proposed to cushion and distribute the jacking force at the joint is subject to approval by the Engineer.

C. Vitrified Clay Jacking Pipe – pipe shall meet the requirements of ASTM C-1208, Standard Specification for Vitrified Clay Pipe for Use in Jacking, Sliplining, and Tunnels, latest revision. The pipe shall have a minimum compressive strength of 7000 psi. The pipe joint collar shall be manufactured of Series 316 stainless steel. A factory supplied load distributing compression ring shall be placed at each joint of pipe.

D. Rubber Couplings used for reconnecting to existing mainline connections or reconnecting services shall be stainless steel shielded rubber couplings or engineer approved equal. Gasket shall meet ASTM C-425 Table 2, latest revisions. Shear ring shall be Series 300 stainless steel with a minimum thickness of .012". Tightening bands shall be Series 316 stainless steel with stainless steel nut and bolt tightening clamps. Shear ring and clamps shall meet all requirements of ASTM A-240, latest revisions.

E. Coupling widths as follows:

   a. 4" diameter coupling shall be 4" wide

   b. 6" through 12"diameter couplings shall be 6" wide

   c. Coupling diameters 15" and larger shall be 10" wide

2.02 EQUIPMENT

A. Major Components

   i) Line and Grade Control System – The control system shall include but not be limited to a theodolite, LED target, camera, and monitor screen.

   ii) Jacking Frame – The jacking frame shall possess adequate strength to advance the pilot tube, the enlargement casing and the string of product pipe from the drive shaft to the receiver shaft. The jacking force shall be easily regulated down to the safe working load rating of the pipe. The frame shall develop a uniform distribution of jacking forces on the end of the pipe. The auger motor shall possess adequate torque to steer the pilot tube and adequate torque and speed to effectively auger the excavated material from the face of the bore to the drive shaft.

   iii) Pilot Tube – The pilot tubes shall be constructed of steel in rigid but short sections to accommodate the small drive and receiver shafts. The tubes shall rigidly

connect to each other, the steering tip and the enlargement casing and have a clear inside diameter large enough to adequately view the LED target. The tubes shall withstand the torque encountered in the steering process.

iv) Enlargement Casing – The enlargement casing shall be constructed of steel to a diameter just larger then the product pipe and have a leading connection compatible with the pilot tube. The leading face of the casing shall possess several large openings for the soil to enter as it advances along the proposed alignment. An internal auger chamber shall funnel the excavated material into the temporary full diameter casings of the Three-Phase Process or into the internal auger casings of the Two-Phase Process. Structural members shall connect the leading edge of the casing to the pilot tube connections.

v) Soil Transportation System – The soil transportation system shall consist of an auger train operating inside the full diameter temporary steel casings of the Three-Phase System and an internal casing and auger train operating inside the product pipe. The internal casings of the Two-Phase Process shall be manufactured to minimize leakage of the excavated material into the product pipe.

vi) Soil Removal – A soil removal system shall be provided to safely remove the excavated material from the drive shaft to the surface.

vii) Hydraulic Power Unit – The hydraulic power unit shall rest on the surface and be connected to the jacking frame by hoses. The unit shall meet all applicable noise standards.

viii) Lubrication System – A lubrication system shall be employed to minimize pipe friction to insure that pipe can be installed from the drive shaft to the receiver shaft within the safe working load rating of the pipe. The system may also be required to minimize the torque required to transport the excavated material to the drive shaft.

B. Line and Grade Control – The equipment must be capable of installing the pilot tubes to the desired line and grade with a tolerance of plus or minus 1.0” between manholes (300 LF).

C. Tunneling Over cut – The over cut of the enlargement casing shall be limited to no more than 1” on the diameter of the product pipe to be installed.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 SHAFTS

A. General- Shafts shall be the minimum size possible commensurate with safe working practices and located as shown on the plans. Jacking shafts can be as small as 8’ to 12’ in diameter. Site conditions, which allow for larger shafts, i.e. 12’x20’ may allow for increased production and therefore be more economical. Where no shaft locations are shown on the plans, the contractor shall determine the locations of the shafts with the

approval of the Engineer. Shaft locations shall, where possible, be kept clear of all intersections and be contained within a single lane of traffic in order to minimize the disruption to the flow of traffic. The contractor shall furnish and install all pump and related equipment to keep the jacking shaft free of water. The design of the shafts shall ensure safe exit and entry into the jacking and receiving shafts. Shoring of the shaft shall extend above grade or a railing provided at all shaft locations. Design of shaft shall provide sufficient backstop capacity to resist forces developed by the thrust jacks. Shoring (shaft lining plates) for jacking and receiving shafts shall be installed tight against excavation in an effort to prevent loss of soil/pipe support during launch and reception. Any space between shoring (shaft liner plates) and excavation, adjacent to pipe installation, shall be filled with Controlled Low Strength Material. Removal of shoring must be accomplished without disturbing line or grade of the installed pipe.

B. Bedding- Installed jacking pipes within the limits of the jacking and receiving shafts must be properly bedded prior to backfill. See plan for proper bedding details at shaft locations.

END OF SECTION

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02630 SITE PREPARATION AND RESTORATION

PART 1 – SCOPE

1.01 This Work shall consist of the removal of brush, rubbish, fences, structures, abandoned appliances, building foundations, all trees, shrubs and plants not to be protected, and all other obstacles within the right-of-way / easement limits shown on the Plans and/or in the Special Instructions; the disposal of debris; and the restoration and/or protection of trees, shrubs, plants, fences, turfed areas, and structures after construction of drainage facilities is completed.

PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the work shall be on the project and approved before the work will be permitted to begin.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 RIGHT-OF-WAY AND EASEMENT.
Rights-of-way and/or easements as shown on the Plans and easement/rights-of-way plats are provided by the City for construction of storm drainage facilities. The Contractor shall confine his construction activities within these areas. The Contractor shall be responsible for obtaining written agreements for use of private property outside of City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Contractor shall provide a copy of all such written agreements to the City immediately upon obtaining same.

3.02 EXISTING OBSTRUCTIONS.
Locations of obstructions shown on the Plans are approximate and are shown only for information purposes and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Contractor shall be removed as necessary and, if directed by the Owner, replaced in their original state or protected by the Contractor at no additional cost to the City.

3.03 REMOVAL OF VEGETATION.

A. The rights-of-way/permanent easements shown on the Plans and right-of-way/easement plats shall be cleared of all dead trees, living trees, stumps, brush, projecting roots, hedge, weeds, pole stubs, logs, and other objectionable material, vegetation and growth. This work shall include the removal of all trees, shrubs, and plants not suitable for moving and replanting as determined by the Owner. All trees, stumps, roots, pole stubs, brush, hedge, and other protruding obstructions within the rights-of-way/easements shall be removed to within 3 inches of existing ground. This work shall be done well in advance of excavation operations. Trees and shrubs to be replanted shall be extracted with an ample ball of earth around roots so that transplanting may be successful. The root ball shall be wrapped in burlap. Vegetation stored for replanting shall be watered sufficiently to protect the root system from dehydration.

B. Low hanging branches and unsound branches on trees or shrubs designated to remain, shall be removed. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

3.04 REMOVAL OF OBSTRUCTIONS.
Existing fence material and posts within the rights-of-way/easement limits shown on the Plans and right-of-way/easement plats shall be moved from the construction area and stored in such a manner as to protect them against damage. The Contractor shall be responsible for the condition of the removed fence material and posts. The Contractor shall demolish and remove all structures and structure foundations within the rights-of-way/easement limits unless otherwise instructed by the Owner. Such structures and foundations shall be removed to 12 inches below the subgrade elevation or as directed by the Owner. If permitted by the Owner, the Contractor shall backfill basements, cisterns, and the like in an approved manner. The Contractor shall remove all abandoned vehicles, appliances and rubbish within the rights-of-way/easement limits.

3.05 PROTECTION OF OBSTRUCTIONS OUTSIDE RIGHT-OF-WAY/EASEMENT LIMITS.
The Contractor shall protect and avoid damage to all trees, shrubs, plants, fences, turfed areas, structures, and all other objects outside of the right-of-way/easement limits shown on the Plans and right-of-way/easement plats from damage due to construction operations. Damage caused by the Contractor shall be repaired or restored at no cost to the City. Particular care shall be used to avoid damage to trees, shrubs, bushes, turfed areas, and private property located adjacent to rights-of-way/easements on private property. No trees, plants, turfed areas, or other objects outside such limits shall be disturbed or damaged without the written permission of the property owner.

3.06 SPECIAL PROTECTION OF OBSTRUCTIONS INSIDE EASEMENT LIMITS.
Wherever the underground installation of drainage facilities conflicts with other improvements previously made by the City, other governmental bodies, or adjacent property owners, the Contractor shall be responsible for their protection and preservation, including necessary removal and storage of such improvements, and subsequent replacement to obtain, to the fullest extent possible, the undisturbed condition.

3.07 DISPOSAL OF DEBRIS.
All trees, brush, logs, snags, leaves, sawdust, bark, construction debris, and refuse shall be collected and disposed of in accordance with all applicable City codes and ordinances. Debris shall be removed from the site as soon as practical and shall not be left until the completion of the contract. If burning of debris is allowed by the Owner, the Contractor must obtain and pay for a permit from the City of Memphis Department of Fire Prevention and all precautions necessary shall be exercised to prevent the spread of fire and such burning shall be in accordance with Division 1, “General Requirements” of these Specifications. Burning shall be done only at approved locations and in conformity with the laws, ordinances, and requirements of agencies and officials having jurisdiction. When materials are to be disposed of, the Contractor shall obtain written permission before hand from the property owner on whose property the disposal is to be made and shall file a copy of such permit with the Owner. Unless otherwise provided in the Contract Documents, the Contractor shall make his own arrangements for disposing of such materials off site.

3.08 REPLACEMENT OF VEGETATION.
As soon as backfill operations permit, the Contractor shall replace transplanted trees, shrubs, and plants. The Contractor shall properly water the transplanted vegetation immediately upon replanting and at suitable intervals thereafter. If shrubs, plants, or trees die after transplanting and before final acceptance of the Work, the Contractor shall at his expensed replace same with equal shrubbery, plants, or trees.

3.09 REPLACEMENT OF FENCES.
Any fences disturbed within the rights-of-way/easement limits shall be replaced to the satisfaction of the Owner. Fences in such poor condition that they cannot be removed and replaced shall be replaced with new fence material similar in original quality, size, and appearance to the removed fence or a written release shall be obtained from the property owners. For chain link fence, new fence materials and construction methods shall conform to the requirements of Specification Section 02820. For box culvert or pipe construction, any fences removed shall be replaced in their original location. Any fence damaged during construction shall be restored to original or better condition. For channel lining construction, removal of fences shall be performed with care and the fence rolled up or stacked and stored on the owner’s property. All side yard fences within the easement shall be replaced or extended to the new channel with in-kind fence material.

3.10 ESTABLISHMENT OF TURFED AREAS.
After final restoration of settled trench surfaces, all areas within the right-of-way or permanent easement limits which were established turfed areas prior to construction will be sodded in accordance with Specification Section 02920. All cut or fill slopes constructed for new drainage facilities will be sodded in accordance with Specification Section 02920 and in conformity with City cross-sections.

3.11 RESTORATION OF OTHER TURFED AREAS.

All areas outside the right-of-way, permanent easement, or cut and fill slopes shall be restored as nearly as practical to their original condition at the Contractor's expense. Finished lawn areas upon which earth has been deposited shall be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled in shall be resodded. Areas where sod is only slightly damaged may be lightly reseeded, if so permitted by the Owner. Sodding and seeding materials and construction methods shall conform to the requirements of Specification Section 02920.

PART 4 – MEASUREMENT

4.01 SITE PREPARATION AND RESTORATION.

A. No measurement of area will be made. When changes in the Contract Documents affect the rights-of-way/easement area, a proportionate adjustment for the increased or decreased area will be made.

B. When the Proposal Sheet(s) does not contain an item for Site Preparation and Restoration, this work will be required within the construction limits and will not be paid for directly but will be considered as a subsidiary obligation of the Contractor under other contract items.

PART 5 – PAYMENT

5.01 SITE PREPARATION AND RESTORATION.

Payment will be made for Site Preparation and Restoration at the contract lump sum price, which price will be full compensation for removal and/or protection of trees, shrubs, plants, brush, rubbish, fences, man-made obstructions including but not limited to structures, abandoned appliances, building foundations, and all other obstructions as may directed by the Owner; the disposal of debris and obstructions removed; and the restoration of trees, shrubs, plants, fences; restoration of turfed areas outside of right-of-way, permanent easement and cut and fill slopes, and all other items as shall be specified in the Plans and Contract Documents or directed by the Owner.

5.06 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02630-01	SITE PREPARATION AND RESTORATION	Lump Sum

END OF SECTION 02630

CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS
SECTION 02631 EARTHWORK

PART 1 – SCOPE

1.01 This work shall consist of all types of excavation, special protection, protection of existing utilities, backfilling, and grading for all types of drainage facilities including such labor, material and equipment, and all other items as may be necessary to complete the earthwork as shown on the Plans, stipulated in the Contract Documents, or directed by the Owner.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. Lumber.
Lumber to be used for bracing trenches shall be no less than 2 inch thick rough cut oak.

B. Pit Run Gravel.
Pit run gravel shall consist of one of the three gradations shown in the table below.

1. Total Percent, by Dry Weight, Passing Each Sieve (U.S. Standard)

Size No.	2 ½ "	2"	1 ½ "	1"	3/8"	No. 40	Clay*
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

* Clay content shall be determined by the Hydrometer Test – AASHTO T 88. Clay content up to 15 percent may be used with the approval of the Owner.

2. That portion passing the No. 40 sieve shall be known as the binder. The binder aggregate shall consist of hard durable particles of limestone or a sound silicious material. Shale aggregate or pipe clay binder will not be acceptable, and in no case shall the percent of silt exceed the percent of clay by more than 25 percent.

3. If the binder material is insufficient to properly bond the aggregate, a satisfactory binding material may be incorporated, as approved by the Owner, so that the resultant mixture will comply with these Specifications. The mixing shall be done uniformly, and blending of materials on stockpiles or in the pits by bulldozers, clamshells, draglines, or similar equipment will not be permitted.

C. Backfill Material.
Material for backfill shall be fine compactible soil selected from site excavation if approved by the owner as being suitable. Additional material needed shall be obtained from borrow excavation.

2.02 EQUIPMENT
All equipment necessary for the satisfactory performance of this work shall be on the Project and approved before work will be permitted to begin.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 EXCAVATION

A. General.
All excavation performed under this Section including trench excavation, structure excavation, and channel excavation but excluding undercut will be considered unclassified excavation regardless of the nature of the material and objects excavated and will not be measured or paid for separately except as specifically noted herein. Pavement removal and replacement shall be accomplished as specified in Specification Section 02950.

1. Undercut Excavation.

   a. Undercut excavation shall consist of removing and disposing of soft, spongy earth, muck, mud, unconsolidated fill, organic matter, and any other unsatisfactory materials below the grade established on the Plans for storm drains, structures, and channels where determined necessary by the Owner. No undercut excavation shall be performed without prior authorization of the Owner in writing. The limits of undercut excavation will be determined by the Owner, who will be present during the undercut operations.

   b. Undercut areas shall be backfilled with suitable material to the grade established on the Plans. The backfill shall be placed in 6 inch maximum lifts and compacted by use of a bulldozer.

2. Unauthorized Excavation Below Subgrade or Outside of Limits.

All unauthorized excavation carried beyond or below the lines and grades given by the Plans or Contract Documents, together with the removal of such excess excavated materials, and the cost of refilling the space of such over dig or unauthorized excavation, shall be at the Contractor's expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Plans for storm drain pipe shall be refilled with suitable material and compacted per Specification Section 02631, Paragraph 3.01.A.1a unless otherwise directed by the Owner. The excess space between the undisturbed bottom of the excavation and subgrade elevations shown on the Plans for box culverts and concrete channel lining shall be refilled with suitable material and compacted per Specification Section 02631, Paragraph 3.01.A.1a. The unauthorized excavation outside of side excavation limits shall be backfilled with select material unless otherwise directed by the Owner. The backfill shall be compacted in accordance with Specification Section 02631, Paragraph 3.01.A.1a.

3. Change in Excavation Location or Grade.

If the Owner orders in writing that the location or grade of a proposed drainage facility be changed from that shown on the Plans, the following provisions will apply.

   a. If the change is made before excavation work has begun and the facility being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications (pipes, manholes, and similar items), the appropriate pay item will apply to the new depth measurements along the changed centerline. If the changed location or grade introduces a new depth classification not included in the Proposal Sheet(s), a Change Order or Construction Change Order will be prepared in accordance with Specification Section 00710 Article 9 "Changes". If the facility being constructed is not covered in the Proposal Sheet(s) by pay items with depths classifications (box culverts, concrete channel lining, unlined channel, inlets, junction structures, etc.) and if the average depth of excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work and no additional compensation (or reduced compensation) will be allowed for the change. If the average depth of excavation per linear foot at the changed location is more than 10 percent above or below original Plan quantities, a new unit price for the actual excavation depth will be established. For purposes of comparing changed quantities to Plan quantities, a 1 foot wide strip will be assumed from natural ground line to invert along both the revised and original locations; quantities will then be calculated for the 1 foot wide strip along both conditions and then divided by the proper lengths.

   b. If the change is made after excavation has already begun on the original Plan location, the procedures described above will apply to payment for work along the changed location. If abandonment of an existing excavation or a portion of an existing excavation is required due to a change by the Owner, the Contractor will be compensated for the backfilling and restoration of the abandoned excavation. Backfilling

and restoration of the abandoned excavation will be accomplished in accordance with the appropriate section of these Specifications.

c. Filling a portion of existing excavation to meet changed grades will be accomplished in accordance with Specification Section 02631 Paragraph 3.01.A.1a.

d. If a change in location and/or grade is authorized in writing by the Owner at the written request of the Contractor; whether before or after excavation work has begun; the Contractor will not receive and additional compensation whatsoever for the changed work even though lengths and/or depth of excavation may be greater than original Plan quantities. Backfilling and restoration of abandoned excavation work will be accomplished totally at the Contractor's expense. If changes requested by the Contractor result in reduced lengths and/or depth of excavation, the revised quantities using Proposal unit prices or Change Orders/Construction Change Orders as appropriate will be used to develop payment.

4. Disposition of Excavated Material.

a. Excavated materials suitable for backfill shall be stored no closer than 2 feet from the edge of the excavation to allow free passage of the Owner and permit the Owner to perform his work in an expeditious and safe manner. Excavated material shall not obstruct crosswalks, sidewalks, street intersections, nor interfere unreasonably with travel on streets by occupants of adjoining property. Gutters or other surface drainage facilities shall not be obstructed. When clear access to fire hydrants, mail boxes, sewer and conduit manholes, and similar utility or municipal service facilities is required, the Contractor must provide such access. Excavated material intended for backfill shall be stored in such a manner as to minimize loss of excavated material due to erosion.

b. All materials excavated, disturbed, damaged, or removed by the Contractor and not to be used for refilling trenches, channels, or structure excavations or to be used in restoration of subsurface or surface facilities or conditions, shall be removed from the site and disposed of by the Contractor, unless otherwise directed. The City reserves the right to retain excess excavation material and direct the Contractor to deliver it to a site specified by the Owner at the Contractor's expense. If the Contractor proposes to store or place such excess excavated material upon any property, written consent of the property owner or owners must be secured in advance and a certified copy thereof be filed with the Owner. No surplus or excess materials shall be deposited in any stream channel nor in any place where preconstruction surface drainage would be changed, without written permission of the Owner.

5. Control of Storm Water.

a. The Contractor shall keep all excavations free of water. He shall provide all dams, flumes, channels, sumps, or other works necessary to keep the excavation entirely clear of water and shall provide and operate pumps or other suitable equipment of adequate capacity for dewatering the excavations. He shall avoid producing mud in the trench or channel bottom by his operations. If necessary or so ordered by the Owner, the Contractor shall place pit run gravel at his own expense to maintain a firm, dry excavation bottom and base. Pipe bedding, laying, jointing, and the placing of concrete or masonry shall be done in a water free trench or excavation, which shall be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water shall be disposed of at the Contractor's expense.

b. All gutters, pipes, drains, conduits, culverts, catch basins, inlets, ditches, creeks, and other storm water facilities shall be kept in operation, or their flows shall be satisfactorily

diverted and provided for during construction. Any facilities disturbed during construction shall be restored to the satisfaction of the Owner.

6. Excavation Around Obstructions.

a. The Contractor shall perform all excavation by hand where excavation by machinery would endanger trees, structures, or utilities which otherwise might be saved by the use of hand excavation.

b. The Contractor shall cautiously excavate test holes to locate the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, sewer, or similar utility comes within the limits of the trench, such facilities shall be properly supported.

B. Trench Excavation.

1. All trenches shall be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking will be allowed only on permission of the Owner, unless otherwise shown on the Plans, and a complete record thereof shall be kept in the Contractor's project diary.

2. The Contractor shall be responsible for prosecuting the work in accordance with the grades and lines shown on the Plans or as directed by the Owner. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material shall be hand excavated so that the pipe may be laid on a firm, undisturbed subgrade.

3. No more than 300 feet of trench shall be opened at any time in advance of the completed storm drain, nor shall more than 100 feet be left unfilled except by written permission from the Owner. In special cases the Owner may limit the distance to which the trench may be opened by notifying the Contractor in writing.

4. The width of trenches below a level 1 foot above the outside top of pipe shall be such as to leave not less than 6 inches on each side of the outside of the pipe for all sizes up to and including 15 inch diameter pipe. Maximum trench width dimension for these pipe sizes shall be 36 inches. For 18 inch diameter pipe, the width of trenches below a level 1 foot above the outside top of pipes shall be such as to allow not less than 6 inches one each side of the pipe, with a maximum trench width of 42 inches. For pipes sizes over 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe shall be such as to allow not less than 12 nor more than 15 inches on each side of the outside top of the pipe. If the trench width at or below that level 1 foot above the outside top of pipe exceeds the widths specified, provision shall be made for the additional load upon the pipe at the Contractor's expense. For pipes other than circular, trench width shall be adjusted to provide for the additional pipe width along the along the horizontal axis.

5. The sides of the trench shall be as nearly vertical as possible. The bottom of the trench shall be carefully graded, formed, and aligned according to the Plans and to the satisfaction of the Owner before storm drains are laid thereon.

6. The bottom of the trench shall be excavated at each joint of bell and spigot pipe to allow the body of the pipe a uniform contact and support throughout its entire length. When mortar joints are specified, bell holes shall be excavated at each joint in the pipe line to provide space underneath the pipe in which to properly build up mortar joints.

C. Excavation For Drainage Structures.

1. The Contractor shall be responsible for prosecuting the Work in accordance with the lines and elevations shown on the Plans or as directed by the Owner. The Contractor shall excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.

2. The outside dimensions of all manholes, inlets, box culverts, channel lining, and other drainage structure excavations shall be at least 12 inches greater than the outside of the masonry or concrete work to permit backfilling around structure.

3. Where structures are to be built in street right-of-way or paved areas, the excavation shall not exceed 2 feet from the outside of the masonry or concrete work. In the event that the excavation exceeds this limit, the Contractor will be required, at his expense, to backfill the entire space around the structure with suitable material compacted as specified in Specification Section 02631 Paragraph 4.0.

4. For drainage facilities to be constructed in fill areas, the fill shall first be placed and compacted in accordance with these Specifications. The excavation for the drainage facilities shall then commence following the placement of fill.

D. Unlined Channel Excavation.

The Contractor shall be responsible for prosecuting the Work in accordance with the grades and lines shown on the Plans or as directed by the Owner. The sides and bottom of the channel shall be excavated and shaped so as to conform with the cross-sections shown on the Plans or as directed by the Owner.

3.02 SPECIAL PROTECTION

A. Treacherous Ground.

When running sand, quicksand, or other treacherous ground is encountered, the work shall be carried on with the utmost vigor and shall be prosecuted day and night should the Owner so direct.

B. Sheeting and Shoring.

1. The Contractor shall furnish, place, and maintain such sheeting and shoring as may be required to support the sides of any excavation to prevent earth movement that could endanger the work or workmen; or to prevent any earth movement which might in any way delay the Work, change the required width of the excavation, or endanger adjacent pavement, utilities, sewers, buildings, or other structures above or below the ground surface; or to contain the construction within a specified area such as an easement or street right-of-way. The Contractor shall place this sheeting and shoring for such protective purposes without the Owner's instructions.

2. During the extraction of sheeting, care shall be exercised to prevent damage due to settlement or movement of new drainage facilities. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, shall not exceed the maximum width of trench specified in Specification Section 02631 paragraph 3.01.B. below an elevation 1 foot above the top of the pipe. Walers and struts shall be designed and installed to present no obstructions to proper placement of the pipe, bedding, cradle or encasement, nor shall they interfere with the satisfactory laying and jointing of the pipe.

3. Sheeting, bracing, and shoring shall be withdrawn and removed as the backfilling is being done, except where and to such extent as the Owner shall order that sheeting, bracing, and shoring be left in place, or where the Owner will permit the same to be left in place at the Contractor's request. The Contractor shall cut off any such sheeting at least 2 feet below the surface and shall remove the cutoff material from the excavation.

4. All sheeting, bracing, and shoring which is not left in place under the foregoing provisions shall be removed in a manner which will not endanger the completed work or other structures, utilities, sewers, or property whether public or private. The Contractor shall exercise care to prevent the opening of voids during the extraction process.

5. Steel drag shields or trench boxes may be used in lieu of sheeting, shoring, and bracing unless the Owner directs otherwise.

C. Excess Width Of Trench.

If the Contractor is permitted to use equipment that results in wider trenches than hereinbefore specified, concrete cradle or additional concrete cradle shall be used around pipe if required to resist the additional load caused by the extra width. The dimensions of this cradle will be specified by the Owner, and no extra compensation will be allowed for the additional material or work.

D. Blasting.

1. Blasting shall be under taken only after the Contractor has received written authorization from the Owner. With respect to the use of explosives in blasting, the Contractor shall apply for and receive all necessary permits and comply with all federal and state laws, rules, ordinances and regulations and requirements of the insurer governing the keeping, storage, use, manufacture, sale, handling, transportation, or other disposition of explosives. The Contractor shall provide additional liability insurance to the City, with limits and coverages as specified by the Owner, covering blasting operations in advance of any blasting. All operations involving the handling, storage, and use of explosives shall be conducted with every precaution under the supervision of a properly licensed individual. The Contractor shall take special precautions for the proper use of explosives both at or near the top of the excavation and in the excavation in order to prevent harm to human life and damage to surface structures, utilities, sewers, or other subsurface structures. The Contractor shall advise the Owner in advance when charges are to be set off. Blasts shall not be fired until all persons in the vicinity have had ample notice and have reached positions of safety.

2. Storm drains shall be carefully protected from all blasts, and all excavations requiring blasting shall be fully completed at least 30 feet in advance of the laying of the pipe. In all cases, the mouth of the pipe shall be provided with a board or other stopper carefully fitted to the pipe to prevent all earth or other substances from entering.

3. After a blast is fired, the Contractor shall thoroughly scale the excavation. All loose shattered rock or other loose material which may be dangerous to the workmen, pipe, or structure shall be removed and the excavation made safe before proceeding with the Work. The fact that the removal of loose, shattered rock or other loose material may enlarge the excavation beyond the required width will not relieve the Contractor from making such removal and filling the extra space. The Contractor shall not be entitled to extra compensation therefore.

E. Wellpoints.

The Contractor shall use wellpoints, sump pumps, or any other method of dewatering as required to lower the water table below the bottom of the excavation. He shall make a request to the Owner and receive approval of the use of special dewatering equipment other than well points or sum pumps. Dewatering operations are considered incidental to the Work and no additional compensation shall be made to the Contractor.

F. Underpinning.

When excavations require underpinning of existing structures, the Contractor shall submit shop drawings of underpinning details to the Owner prior to commencement of excavation below the

foundation of the structure. Review of underpinning details by the Owner shall not relieve the Contractor of his responsibility for protection of the structure and its contents.

3.03 EXISTING UTILITIES

A. Location.

The Plans indicate the available records of location of existing structures and facilities, both above and below the ground, but the City assumes no responsibility for the accuracy or completeness of this information. Utility service connections are not shown on the Plans, but can be encountered at any location on the Project. If it is necessary to adjust or relocate any utility, it shall be the Contractor's responsibility to coordinate the work with the appropriate utility. Any cost or delays incurred by the Contractor in this activity shall be incidental and no additional compensation will be made.

B. Protection.

1. If the construction of the storm drains, structures, or channel requires the removal and replacement or protection of any overhead wires or poles, the Contractor shall make satisfactory arrangements for such work with the owner or owners of such wires and poles and no additional payment will be made by the City.

2. The Contractor shall protect any sewer or utility within the limits of the construction. The Contractor shall proceed with caution in any excavation and shall use every means to determine the exact location of underground structures, pipe lines, conduits, and similar obstructions prior to excavation in the vicinity thereof. The City will not be responsible for the cost of protection or repair or replacement of any structure, pipe line, conduit, service connection, or similar facility above and below ground which may be broken or otherwise damaged by the Contractor's operations. All water and gas pipes and other conduits adjacent to or crossing the excavation shall be properly supported and protected by the Contractor.

C. Service Connections.

1. Sewer and utility services between mains and buildings shall be maintained and adjusted as necessary by the Contractor so as to provide as nearly a continuous operation as reasonably can be expected. This shall be accomplished in any way that the Contractor may desire, provided that the individual service not be inoperative more than two consecutive hours. The occupants shall be notified by the Contractor at least six hours in advance of such service interruptions. When a break occurs, the Contractor shall notify the affected occupant(s) of the probable length of time that the service will be interrupted.

2. If existing underground facilities or utilities require removal and replacement for the prosecution of this Work, all replacements of such underground construction or parts thereof shall be made with new materials conforming to the requirements of these Specifications or, if not specified, as approved by the Owner.

3. The removal and replacement of water services to accommodate new construction shall be the Contractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade. This work will be incidental to the construction of the drainage facility and no additional compensation will be made.

4. The removal and replacement of sewer services to accommodate new construction shall be the Contractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched. Payment will be made in accordance with Specification Section 02631 Paragraph 5.05.

5. The Contractor shall be responsible for any damage to the service as a result of his operations. The City does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

3.04 BACKFILLING

A. General.

1. Bedding for drainage facilities shall be constructed in accordance with the following specifications for the various type facilities:
   a. Storm Drain Pipe: Specification Section 02632 Paragraph 3.02.B
   b. Manholes, Inlets and Special Structures: Specification Section 02640 Paragraph 3.02
   c. Reinforced Concrete Box Culverts: Specification Section 02641 Paragraphs 3.02.B and 3.01.B

After drainage facilities have been bedded and installed in accordance with appropriate specifications and upon permission of the Owner, the backfill may be placed. No trash will be allowed to accumulate in the space to be backfilled. Particular care shall be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.

2. The Contractor shall at all times be responsible for the condition of the trenches and filled areas. He shall maintain frequent inspection of same and at any time before the final acceptance of the work by the City the trenches or filled areas settle and sunken places appear, he shall be required to refill these sunken places with suitable material as soon as they are discovered. All trenches shall be barricaded and caution lighted at all times for the protection of the public.

3. Backfilling shall be accomplished as soon as practicable after underground work is completed and inspected. Backfilling operations shall proceed in an orderly fashion following as closely behind construction operations as practical.

4. All backfill shall be placed in uniform horizontal layer. “Ramping,” that is pushing backfill material down a ramp into excavated areas, will not be permitted unless authorized in writing by the Owner.

B. Backfill in Street Right-Of-Way and Improved Property

1. Backfill Material in Pavement Areas.

Backfill in excavations through pavement in street right-of-way or wherever prevention of backfill settlement is considered essential such as driveways and paved parking areas on private property, and where the Plans require or the Owner orders, shall be made with pit run gravel or other acceptable material from the top of the bedding material or foundation to the subgrade elevation of the pavement. Pea gravel, sand or similar granular materials approximately uniform in size and without bonding properties shall not be used.

2. Backfill Material Outside of Pavement Areas.

a. Backfill in excavations outside of pavement in street right-of-way or outside of public right-of-way shall be made with select, job-excavated earth from the top level of the bedding material or foundation to the subgrade elevation in paved area, or to within 1 inch of the surface in areas to be sodded, or to the surface in all other areas.

b. Nongranular, job-excavated material shall be free from debris, organic matter, perishable compressible materials, and shall contain no stones or lumps or rock fragments larger than 6 inches in dimension, nor be in such amount that will interfere with

the consolidating properties of the fill material. Care shall be taken that stones and lumps are kept separated and will distributed, and that all voids are completely filled with fine materials. The upper 3 feet of backfill in sodded or planted areas shall be free of such rocks or lumps larger than 1 inch in diameter.

3. Placement and Compaction.

a. Storm Drain Trenches.
As soon as the pipe has been bedded, laid, jointed, and inspected by the Owner, backfilling shall continue in the following manner. Backfill shall be placed by hand in 6 inch loose layers above the bedding and tamped with heavy tampers or pneumatic tampers, special care being taken not to damage the pipe or joints, to a point 2 feet above the outside top of the pipe. From this point to the subgrade elevation of the pavement, or to the bottom of the sod, or to the original ground surface in all other areas, suitable backfill shall be placed in 12 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).

b. Structure and Box Culvert Excavations.
As soon as the masonry or concrete work has set sufficiently to withstand compaction, and the Owner has inspected it, suitable backfill shall be placed in 6 inch loose layers concurrently and uniformly on all sides and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfill shall be placed in this manner concurrently on all sides from the foundation of the structure or culvert to the subgrade elevation of the pavement, or to the bottom of the sod or to the original ground surface in all other areas.

c. Concrete Channel Lining Excavations.
As soon as concrete work has set sufficiently to withstand backfilling and has been inspected by the Owner, select backfill material shall be placed by methods other than ramping and compacted by jetting or flooding from the foundation of the channel lining to 3 inches above the top of the wall. Backfill will be rounded slightly adjacent to the top of wall to an elevation 1 inch above the top of the wall to assure positive surface drainage over the top of the wall. Backfill operations shall be coordinated with placement of the weep hole drainage system behind the channel lining wall. Special care shall be exercised during backfilling operations to prevent settlement behind channel lining walls.

C. Backfill in Open Areas and Unimproved Property

1. Backfill Material. Backfill for storm drain pipe excavations in open areas and unimproved property shall be made with select earth material from the top level of the bedding material or foundation to the surface. Backfilling for structures, box culverts, and concrete channel lining excavations in open areas and unimproved property shall be performed in accordance with Specification Section 02631 Paragraph 3.04.B. Nongranular, job-excavated material to be used for backfill shall be free from debris, organic matter and perishable compressible materials, and shall contain no stones or lumps or rock fragments larger than 6 inches in dimension or in such amount that will interfere with the consolidating properties of the fill material. Stones and lumps shall be kept separated and well distributed, and all voids shall be completely filled with fine materials.

2. Placement of Backfill. Backfill procedures specified for improved areas shall apply from the trench bottom to a point 2 feet above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be placed by bulldozer or other mechanical means.

D. Drainage Facilities Placed on Fill

1. Fill material placed in areas over which drainage facilities will be constructed shall be select earth material from the elevation of suitable subgrade to the bottom elevation for bedding or foundation of the drainage facility.

2. Placement and Compaction. If drainage facilities are constructed on filled areas, the fill material shall be placed in 6 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) up to a point at least 2 feet above the outside top of the pipe or to the foundation of manholes, inlets, special structures, box culverts, concrete channel lining and concrete ditch paving. If compaction standards for storm drain pipe exceed that of the adjoining fill, the width of compaction for the storm drain shall be not less than the outside diameter of pipe plus 10 feet. If compaction standards for the manhole, inlets, special structure, box culverts, concrete channel lining and concrete ditch paving exceed that of adjoining fill, the limits of compaction for the facility shall be not less than 5 feet outside of the facility base slab.

3.05 FINAL GRADING

A. Final grading around and above drainage facilities shall be shaped to the slope of adjacent undisturbed ground. Sufficient grading operations shall be performed to provide natural surface drainage from adjacent properties into drainage facilities.

B. Grading above the top of concrete channel lining walls shall be accomplished in accordance with proposed cross-sections supplied by the City at the preconstruction conference or as directed by the Owner. Grading shall provide adequate drainage over the top of channel walls. Side slopes shall be graded to provide a minimum slope of ½ inch per foot beginning 3 inches above the top of channel walls. Side slopes shall be rounded off near the channel wall to an elevation of 1 inch above the top of wall. The addition of sod will provide a final side slope elevation 2 inches above the top of wall.

PART 4 – MEASUREMENT

4.01 UNDERCUT BACKFILL
Undercut backfill will be measured by the ton of suitable material.

4.02 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE
Sheeting and shoring directed to remain in place will be measured by the 1,000 board feet, in place prior to being cut off below grade. Sheeting and shoring placed and removed by the Contractor will not be measured for payment.

4.03 PAVEMENT BACKFILL
Pit run gravel or other suitable materials used for backfill as determined by Specification Section 02631 Paragraph 3.04.B will be measured by the ton and will be paid for at the contract unit price per ton furnished and placed, which price will be full compensation for furnishing, placing and compacting the selected fill.

4.04 UNLINED CHANNEL
Unlined channel will be measured per linear foot along the centerline for various channel cross-sections, complete in place.

4.05 SEWER BUILDING (HOUSE) CONNECTION REMOVAL AND REPLACEMENT
Sewer building connection removal and replacement for construction of drainage facilities shall be measured per each, complete in place. Sewer building connections damaged by the Contractor which do not require removal and replacement for construction of drainage facilities will not be measured for payment.

4.06 GENERAL
All work for excavation, blasting, drainage of trench and dewatering, backfilling of excavation, compaction, grading, protection of existing utilities, water service connection adjustments, disposal of excess materials, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

4.07 COMPACTION TESTING
Soil test as required by the Owner will be paid for by the test as performed by a testing agency which meets the approval of the Owner.

PART 5 – PAYMENT

5.01 UNDERCUT BACKFILL
Accepted quantities of undercut backfill will be paid for at the contract unit price per ton of backfill material furnished and placed, which price will be full compensation for undercut excavation, special protection, protection of existing utilities, and backfilling to bottom of facility subgrade elevations, complete in place.

5.02 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE
Accepted quantities of sheeting and shoring directed by the Owner to remain in place will be paid for at the contract unit price per 1,000 board feet in place prior to being cut off below grade, which will be full compensation for material only. The cost of placing sheeting and shoring to remain in place shall be incidental to the work. No payment will be made for sheeting and shoring placed and removed by the Contractor.

5.03 COMPACTION TESTING
Accepted quantities of compaction tests as required by the Owner will be paid for at the contract unit price per test.

5.04 UNLINED CHANNEL
Accepted quantities of unlined channel will be paid for at the contract unit price per linear foot for various channel cross-sections, which price will be full compensation for excavation, removal, and disposal of excavated material and grading, complete in place.

5.05 SEWER BUILDING (HOUSE) CONNECTION REMOVAL AND REPLACEMENT
Accepted quantities of sanitary sewer building connections removed and replaced will be paid for at the contract unit price per each connection, which price will be full compensation for excavation, removal of old connection line and appurtenances, materials and construction of new connection, joining to existing connection line, and backfilling, complete in place.

5.06 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02631-01	Undercut Backfill	Ton
02631-02	Sheeting and Shoring Directed to Remain In Place	1,000 Board Feet
02631-03	Soil Compaction Test	Each
02631-04	Unlined Channel	Linear Foot
02631-04.____	Description	Linear Foot

Item No.	Pay Item	Pay Unit
02631-05	Sewer Building (House) Connection Removal and Replacement	Each
02631-06	Pavement Backfill	Ton

END OF SECTION 02631

PART 1 - SCOPE

1.01 Pavement markings are painted or plastic markings applied to the street surface for regulating, warning, or guiding traffic on the street. The work covered by this section shall consist of furnishing and supplying pavement markings in accordance with these Specifications and the latest revision of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) published by the Tennessee Department of Transportation and in conformity with the lines, dimensions, patterns, locations, and details shown on the Plans or established by the Owner.

1.02 This Section describes the general and specific requirements for conventional and rapid dry pavement marking paint, reflective hot plastics, reflective cold preformed plastics, pliant polymer film, sheeting or tape, powder pavement marking materials, glass beads for reflective pavement marking paint and plastics, and raised reflective pavement markers used by the City in its pavement marking program.

PART 2 - MATERIALS AND EQUIPMENT

The methods of sampling and testing all materials and products covered by this specification shall be in accordance with the latest standards of the American Society for Testing Materials, the American Association of State Highway and Transportation Officials, the Federal Government, or of other recognized standardizing agencies as indicated for each material.

2.01 MATERIALS

A. Conventional Reflective Pavement Marking Paint (Type "A" Paint).
This describes the general and specific requirements for reflective pavement marking paints to be used by the City in its pavement marking program. This covers ready mixed paint products of spraying consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavements. The paint type relative to drying time hereinafter shall be referred to as conventional paint – over 3 minutes drying time (requiring line protection devices).

1. General Properties.

a. Condition and Stability.
The paint shall be homogeneous, shall be well ground to a uniform and smooth consistency and shall not skin or settle badly, nor cake, liver, thicken, curdle or gel in the container. The paint shall be capable of being broken up and mixed without difficulty by use of a paddle and shall show the desired characteristics at any time within a period of 6 months from the date of delivery. The paint shall be tested in accordance with ASTM D 869 and D1309 and a paint rated below six (6) shall be considered unsatisfactory.

b. Foreign Matter.
The paint shall be free from skins, dirt and other foreign matter and shall not contain more than 1 percent water. The paint shall be tested in accordance with methods 4081, 4091 and 4092 of Federal Test Method No. 141.

c. Suitability to Application.
The paint shall be suited to application by means of spray type pavement marking equipment used by the City and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

d. No Tracking Time.
The conventional paint, when applied with glass spheres to dry concrete or bituminous pavement surface under normal field conditions at the required application rates with pavement temperature between 35^0F and 45^0F and under all humidity conditions suitable for applying paint, shall dry to a no tracking condition in 45 minutes. The no tracking time shall

be determined by passing over the line in a simulated passing maneuver with a passenger car after the expiration of above time. A line showing no visual paint deposition to the pavement surface when viewed from a distance of 50 feet shall be considered as showing no tracking and conforming to the requirements for field drying conditions. The paint may also be tested in accordance with ASTM D 711 and when so tested, shall dry to no pickup in 30 minutes.

e. Viscosity.
The conventional paint, as received, shall have a consistency determined on the Stormer Viscosimeter and expressed as Krebs Units at 77^0 of 70-80 K.U. Any paint which changes consistency within six months after receipt so that the consistency falls outside the viscosity limits stated above shall be considered to have failed this requirement.

f. Color.
The paint shall visually match the Federal Highway Administration color tolerance chart for standard highway yellow or white. The color determination shall be made after the paint has dried for 24 hours on premix as received and on combination and drop-on types after the beads have been dropped in. The paint shall not contain any organic coloring matter and shall not discolor in sunlight.

g. Bleeding.
When tested and evaluated on both tar and asphalt substrates in accordance with the Method of Laboratory Test for Degree of Resistance of Traffic Paint to Bleeding, ASTM D 969, and The Method of Evaluating Degree of Resistance of Traffic Paint to Bleeding, ASTM D 868, the numerical rating of degree of bleeding shall not be less than six (6). Paints will be tested for bleeding with the prescribed quantity of glass spheres in or on the paint.

h. Hiding Power.
The pigmented binder, when tested in accordance with Method 4121 of Federal Test Method 141, "Dry Opacity," and when applied at the rate of 10 mils wet film thickness over a Morest Black and White Hiding Power Chart, Form 03-B, shall show complete hiding or give a contrast ration of not less than 0.98 between the reflectance of the black and of the white chart surfaces as determined by a Hunter Multipurpose Reflector.

2. Packaging.
Paint purchased under this Specification for regular use by the City shall be shipped in clean, open headed pails of 5 gallons capacity, sealed, vapor proof, and meeting current Interstate Commerce Commission requirements. Each container shall be plainly marked, both on the head and side, with a durable, weather resistant ink or paint, showing the name and address of the manufacturer or vendor, description of material, purchase order number, batch number and volume and weight of contents.

3. Special Handling or Use Instructions.
Any special handling, storage or use instructions made necessary by the use of unusually flammable solvents shall be provided by the manufacturer.

B. Rapid Dry Reflective Pavement Marking Paint (Type "B" Paint).
This describes the general and specific requirements for reflective pavement marking paints to be used by the City in its pavement marking program. This covers ready mixed paint products of spraying consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavements. The paint type relative to drying time hereinafter shall be referred to as rapid dry paint—1 to 3 minutes drying time. The rapid dry paint is heated during application to achieve uniform sprayable viscosity.

1. General Properties.

a. Condition and Stability.
The paint shall be homogeneous, shall be well ground to a uniform and smooth consistency and shall not skin or settle badly, nor cake, liver, thicken, curdle or gel in the container. The paint shall be capable of being broken up and mixed without difficulty by use of a paddle and shall show the desired characteristics at any time within a period of six months from the date of delivery. The paint shall be tested in accordance with ASTM D 869 and D 1309 and a paint rated below six (6) shall be considered unsatisfactory.

b. Foreign Matter.
The paint shall be free from skins, dirt and other foreign matter and shall not contain more than 1 percent water. The paint shall be tested in accordance with methods 4081, 4091 and 4092 of Federal Test Method No. 141.

c. Suitability to Application.
The paint shall be suited to application by means of spray type pavement marking equipment used by the City of Memphis and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

d. No Tracking Time.
The rapid dry paint, when applied with glass spheres to dry concrete or bituminous pavement surface under normal field conditions at the required application rates with pavement temperature between 35^0F and 45^0F and under all humidity conditions suitable for applying paint shall dry to a no tracking condition in 60 seconds. The no tracking time shall be determined by passing over the line in a simulated passing maneuver with a passenger car after the expiration of above time. A line showing no visual paint deposition to the pavement surface when viewed from a distance of 50 feet shall be considered as showing no tracking and conforming to the requirements for field drying conditions. The paint may also be tested in accordance with ASTM D 711 and when so tested, shall dry to no pickup in 8 minutes.

e. Viscosity.
The rapid dry paint, as received, shall have a consistency determined on the Stormer Viscosimeter and expressed as Krebs Units at 77^0 of 90-110 K.U. Any paint which changes consistency within 6 months after receipt so that the consistency falls outside the viscosity limits stated above shall be considered to have failed this requirement.

f. Color.
The paint shall visually match the Federal Highway Administration color tolerance chart for standard highway yellow or white. The color determination shall be made after the paint has dried for 24 hours on premix as received and on combination and drop-on types after the beads have been dropped in. The paint shall not contain any organic coloring matter and shall not discolor in sunlight.

g. Bleeding.
When tested and evaluated on both tar and asphalt substrates in accordance with the Method of Laboratory Test for degree of Resistance of Traffic Paint to Bleeding, ASTM D 969, and The Method of Evaluating Degree of Resistance of Traffic Paint to Bleeding, ASTM D 868, the numerical rating of degree of bleeding shall not be less than six (6). Paints will be tested for bleeding with the prescribed quantity of glass spheres in or on the paint.

h. Hiding Power.
The pigmented binder, when tested in accordance with Method 4121 o f Federal Test Method 141, “Dry Opacity”, and when applied at the rate of 10 mils wet film thickness over a Morest Black and White Hiding Power Chart, Form 03-B, shall show complete hiding or give a

contrast ratio of not less than 0.98 between the reflectance of the black and of the white chart surfaces as determined by a Hunter Multipurpose Reflector.

2. Packaging.

Paint purchased under this specification for regular use by the City shall be shipped in clean, open headed drums of 55 gallons capacity, sealed, vaporproof, and meeting current Interstate Commerce Commission requirements. Each container shall be plainly marked, both on the head and side, with a durable, weather resistant ink, or paint, showing the name and address of the manufacturer or vendor, description of material, purchase order number, batch number and volume and weight of contents.

3. Special Handling or Use Instructions.

Any special handling, storage or use instructions made necessary by the use of unusually flammable solvents shall be provided by the manufacturer.

C. Hot Extruded and Hot Spray Thermoplastics.

1. Type of Material.

This section covers thermoplastic materials suitable for use as reflecting pavement markings on Portland cement concrete or bituminous pavement. The materials shall be manufactured for application by extrusion or spraying onto the pavement in molten form with glass spheres mixed in and also dropped into the material immediately after it is applied.

2. General Characteristics.

The compound shall resist deterioration by contract with sodium chloride, calcium chloride or other chemicals used to prevent roadway ice, or because of the oil content of pavement materials or from oil droppings or other effects of traffic. In the plastic state, materials shall be free of fumes which are toxic or otherwise injurious to persons or property. The material shall withstand deterioration if held at the plastic temperature for a period of four hours, or by reason of three reheatings to the plastic temperature. The temperature versus viscosity characteristics of the plastic material shall remain constant through up to three reheatings and shall be the same from batch to batch. The color shall be stable for at least three reheatings and between batches. To insure the best possible adhesion, the compound, as specified, shall be installed in a melted state at the temperature recommended by the manufacturer, and the material shall retain its color if kept at this temperature for up to four hours.

a. Foreign Matter.

The binder shall consist of a mixture of resins, at least one of which is solid at room temperature. The total binder content of the thermoplastic compound shall be a minimum of 15 percent and a maximum of 35 percent by weight. The pigmented binder shall be well dispersed and free from all skins, dirt, foreign objects or such ingredients as will cause bleeding, staining, or discoloration. The filler shall be a white calcium carbonate silica or an equivalent filler with a compression strength of 5,000 pounds per square inch (34.5 MPa).

b. Suitability for Application.

The thermoplastic material shall be a product especially compounded for traffic markings. The markings shall remain intact under normal traffic conditions at temperatures below 140^0F (60^0C). The markings shall have a uniform cross-section. Pigment shall be evenly dispersed throughout the material. The density and character of the material shall be uniform throughout its thickness. The stripe shall maintain its original dimensions and placement. The exposed surface shall be free from tack and shall not be slippery when wet. The material shall not lift from the pavement in freezing weather. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking.

c. Drying Time.

The drying time shall follow a characteristic straight line function, the lower limits of which are

2 minutes maximum at 50^0F (10^0C), the upper limits of which are 15 minutes at 90^0F (32.2^0C), both temperatures measured as surface temperatures. After application and proper drying time, the material shall show no appreciable deformation or discoloration under local traffic conditions or in air and/or road temperatures ranging from -20^0F to 120^0F (-30^0C to 50^0C).

d. Reflectorization.
During manufacture, reflectorizing glass spheres shall be mixed into the material as follows by weight of the material; Extruded Thermoplastic -- 20 percent minimum to 50 percent maximum. Hot Spray Thermoplastic -- 20 percent minimum to 30 percent maximum. Glass spheres shall also be automatically applied to the surface of the material at a uniform rate of approximately 6 pounds (2.72 kg) of glass spheres of every 100 square feet (9.29 m^2) of line. These glass spheres shall be dropped or sprayed onto the thermoplastic material while it is in a molten state immediately after it has been applied to the pavement. Required properties of glass spheres used in hot thermoplastic installations are described in Specification Section 02760 Paragraph 2.01 J.

3. Physical Requirements.

a. Color.
The color shall conform to the following when tested by Federal Test Method Standard 141 Method 4252;
White: Federal Color Chip No. 37875 (Fed. Std. No. 595).
Yellow: Federal Color Chip No. 33535 (Fed. Std. No. 595).

b. Water Absorption.
Materials shall have a maximum of 0.5 percent by weight of retained water when tested by ASTM D 570. "Water-Absorption of Plastics", procedure (A).

c. Softening Point.
Materials shall have a softening point of 190^0F (87.8^0C) minimum, as determined by ASTM E 28, "Method of Test for Softening Point by Ring and Ball Apparatus".

d. Specific Gravity.
Specific gravity of the thermoplastic compound, at 77^0f (23.2^0C), shall be from 1.6 to 2.3.

e. Impact Resistance.
Impact resistance shall be a minimum of 10 inch pounds (1.13J) at 77^0F (23.2^0C) after the material has been heated for four hours, at application temperature and cast into bars of 1 inch (2.54cm) cross-sectional area, 3 inches (7.62 cm) long and placed with 1 inch (2.54 cm) extending above the vice in a cantilever beam (Izod type) tester using the 25 inch-pound (2,825 J) scale. This instrument is described in ASTM D 256.

f. Abrasion Resistance.
The material shall show a maximum loss of 0.5 grams when subjected to 200 revolutions on a Taber Abraser at 77^0F (23.2^0C) using H-22 calibrate wheels weighted to 500 grams. The panel for this test will be prepared by forming a representative lot of material at a thickness of 125 mils (3.175 mm) on a 4 inch square (25.8 cm^2) monel panel 0.050 inch (1.27 mm) thick, on which a suitable primer has been applied. The wearing surface shall be kept wet with distilled water during the test.

4. Packaging.

a. The material shall be delivered in containers of sufficient strength to permit normal handling during shipment and transportation on the job without loss of material. Each container when filled shall weigh a minimum of 21 pounds (9.59 kg) and a maximum of 52

pounds (23.6 kg).

b. Each unit container shall be clearly and adequately marked to indicate the color of the material, the process batch number or other similar manufacturer's identification, the manufacturer's name, address of the plant and the date of manufacture.

D. Cold Thermoplastics.

1. Type of Material.
This section covers reflectorized cold thermoplastic materials preformed into rolls or ribbons of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or bituminous pavement.

2. General Characteristics.

a. Reflectorized cold plastic pavement marking material shall consist of homogeneous, extruded, prefabricated thermoplastic ribbon of specified thickness and width of either white or yellow color and shall contain reflective glass spheres uniformly distributed throughout the entire cross-section that shall be capable of being affixed to nonbleeding bituminous or Portland cement concrete pavements. The reflectorized material shall be of the plastic, cold flow type.

b. The reflectorized cold plastic pavement marking material shall consist of the following components with maximum and minimum composition by weight tolerances as shown:

	Maximum	Minimum
Plastics and Plasticizers	46%	40%
Pigments	42%	38%
Glass Spheres	18%	14%

c. Pigments shall include titanium dioxide conforming to the requirements of ASTM D 476 for white plastic material and CP medium chrome yellow conforming to the requirements of ASTM D 211 for yellow materials. Reflective glass spheres shall contain the physical properties described in Specification Section 02760 Paragraph 2.01 H.

d. When extruded, the reflectorized cold thermoplastic material without precoated adhesive shall be 0.09 inch thick, with a tolerance of plus or minus 5 percent. The edges shall be clear cut and true. The cold plastic material may be supplied complete with a precoated, factory applied adhesive backed with a protective release paper so as to make possible immediate pavement application without the use of heat, solvent, or other types of adhesive operations or it may be furnished with separate adhesives as recommended by the manufacturer. Whether the adhesive is precoated or supplied separately, the adhesive shall be such as to allow the cold thermoplastic material to be repositioned on the pavement surface to which it is applied before permanently fixing it in its final position with a downward pressure.

3. Physical Requirements.

a. Bend Test No. 1 (With Precoated Adhesive).
The plastic shall be of such a structure that at a temperature of 80^0F, a piece of 3 inch x 6 inch material (with paper backing) placed upon a 1 inch diameter mandrel, may be bent over the mandrel until the end faces are parallel and 1 inch apart. By visual inspection, there shall be no fracture lines apparent in the uppermost surface.

b. Bend Test No. 2. (Without Paper Backing).
A piece of plastic 6 inch x 12 inch in size (paper backing removed) when balanced upon a supported ½ inch diameter mandrel, reflective side up, and left in this position at a

temperature of 80^0F, shall have flexed out of its own weight at the end of eight hours into an inverted "V" position with the free ends at an angle of not more than 30^0 from the vertical. The uppermost surface of the plastic shall show no fracture or breaks. Upon removing the plastic from the mandrel, the material should be firmly but not abruptly returned to a semi-flat position with the reflective side down. The plastic, at a temperature of 80^0F on a smooth, flat, glass surface, shall have returned to its original flat condition in not more than 8 hours.

c. Tensile Strength.
Employing ASTM D 638, the plastic shall have a tensile strength of 300 psi plus or minus 100 psi. The elongation shall be no greater than 50 percent. The tensile strength calculations should be based on the minimum measured thickness of the test specimen. The rate of pull of the test shall be 0.25 inch per minute. The test shall be conducted at a temperature of 70^0 to 80^0 F using a strip of material 6 inches long and 1 inch wide.

d. Plastic Pull Test.
A 6 inch long by 1 inch wide section of the thermoplastic material shall support a dead load weight of 6 pounds for not less than thirty minutes. This test shall be conducted at a temperature of 70^0 to 80^0 F.

e. Glass Sphere Retention.
A 2 inch specimen of thermoplastic material shall be cut at right angle to the beveled edge and bent parallel to the beveled edge on a ½ inch diameter mandrel. While the specimen is bent, a strip of ½ inch wide masking tape shall be applied firmly along the length of the area of maximum bend and then removed. Retention of any glass spheres on the masking tape when the tape is removed shall be cause for rejection of the material

f. Gloss.
The plastic material shall have a maximum 60^0 gloss of 10 units as measured in accordance with ASTM D 523.

g. Abrasion Resistance.
The plastic material shall have a maximum loss in weight of 0.25 grams in 500 revolutions when abraded according to Federal Test Method Standard No. 141 (Method 6192), using H-18 calibrate wheels with 1,000 gram load on each wheel.

4. Suitability for Application.

a. The cold thermoplastic material shall be capable of application to nondefective pavement surfaces that are free from dirt or other foreign matter and at a temperature of 60^0F or more.

b. Adhesive, activators, or special coatings for various types of pavement surfaces shall be provided with the thermoplastic material. Detailed information must be supplied with the thermoplastic material outlining required application procedures for such adhesives, activators, or special coating.

c. Cold plastics shall be capable of being applied to new asphaltic pavement immediately prior to the final rolling of the new surface and of being rolled into place with conventional pavement and highway rollers. The plastic material and adhesives used in such applications shall be of the type that water used on the road roller to prevent asphalt pickup shall not be harmful to the successful application of the plastic.

5. Packaging.
The cold thermoplastic strips shall be supplied in rolls or strips of specified lengths (usually 150 feet), of the width specified, except for standard symbols and words. Rolls or strips shall be packaged in cartons suitable to allow for easy dispensing.

E. Pliant Polymer Films.

1. Type of Material.
This section covers reflectorized pliant polymer film materials processed into rolls or ribbons of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement.

2. General Characteristics.

a. Reflectorized pliant polymer film shall consist of a laminated retroreflective coating of glass beads bonded to a conformable resilient pliant polymer film white or yellow in color which is protected on the reverse side by a protective liner. This liner is removed before application. The marking film shall have reflective elements uniformly dispersed throughout and when properly applied using a specially designed contact cement shall conform and adhere to asphaltic concrete and portland cement concrete surfaces.

b. Color shall be white and yellow, consistent with normal highway use.

c. The normal thickness of the marking films shall be available as follows:

White	Yellow
0.06" (1.5mm)	0.06" (1.5mm)

3. Physical Requirements.

a. The marking film shall have the following average minimum brightness values at 0.2^0 and 0.5^0 observation angles and 86^0 entrance angle, measured in accordance with the photometric testing procedure in Federal Specification FP-74, Section 718.01 (a), except that the brightness values shall be expressed as candlepower per foot candle per 5 sq. ft. panel (2-1/2 feet by 2 feet (0.76 m x 0.61 m)). The five square feet is derived from a standard stripe, defined as 4 inches by 15 feet = 5 sq. ft. (10.1 cm by 4.57 m = 0.46 sq. meters).

b. Brightness Values (candle power per foot candle per 5 sq. ft.)

	White		Yellow	
Observation Angle	0.2^0	0.5^0	0.2^0	0.5^0
Entrance Angle – 86^0	0.20	0.15	0.15	0.10

4. Suitability for Application.
The marking film shall adhere to asphaltic concrete and Portland cement concrete surfaces when applied according to the manufacturer's recommendations at pavement surface and ambient air temperatures down to 50^0F (10^0C) when daily temperatures above 70^0F are prevailing to ensure film conformance and adherence to pavement surface. Following application the marking film shall be ready for traffic. Areas of minor damage may be readily patched with an inlay of this film in accordance with the manufacturer's recommendation.

5. Durability.
The marking film, when applied in accordance with the manufacturer's recommended procedures, shall provide a neat, durable marking maintaining the original design and configuration. Although the reflectivity will be reduced by wear, the film shall provide a cushioned resilient substrate to reduce bead crushing and loss. The film shall be weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage throughout the useful life of the marking, and shall show no significant tearing, roll back, or other signs of poor adhesion. Applied

as recommended the marking film shall be expected to have an effective performance life, under normal conditions, of 3 years.

6. Packaging.

The pavement marking film as supplied shall be of good appearance, free of cracks, and the edges shall be clean cut and well defined. The film and contact cement shall be packaged in standard commercial containers in accordance with commercially accepted standards. These materials as supplied may be stored at normal temperatures for a period of one year after purchase.

F. Sheeting and Tape.

1. Type of Material.

This section covers reflectorized sheeting or tape materials processed into rolls of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement.

2. General Characteristics.

Reflectorized sheeting or tape shall consist of a white or yellow, weather and traffic resistant reflective film on a conformable backing precoated with a pressure sensitive adhesive. The adhesive shall be protected by a removable liner. Color shall be white or yellow as specified for pavement markings. The average thickness of the sheeting or tape shall be 0.03 inch.

3. Physical Requirements.

a. Reflectivity.

(1) The white and yellow sheeting or tape shall be retroreflective reflecting white or yellow respectively, shall be readily visible when viewed with automobile headlights at night, and shall have the following minimum reflective values at 0.2^0 and 0.5^0 divergence angles measured in accordance with the photometric testing procedures of Federal Specification LS-300A, "Sheeting & Tape, Reflective; Nonexposed Lens Adhesive Backing", Para. 4.4.7 or as amended. Reflective values shall be expressed as candlepower per foot candle per square foot (candelas per lux per square meter) measured on a 5 sq. ft. panel (2-1/2 feet by 2 feet) at an 86^0 incidence angle. The 5 sq. ft. is derived from a standard stripe, defined as 4 inches by 15 feet = 5 square feet. From this the 2-1/2 feet x 2 feet panel used is for convenience in testing and comparison.

Reflectivity Value (candle power per foot candle per square foot)

	White		Yellow	
Divergence Angle	0.2^0	0.5^0	0.2^0	0.5^0
Incidence Angle 86^0	0.20	0.18	0.18	0.16

(2) A 2-1/2 feet x 2 feet panel, completely covered with either white or yellow pavement marking sheeting, shall be placed, reflective side up, in a horizontal pan sufficiently high above the pan side (or edge) so that the reflective pan shall be completely in view for measurement. The panel shall be tipped at an angle of 4^0 to the horizontal bottom of the pan for drainage. The entire panel shall be quickly flooded with clean water and allowed to drain. The minimum reflective value expressed as candlepower per foot candle per square foot shall be measured between 15 and 30 seconds after the panel starts to drain. The minimum reflective values shall be as follows:

Reflectivity Value (candle power per foot candle per square foot)

	White		Yellow	
Divergence Angle	0.2^0	0.5^0	0.2^0	0.5^0

Incidence Angle 86^0	0.10	0.09	0.09	0.08

b. Adhesive and Liner.

(1) The marking material shall have a precoated pressure sensitive adhesive and require no activation. The adhesive shall be protected, prior to application, with a removable liner to prevent contamination during processing, cutting, and handling. The liner shall release from the adhesive easily, without splitting or tearing, and shall not shrink or prematurely release from the adhesive during processing, storage or handling.

(2) Test pieces of the marking material shall be applied according to manufacturer's instructions and tested in accordance with ASTM D 1000, Method D, with two exceptions:

(a) A stiff, short bristle, roller type, tamper brush shall be substituted for the weighted rubber roller used to roll the test strips onto the metal test panel. The stiff, short bristles, shall be required to produce a tamping action between the beads to assure maximum contact of the marking material adhesive to the metal panel. Heavy pressure shall be exerted on the brush when rolling the sample.

(b) The beaded surface of the marking test pieces shall be covered with a thin tape not over 1 inch wide to prevent interference with or locking of the beads when the test piece is bent back 180^0 on itself for the adhesion test.

c. Application Properties.
The material shall adhere to asphalt and concrete surfaces when applied to manufacturer's recommendations at surface temperatures down to 35^0F (2^0C) and shall be immediately ready for traffic following application.

d. Conformability.
The marking material shall be thin, flexible, formable, and following application shall remain conformed to the texture of the pavement surface.

e. Thickness.
The average thickness of the material, excluding liner, shall be determined by taking 5 micrometer readings (using micrometer with approximately ¼ inch anvil and spindle) on a sample applied to an aluminum panel and deducting the thickness of the aluminum panel. The average thickness of 5 readings shall not be less than 20 mils nor more than 45 mils.

f. Removability.
Marking material shall be removable by following the manufacturer's recommendations, if the material is substantially intact. Removal shall not require sandblast, solvent or grinding methods and shall not result in objectionable staining of the pavement surface.

g. Durability and Wear Resistance.
The pavement marking material applied to asphalt or concrete in accordance with the manufacturer's recommended procedures shall be weather-resistant and show no appreciable fading, lifting, or shrinkage during the useful life of the line. Samples of material shall be applied to 4 inch by 4 inch test panels of 0.040" aluminum, (6061-T6 alloy), prepared according to recommendations of marking material manufacturer. The applied sample shall be tested in accordance with Federal Test Method Standard No. 141, Method 6192, using a CS-17 wheel and 1000 gram load and shall not wear through to the metallic surface in less than 5000 cycles. Care shall be taken to adjust the vacuum suction for the most effective removal of the abradings.

NOTE: Taber wheels used for this test shall have a "Shore A" Durometer hardness of

between 76 and 86 measured according to ASTM D 2240.

4. Packaging.

a. The pavement marking material as supplied shall be of good appearance, free from cracks, and edges will be true, straight and unbroken. The marking material shall be available in precut symbols and legends as specified and as roll goods up to 48 inches in width with no more than three splices per 50 yards of length.

b. The pavement material shall be packaged in accordance with accepted commercial standards and when stored under normal conditions shall be suitable for use for a period of at least on year after purchase.

G. Striping Powder.

1. Type of Material.
This section covers ready mixed powder products of application consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement with or without liquid road surface conditioner.

2. General Properties.

a. Description.
The striping powder shall be a free flowing plastic type pavement marking material which is premixed with glass spheres for reflectorization. When flame sprayed to clean portland cement concrete and asphaltic concrete pavement road surface by a suitable mechanical striper, the striping powder shall produce an instant dry to no pickup, adherent, reflectorized stripe capable of resisting deformation by traffic. A liquid may be desired for application to some road surfaces before application of the marking powder; if so, it shall be so stated on the request for bid.

b. Suitability to Application.

(1) The powder shall be suited to application by means of flame sprayed gun type pavement marking equipment used by the City of Memphis and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

(2) The liquid road surface conditioner shall be suited to application by pressure spray gun system or by conventional paint roller.

c. Physical Characteristics of Striping Powder.
The striping powder shall be a dry mixture capable of freely flowing through the flame spray marking equipment at the rate of 14 to 18 ounces per 30 seconds when exposed to combined conditions of humidity up to 90 percent relative humidity and ambient air temperature up to 100^0F. The striping powder shall require no thinning, mixing or heating prior to use and shall be satisfactorily usable at minimum road surface temperatures of 50^0F and minimum ambient air temperature of 60^0F.

d. Color.
The striping powder shall match the Federal Highway Administration color tolerance chart for standard highway yellow or standard highway white as required by the order. Color determinations shall be made on casts of samples melted at 200^0F and poured into aluminum foil weighting dishes of the following dimensions:

Rim diameter - 58mm

Height - 18mm

e. Particle Size.
The finished powder as supplied shall have the following grading:

U.S. Sieve No.	Percent by Weight Retained
30	0 - 2
230	93 - 100
Pan	0 - 5

f. Softening Point.
Tested in accordance with "ring and ball softening point determination" ASTM Test No. E 28, the softening point shall be from 215^0 to 225^0F.

g. Liquid Road Surface Conditioner.
The liquid, when specified, shall require no thinning, be easily applied, and be compatible with road surfaces and the marking powder supplied.

h. Glass Spheres.
The finished powder shall contain intermixed glass spheres.
NOTE: Representative finished powder samples, taken from a thoroughly mixed, full carton of finished powder, must be used for all glass sphere determinations.

(1) Index of refraction of glass spheres: 1.5 minimum; 1.6 maximum.

(2) Percent of weight of glass spheres: 30 percent minimum; 35 percent maximum.

Method of Determination of Percent by Weight of Glass Spheres:
- Equipment:
  - Laboratory triple beam balance.
  - U.S. standard screen (270) mesh.
  - 400 ml. glass beaker.
  - Oven at 200^0F.
- Procedure:
  - Weigh 100 grams of finished powder in 400 ml. beaker.
  - Add 200 ml. of suitable solvent (alcohol, aromatic solvent, or Ketone)
  - Pour solution on 270 mesh screen (flush beaker with solvent to remove all the beads).
  - Wash the beads on the screen with solvent until they are clear.
  - Dry in oven at 200^0F and weigh the amount of beads recovered.
  - Calculate percent of beads by:
    $\frac{\text{Wt. of Beans}}{\text{Wt. of Sample}} \times 100\% = \%$ of beads.

(3) Grading of glass spheres.

U.S. Sieve No.	Percent by Weight Retained
40	0 - 5
70	15 - 60
230	35 - 85
Pan	0 - 15

(4) Other Properties of Glass Spheres.
The properties of crushing resistance, roundness, index of refraction and chemical resistance shall be as required in Specification Section 02760 Paragraph 2.01 H.

3. Equipment.
Striping powder id designed for application by a light weight hand propelled striper as described in Specification Section 02760 Paragraph 2.02 D.

4. Packaging.
The finished powder shall be delivered ready for use and shall be packaged in 25 pound cartons or other acceptable containers clearly identified as to manufacturer, color, contents and quantity and shall be free of lumps, foreign particles or other matter. Cartons employed for packaging shall withstand normal handling and shall have a suitable protective interliner to resist moisture absorption. The powder, as supplied, may be stored at temperatures not to exceed 90^0F for up to one year, without adversely affecting the physical properties stated in this Specification. The liquid road surface conditioner, if required, shall be delivered ready for use in one gallon containers meeting current Interstate Commerce Commission requirements.

5. Properties of Applied Powder Line.
Dispensed and properly applied by flame spray gun type striper, the finished line shall be reflective and shall adhere so as to form a smooth continuous film on both portland cement concrete and asphaltic concrete road surfaces. Minor temporary line discoloration, due to surface soot, shall be permissible on adjacent overlapping lines. Lines exhibiting surface soot shall regain full color with traffic wear. A properly applied striping powder line shall not exhibit bleeding when applied on cured asphalt surfaces. An applied line shall dry to no pickup (10 mils application) when tested in accordance with ASTM Test No. D 711. Determination shall be made by averaging a minimum of 3 no-pickup readings at each pavement temperature tested. When the pavement temperature is between 50^0F and 90^0 F, drying time should be 10 seconds or less. When the pavement temperature is between 90^0F and 140^0F, drying time should be 25 seconds or less. Liquid road surface conditioner shall be easily applied by pressure spray gun or conventional paint roller with a solvent resistant sleeve with 7/16 inch nap. It shall be allowed to dry on the pavement surface for approximately 5 minutes prior to applying marking powder.

H. Glass Spheres For Reflectorization.
This section describes the general and specific requirements for glass beads to be applied with pavement marking paints and the physical properties of glass spheres to be applied with other binders to be used by the City.

1. Physical Properties for all Glass Spheres.

a. General.
Glass beads shall be clear, colorless, and clean, and of such character as to permit their embedment in a pigmented binder having their upper surface exposed to permit the refracting of light rays. The beads shall be bisymmetric bonding in that when applied to a paint, plastic, or polymer binder they shall hemispherically embed (to approximately their equator) in the binder film for maximum durability and brightness.

b. Crushing Resistance.
The crushing resistance of glass spheres shall be determined in accordance with ASTM D 1213. A 40 pound dead weight for 20 to 30 mesh spheres shall be the average resistance of the spheres tested.

c. Roundness.
The roundness of glass spheres shall be determined by ASTM D 1155. A maximum of 25 percent (by weight) shall contain irregular or fused sphered particles

d. Refractive Index.

The spheres shall have an average index of refraction not less than 1.50 nor more than 1.60 when tested by the liquid immersion method at 25^0C.

e. Chemical Resistance.
The glass spheres shall withstand immersion in water and acids without undergoing noticeable corrosion or etching and shall not be darkened or otherwise noticeably decomposed by sulfides. The tests for chemical resistance shall consist of one hour immersion in water and in solutions of corrosive agents followed by microscopic inspection. A 3 to 5 gram portion of the sample shall be placed in each of three Pyrex glass beakers or porcelain dishes; one sample shall be covered with distilled water, one with a 3N solution of sulfuric aced and the other with a 50 percent solution of sodium sulfide. After one hour of immersion, the glass spheres of each sample shall be examined microscopically for evidence of darkening and frosting.

NOTE: The tests described in United States Federal Specification TT-P-85b, items 4.4:13; 4.4:14; 4.4:15; and 4.4:16 may be substituted for the test described above.

f. Flow Properties.
The glass spheres shall flow freely through the dispensing equipment in any weather suitable for striping.

g. Color.
The glass spheres shall be colorless to the extent that they impart no off-color day or nighttime hue to the binder when applied at normal application rates.

2. Properties Of Glass Spheres For Use With Pavement Marking Paint.

a. Gradation.
A sieve analysis of glass spheres shall be made in accordance with ASTM D 1214. Required gradations are as follows:

(1) 5 to 20 percent passing #20; retained on #30 sieve.
(2) 30 to 75 percent passing #30; retained on 350 sieve.
(3) 9 to 32 percent passing #50; retained on #80 sieve.
(4) 0 to 10 percent passing #80 sieve.

b. Flotation.

(1) A minimum of 90 percent of the flotation glass spheres shall float on xylol (aromatic solvent) and a minimum of 75 percent shall float on heptane (aliphatic solvent) when tested as follows:

(2) A single layer of spheres shall be spread on the flat center of a clean inverted pint tin can lid. Solvent shall be slowly introduced with a syringe or dropper into the circular groove at the edge of the lid until it overflows into the center. The percentage of spheres floating on the solvent surface shall be estimated visually.

3. Gradation of Glass Spheres For Use With Plastic Pavement Marking Materials.
A sieve analysis of glass spheres should be made in accordance with ASTM D 1214. Gradations of glass spheres must be approved by the Owner for use with each plastic material. Typical gradations required for various types of plastic pavement marking materials are as follows:

a. To be included in hot thermoplastic material:
(1) 80 to 100 percent passing #60 sieve.
(2) 0 to 10 percent passing #140 sieve.

b. For application on molten thermoplastic material:

(1) 90 to 100 percent passing #20 sieve.
(2) 20 to 50 percent passing #50 sieve.
(3) 0 to 10 percent passing #80 sieve.

c. For cold thermoplastics and pliant polymer film:
(1) 100 percent passing #60 sieve.
(2) 0 to 15 percent passing #140 sieve.

4. Packaging.
The glass spheres shall be packaged in multiply paper, polyethelene, or burlap bags with a waterproof liner. The bags shall be strong enough to permit normal handling during shipment and transportation on the job without any loss of spheres and shall be sufficiently water resistant so that spheres will not become wet or caked during transit. The bags of glass spheres shall weigh a maximum of 60 lbs. each.

I. Raised Reflective Pavement Markers.

1. Classification.
Type 1, One Color, Reflective Markers (Two-way Traffic).
Type 2, One Color, Reflective Markers (One-way Traffic).
Type 3, Two Color, Reflective Markers (One-way Traffic).

2. Description.
Reflective pavement markers shall be of the prismatic reflector type, consisting of a high impact plastic shell filled with a mixture of inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain one or two prismatic faces, molded to reflect incident light, from a single direction or from opposite directions. The shell shall be of one color or of a combination of two colors which will be the same as reflective elements and shall be of size and shape shown on the plans. The base of the marker shall be free from gloss or substances which may reduce its bond to the adhesive. The presence of a soft or resin film on the surface of the base will be cause for rejection.

3. Specific Intensity.
The specific intensity of each reflective surface, when tested at 0.2 degree angle of divergence, shall not be less than the following specified values:

	Clear	Yellow	Red
0^0 Incidence Angle -	3.0	1.5	0.75
20^0 Incidence Angel -	1.2	0.60	0.30

The following definitions and tests shall be applicable:

a. Angle of Incidence.
The angle formed by a ray from the light source to the marker, and the normal to the leading edge of the marker face.

b. Angle of Divergence.
The angle formed by a ray from the light source to the marker and the returned ray from the marker to the measuring receptor.

c. Specific Intensity.
The mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incident light.

$$SI = R_L / I_L \times D^2$$

Where: SI = Specific Intensity
R_L = Reflected Light
I_L = Incident Light
D = Test Distance

d. Test Method.
The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch. The photocell receptor width shall be 0.05 inch and shall be shielded to eliminate stray light. The distance from the center of the light source aperture to the center of the photocell shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receptor shall be modified in the same proportion as the test distance.

4. Color.
The color of the raised reflective pavement markers when illuminated by an automobile headlight shall be clear, yellow, or red as required. Off-color reflection shall constitute grounds for rejection.

5. Load Test.
The raised reflective pavement markers shall support a minimum load of 2,000 pounds applied in the following manner: A random sample of three markers shall be selected for the load test. The markers shall be centered base down over the open end of a vertically positioned hollowed metal cylinder. The cylinder shall be one inch high, with an internal diameter of 3 inches and a wall thickness of ¼ inch. A load necessary to test the marker shall be applied at a speed of 0.2 inch per minute to the top of the marker through a one inch diameter solid metal plug centered on the top of the marker. Failure shall consist of either (1) breakage or significant deformation of the marker at a load of less than 2,000 pounds; or(2) significant delaminating of the shell and the filler material regardless of the load required to break the marker.

6. Sampling and Tolerances.

a. Sampling.
Twenty markers selected at random will constitute a representative sample for each lot consisting of 10,000 markers or less. Forty markers will constitute a representative sample for lots consisting of more than 10,000 markers. The lot size shall not exceed 25,000 markers.

b. Tolerances.

(1) At least 90 percent of the original sampling of each lot of markers shall pass all tests except the strength tests. If less than 90 percent but more than 70 percent pass all tests, a resample of that lot will be allowed at the request of the Contractor. When less than 70 percent of the markers from the original sample comply with the requirements, the lot represented by the samples will be rejected and not resample will be allowed.

(2) Should any one of the 3 samples selected for strength testing fail to comply with the strength requirements of this Specification, 6 additional samples will be tested. The failure of any one of these 6 samples shall be cause for the rejection of the entire lot or shipment represented by the samples.

7. Packing And Shipping.
Shipments shall be made in containers which are acceptable to common carriers and packages in such a manner as to ensure delivery in perfect condition. Any damaged shipments shall be replaced by the Contractor. Each package of pavement markers shall be clearly marked as to name of the manufacturer, color, type, lot number, quantity enclosed, and date of manufacture.

J. Epoxy Adhesive For Pavement Markers.

1. General.

a. This Specification describes Type 1R epoxy adhesive (Rapid Setting Pavement Marker Adhesive) which is designed to bond plastic traffic markers to roadway and bridge surfaces. The adhesive is intended for mixing by automatic metering, mixing and application equipment. Rapid Setting Marker Adhesive must be used when pavement temperature is above 50^0F.

b. The adhesive shall be furnished in two components, herein referred to as Epoxy Resin Component and Hardener Component; the two components shall be mixed 1 to 1 by volume just prior to use.

2. Component Properties.

The manufacturer shall certify by lot number the following chemical properties as determined by the designated test methods.

a. Component Resin:

(1) Viscosity, Poises @ 77^0F.	ASTM D 445 Note (1)
(2) Epoxide Equivalent (Filled and also unfilled when applicable)	ASTM D 1652 Note (2)
(3) Volatiles, percent by weight distilled below 350^0F.	ASTM D 1078
(4) Ash Content percent by weight	ASTM D 482

b. Component Hardener.

(1) Viscosity, Poises @ 77^0F.	ASTM D 445 Note (1)
(2) Volatiles, percent by weight distilled below 350^0F.	ASTM D 1078
(3) Ash content percent by weight	ASTM D 482

Note (1) 400 ml. sample with Brookfield Viscometer, Model LVT with specified spindle rotating at specified speed.
Note (2) Grams of material containing 1 gram equivalent of epoxide (WPE).

c. Component Ratio.

The ration of Resin and Hardener components to be mixed together to form the finished adhesive shall be 1 to 1 by volume and the components will be packaged in the proper proportions.

d. Dispersion.

All pigments, fillers, and/or thixotropic agents present in either the Epoxy Resin or Hardener component must be sufficiently dispersed so that no appreciable separatin or settling will occur during storage.

e. Nonvolatile Components.

Each component of the adhesives shall be 100 percent nonvolatiles. A test for any volatiles shall be made.

f. Color Coding.

The components shall be color coded so that visual inspection will assure homogeneous mixing. The color will be subject to approval of the Owner.

3. Mixed Components – Physical Properties

The mixed marker adhesive shall comply with the following physical requirements when tested according to the methods which are available from the Owner.

Property	Requirements
Thixotrophy – Sag Test (Maximum)	.250 inches
Gel Time or Pot Life	7 – 12 minutes

Property	Requirements
Set time (to obtain a minimum strength of 180 psi) @ 77^0F or at temperature recommended by manufacturer:	40 minutes
Bond Strength (24 hours @ 77^0F) (Minimum)	250 psi
Property Retention – after 5 cycles 0^0F to 100^0F (Minimum)	98 percent

4. Packing and Marking.
The component resin and component hardener shall be delivered in the manufacturer's original clean, sealed containers. Each container shall bear a label with the following information shown thereon: The name and address of the manufacturer, designation (component resin or component hardener), date of manufacture, batch number (a batch shall consist of a single charge of all components in a mixing chamber), mixing instructions, a warning concerning toxicity and handling precautions.

5. Sampling.
A sample from each batch of each component shall be submitted to the City for testing. The sample shall be taken from the vendor's stock or from the shipment to the Contractor.

2.02 APPLICATION EQUIPMENT
All equipment required for the satisfactory performance of this Work shall be on hand and approved by the Owner before execution of the Work will be permitted to begin.

A. Painting Equipment.

1. Paint shall be applied by means of a machine of the spray type capable of satisfactorily applying the paint under pressure through a nozzle spraying directly upon the pavement. The machine shall be equip[ed with an air blast device for cleaning the pavement ahead of the painting operation, a guide pointer to keep the machine on an accurate line, and a device to agitate the paint. It shall also have a device to maintain a uniform flow and application of the paint, an automatic device to provide a broken or skip line of the length required, and a least 3 spray guns capable of being operated either individually or 2 or 3 together. The machine shall be equipped with a bead or sphere dispenser which can be regulated to dispense the spheres automatically at the uniform rate required. The equipment shall be so designed and operated as to permit traffic to pass on the roadbed with safety.

2. Each spray application machine must be equipped with an automatic counting mechanism capable of recording the number of linear feet of material applied to the roadway surface with a accuracy of 0.50%, to be checked by the Owner.

3. The equipment required for the application of conventional paints may range from simple hand or self-propelled stripers to relatively large truck mounted equipment. Paint heating equipment is not normally required for the application of this type material.

4. The application equipment for rapid dry paint shall be truck-mounted due to the pain heating equipment required. Rapid dry paints require heating to a maximum of 170^0F at the spray nozzle as recommended by the manufacturer.

B. Hot Plastic Application Equipment.

1. The equipment used to install hot extruded thermoplastic materials by contract under this Specification shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the shaping die shall prevent accumulation and clogging. All parts of the equipment which come in contact with the material shall be constructed for easy accessibility and exposure for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the shaping die, maintain the material at the plastic temperature. The use of pans, aprons or similar appliances which the die overruns will not be permitted under this Specification. The equipment shall provide for varying die widths and to produce varying widths of traffic marking. The equipment shall permit preheating of the pavement immediately prior to application of the thermoplastic material if preheating is recommended by the thermoplastic manufacturer.

2. The equipment used to install hot extruded or spray thermoplastic materials by contract under this Specification shall be constructed so as to insure continuous uniformity in the dimensions of the stripe. The thickness of the material on the pavement shall be as specified on the Plans. The applicator shall provide a means for clearly cutting off square stripe ends and shall provide a means for applying “skip” lines. The equipment shall provide for varying widths of traffic markings. The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

3. Glass spheres applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the striping machine so that the beads are dispensed almost instantaneously upon the installed line. The glass sphere dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

4. A special kettle shall be provided for melting and heating the thermoplastic material. The kettle must be equipped with an automatic thermostatic control device for positive temperature control and to prevent overheating of the material. The heating kettle and applicator shall meet the requirements of the National Board of Fire Underwriters, of the National Fire Protection Association of the state and of the local authorities.

C. Cold Plastic Application Equipment.

Cold thermoplastics may be rolled into place with conventional pavement and highway rollers. Special equipment necessary for the successful installation of any cold thermoplastic shall be provided on a loan basis by the manufacturer of the thermoplastic material.

D. Striping Powder Application Equipment.

Striping powder is designed for application by a light weight hand propelled striper with a propane fired application gun. An external compressor capable of delivering 18 cfm at 70 psi is required for the system.

PART 3 - APPLICATION REQUIREMENTS

3.01 REFLECTIVE PAVEMENT MARKING PAINT.

A. Cleaning and painting shall be performed utilizing equipment of the kind and in the manner specified herein. On sections where no previously applied line is available to serve as a guide or if the line is to be relocated, the proposed location of the new line shall be spotted with paint in advance of the application. On tangent sections the control points shall be spaced no more than 500 feet apart and on curves at intervals that will insure the accurate location of the line. Gaps in all lines shall be left at intersections as shown in the MUTCD, or as directed.

B. No paint shall be applied over a chalk line, wire, or cord, but such guide marks shall offset the

paint line to be placed. On sections where previously applied lines are visible, the Contractor shall use the old lines unless otherwise directed. No paints shall be applied to areas of pavement when any moisture remains on the surface, or wind conditions are such as to cause a film of dust to be deposited on the line areas after these areas have been prepared for painting.

C. Paint shall be applied so as to deposit a uniform wet film thickness of 0.015 inches, which is at the rate of 16.5 gallons per mile for a solid stripe 4 inches wide, or as recommended by the manufacturer when approved in writing by the Owner. This rate of application shall apply to all types of paint, with proper adjustment made in gallons for an intermittent line or wider lines. The quantity of paint shall not underrun the designated amount by more than 5%, and if a check of the rate of application (are of line applied per unit volume of material) indicates a greater variation than this, the work shall be stopped until the paint machine is properly adjusted or replaced. This percent of variation is set out to give the contractor some leeway in starting the job and in getting his machine in adjustment but it is not expected that there shall be either a continuous overrun or underrun but that the final figures shall indicate that the average rate application closely approaches the rate established above.

D. Rapid dry (Type "B") paint shall be heated before application to a maximum of 170^0F at the spray nozzle or as recommended by the manufacturer.

E. Drop-on type glass beads shall be uniformly applied to the painted surface at a uniform rate of not less than six pounds per gallon of paint applied.

F. Protection of traffic lines and markings shall be provided by the Contractor. Warning and directional signs as shown on the Plans or as directed shall be placed to control traffic in the marking area. If the drying time of the material being used exceeds 60 seconds, the newly applied markings shall be protected by placing traffic cones or other approved warning devices at frequent intervals as directed. These devices shall be left on the line until the material is dry or firm enough not to track or receive impressions from normal traffic. They shall be removed as soon as possible (because of the traffic hazard) and shall never be left in the roadway overnight. If so directed, flaggers shall be provided to direct traffic.

G. The general appearance shall be that of clearly delineated lines with a minimum crooked and waving appearance, due consideration being given to the contours and roughness of the pavement. Segments of broken line strip shall square off positively at each end. The paint lines shall be without mist, drip or splatter. Lines that do not meet these requirements when placed shall be removed and/or corrected by the Contractor to the satisfaction of the Owner and without extra compensation.

H. The paint equipment shall be so operated that it will be unnecessary for traffic to cross the newly painted line behind the equipment in order to safely pass the painting machine, and traffic shall be allowed to keep moving at all times.

3.02 HOT THERMOPLASTICS.

A. The material shall be applied to the pavement by the spray method or by the extrusion method wherein one side of the shaping die is the pavement and the other three sides are contained by, or a part of, suitable equipment for heating and controlling the flow of material.

B. The material, when formed into traffic stripes, must be readily renewable by placing a thin overlay of new material directly over an old line of the same material. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place.

C. The finished lines shall have well-defined edges. The Contractor shall clean off dirt and grease where necessary by sand blasting or other approved methods.

D. A primer sealer of a type and if recommended by the manufacturer of the thermoplastic material shall be applied to the pavement surface prior to the installation of the thermoplastic material.

E. To insure optimum adhesion, the thermoplastic material shall be installed in a melted state at a temperature of 375^0 to 475^0F (190^0 – 246^0C).

F. Longitudinal lines shall be offset at least (2) inches (5cm) from construction joints of portland cement concrete pavements.

G. Openings of (6) inch (15cm) lengths shall be provided at (20) foot (6m) intervals in edge lines placed on the inside of superelevated curves to prevent the ponding of water on the pavement surface.

H. For non-defective pavement surfaces carrying volumes less than 50,000 vehicles per day, the contractor shall guarantee to replace or renew without cost to the City that part of the pavement markings installed which have not remained to perform useful service as follows:

1. Crosswalks and Stop Lines applied at a thickness of 125 mils (3.157mm):
75% of the total of any one intersection for one year

2. Lane Lines, Edge Lines and Center Lines applied at a thickness of 90 mils (2.286mm):
80% of a unit for one year and 60% of a unit for two years. (A "unit" is defined as any length of highway having installed thereon 2,000 lineal feet (610 m) of line of specified width in any combination or pattern). Warranties for thinner lines in these applications or for traffic volumes may be reduced commensurately.

3. The replacement material installed under this guarantee shall be guaranteed the same as the original material, from the date of the original installation.

Note 1: The intent is not to extend the original warranty period.
Note 2: The warranty does not cover those markings that have been removed by such devices as snow plows, chains, or studded tires.

3.03 COLD THERMOPLASTICS.

A. The cold thermoplastic material shall be applied to non-defective pavement surfaces that are free from dirt or other foreign matter. For normal application the pavement temperature shall be 60^0F or more. Application to be made at pavement temperatures below 60^0F shall be approved in writing by the Owner. Special instructions shall be supplied by the vendor for application to be made at pavement temperatures below 60^0F.

B. Adhesive, activators, or special coatings for various types of pavement surfaces provided with the thermoplastic material shall be installed according to the manufacturer's specifications. Cold plastics may be applied to new asphaltic pavement immediately prior to the final rolling of the new surface and rolled into place with conventional pavement and highway rollers.

C. Longitudinal lines shall be offset at least 2 inches from construction joints of portland cement concrete pavements. Openings of 6 inches length shall be left at 20 foot intervals in edge lines placed on the inside of superelevated curves so as to prevent the ponding of drainage of the pavement surface.

3.04 PLIANT POLYMER FILM.

The marking film shall be applied to asphaltic concrete and portland cement concrete surfaces according to the manufacturer's recommendations at pavement surface and ambient air temperatures 60^0F or more and when daily temperatures above 70^0F are prevailing to insure film conformance and adherence to pavement surface. Following application, the marking film is ready for traffic. Areas of minor damage shall be patched with an inlay of this film in accordance with the manufacturer's recommendation.

3.05 SHEETING AND TAPE.

Sheeting and tape material shall be applied directly to clean portland cement concrete and asphaltic concrete surfaces according to the manufacturer's recommendations at surface temperatures above 35^0F and shall be ready for traffic immediately following application.

3.06 STRIPING POWDER.

The powder shall be flame sprayed to clean portland cement concrete and asphaltic concrete to produce a solid, full width line of the required thickness. A liquid road surface conditioner may be required for application to some road surfaces before the application of the marking powder. Liquid road surface conditioner shall be applied by pressure spray gun system or by conventional paint roller.

3.07 RAISED REFLECTIVE PAVEMENT MARKERS.

A. Raised reflective pavement markers shall be cemented to the pavement with epoxy resin adhesive spaced as shown on the Plans. Markers shall not be installed over joints in rigid type pavements.

B. The portion of the highway surface to which the marker is attached by the adhesive shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers and any other material which would adversely affect the bond of the adhesive. Cleaning shall be done by sand blast cleaning on all pavement surfaces. The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient t result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been pressed in place. All markers shall be cemented to the pavement within 10 minutes after the start of mixing of any one batch of adhesive. The marker shall be placed in position and pressure applied until firm contact is made with the pavement. Excess adhesive around the edge of the marker and all adhesive obscuring the reflective surface of the marker shall be immediately and completely removed with a clean, absorbent cloth. The use of thinners or solvents or any type for this purpose is prohibited. The marker shall be protected against impact until the adhesive has hardened to the degree designated by the Owner.

C. The specified adhesive requires that mixing operation and placing of the marker be done rapidly. The pot life of the adhesive may be prolonged by cooling after mixing the components or by spreading it out in a thin layer on a board before application. Any mixed batch of adhesive which becomes viscous because of its acquiring a partial set such that the marker cannot be pressed into place with the adhesive readily extruding from the edges shall not be used.

D. Immediately prior to mixing, each component of the adhesive (Package A and B) shall be thoroughly redispersed by stirring. Any material that cannot be readily redispersed shall be rejected. After redispersement, one volume from Package A shall be mixed with one volume from Package B until a uniform gray color without visible streaks of white or black is obtained.

E. When approved fast setting adhesive is used, the components shall be mixed by a 2 component type automatic mixing and extrusion apparatus, and the markers shall be placed immediately after the adhesive has been mixed and extruded.

3.08 REMOVAL OF PAINTED MARKINGS.

A. Painted pavement markings shall be removed where specified. The method used for paint removal shall be approved by the Owner prior to the beginning of the work. Removal of existing painted pavement markings by painting over with black paint or asphalt will not be allowed.

B. When the method of removal causes sand or other material to be accumulated on the pavement, the residue shall be removed as the work progresses. Painted markings shall be removed by methods that cause the least possible damage to the pavement. All damage to the pavement or surface caused by pavement marking removal shall be repaired as directed by the Owner at the

Contractor's expense.

C. Where a plastic marking will replace the painted marking, paint removal shall consist of removing enough paint to assure proper installation of the plastic. The paint removal shall be uniform and shall expose a minimum of 75 percent of the surface area that is to receive the plastic materials.

PART 4 – CERTIFICATION AND GUARANTEE

4.01 The Contractor shall furnish the Owner at, or before, the time of delivery, three copies of certification of conformance to the tests and requirements for traffic pavement marking materials of these Specifications. The certification shall consist of the following:

A. The name of the manufacturer of the material.

B. The batch or lot number of the material represented.

C. The test results of each required test.

D. A statement to the effect that a representative sample of the specific lot shipped has been tested and meets the requirements of these Specifications.

E. The name and title of the authorized representative of the manufacturer certifying to the correctness of the report.

F. The manufacturer shall guarantee the traffic pavement marking material supplied under these Specifications to meet all parts of these Specifications and shall agree to replace any amount of material found defective during inspection or installation of the material.

G. All replacement by the manufacturer shall be free of charge to the City, including all freight and handling charges. Material replaced under this guarantee shall, at the written request and expense of the manufacturer, be returned to the manufacturer by the City, unless said material has been installed.

PART 5 - MEASUREMENT

Accepted installed items related to pavement marking shall be measured in the units and as described herein. All work not described herein, included removal of existing pavement marking, shall be considered incidental to the installation of pavement markings and shall not be measured separately.

5.01 RAISED REFLECTIVE PAVEMENT MARKERS.
Accepted raised reflective pavement markers of each type shall be measured by the raised reflective pavement marker complete in place, per each.

5.02 PAINTED CURB.
Accepted curb painting shall be measured in linear feet to the nearest foot along the edge of the painted curb complete in place.

5.03 SOLID BARRIER LINE (4")
Accepted solid barrier lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

5.04 BROKEN LANE LINE (4")
Accepted broken lane lines shall b e measured in linear feet to the nearest foot along the center of each line including painted and unpainted portions complete in place.

5.05 DOUBLE SOLID BARRIER LINE (4")
Accepted double solid barrier lines shall be measured in linear feet to the nearest foot along the center of each pair of lines complete in place.

5.06 DOUBLE BROKEN BARRIER LINE (4")
Accepted double broken barrier lines for reversible lanes shall be measured in linear feet to the nearest foot along the center of each pair of lines including painted and unpainted portions complete in place.

5.07 DOUBLE BROKEN / SOLID BARRIER LINE (4")
Accepted double broken / solid barrier lines for restriction of passing in one direction or two-way left turn lanes shall be measured in linear feet to the nearest foot along the center of each pair of lines including painted and unpainted portions complete in place.

5.08 DOTTED LINE (4")
Accepted dotted lines for extension of lines through intersections shall be measured in linear feet to the nearest foot along the center of each marked dot complete in place.

5.09 SOLID BARRIER LINE (12")
Accepted solid barrier lines for channelization shall be measured in linear feet to the nearest foot along the center of each line complete in place.

5.10 CROSSWALK.
Accepted crosswalk lines shall be measured in linear feet to the nearest foot along the center of each line complete in place. The boundary lines shall be measured separately.

5.11 STOP LINE.
Accepted stop lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

5.12 TRANSVERSE SHOULDER LINES.
Accepted transverse shoulder lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

5.13 CHANNELIZATION.
Accepted pavement channelization marking complete in place shall be measured in square feet to the nearest square foot for the total area, marked and unmarked, to be channelized including boundary lines.

5.14 – 5.20 PAVEMENT MARKING (DESCRIPTION).
Accepted pavement marking (description) complete in place shall be measured as described on the Plans or in the Contract Documents.

5.21 STRAIGHT ARROW.
Accepted straight arrows shall be measured by the pavement arrow complete in place, per each.

5.22 TURN ARROW.
Accepted turn arrows shall be measured by the pavement arrow complete in place, per each.

5.23 STRAIGHT-TURN ARROW.
Accepted straight-turn arrows shall be measured by the pavement marking arrow complete in place, per each.

5.24 DOUBLE TURN ARROW.
Accepted double turn arrows shall be measured by the pavement marking arrow complete in place, per each.

5.25 PAVEMENT MARKING WORD "ONLY"
Accepted word "ONLY" pavement markings shall be measured by each pavement marking word complete in

place, per each work.

5.26 PAVEMENT MARKING WORD (DESCRIPTION).
Accepted pavement marking words as described on the Plans shall be measured by each pavement marking word complete in place, per each word.

5.27 PAVEMENT MARKING DESIGNS (DESCRIPTION).
Accepted pavement marking designs as described on the Plans shall be measured by each pavement marking design complete in place, per each design.

5.28 EXISTING STRIPING REMOVAL AS PER PLAN.
Accepted lane striping and pavement markings in place as per plan. Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price shall be full compensation.

5.29 LANE STRIPING AND PAVEMENT MARKINGS IN PLACE AS PER PLAN.
Accepted removal of all existing striping as shown per plan. Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price shall be full compensation.

PART 6 – PAYMENT

6.01 The unit price to be paid for pavement markings shall include the locating and layout of all pavement markings. The contract unit price shall be full compensation for accepted and installed pavement marking, complete in place, measured as described herein and shall include layout, materials, labor, equipment, tools, royalties, and other incidentals required to complete the work. Payment shall be made under the Pay Item Schedule which describes each pay item. The material of which each pavement marking except Item 02760 5.01, "Raised Reflective Pavement Markers", is to be constructed is defined by the two digits following the decimal according to the following code:

A.

Code	Material
01	Conventional Reflective Pavement Marking Paint (Type "A" Paint)
02	Rapid Dry Reflective Pavement Marking Paint (Type "B" Paint)
03	Hot Thermoplastics
04	Cold Thermoplastics
05	Pliant Polymer Film
06	Sheeting and Tape
07	Striping Powder

6.02 PAYMENT WILL BE MADE UNDER:

Item Number	Item Description	Pay unit
02760-5.01	RAISED REFLECTIVE PAVEMENT MARKER	Each
02760-5.01.01	Raised Reflective Pavement Marker (Type I)	Each
02760-5.01.02	Raised Reflective Pavement Marker (Type II)	Each
02760-5.01.03	Raised Reflective Pavement Marker (Type III)	Each
02760-5.02.___	PAINTED CURB	Lin. Ft.
02760-5.03.___	SOLID BARRIER LINE (4")	Lin. Ft.

02760-5.04.___	BROKEN LANE LINE (4")	Lin. Ft.
02760-5.05.___	DOUBLE SOLID BARRIER LINE (4")	Lin. Ft.
02760-5.06.___	DOUBLE BROKEN BARRIER LINE (4")	Lin. Ft.
02760-5.07.___	DOUBLE BROKEN / SOLID BARRIER LINE (4")	Lin. Ft.
02760-5.08.___	DOTTED LINE	Lin. Ft.
02760-5.09.___	SOLID BARRIER LINE (8")	Lin. Ft.
02760-5.10.___	CROSSWALK	Lin. Ft.
02760-5.11.___	STOP LINE	Lin. Ft.
02760-5.12.___	TRANSVERSE SHOULDER LINES	Lin. Ft.
02760-5.13.___	CHANNELIZATION	Lin. Ft.
02760-5.14-5.20.___	PAVEMENT MARKING (DESCRIPTION)	Each
02760-5.21.___	STRAIGHT ARROW	Each
02760-5.22.___	TURN ARROW	Each
02760-5.23.___	STRAIGHT-TURN ARROW	Each
02760-5.24.___	DOUBLE TURN ARROW	Each
02760-5.25.___	PAVEMENT MARKING WORD "ONLY"	Each
02760-5.26.___	PAVEMENT MARKING WORD (DESCRIPTION)	Each
02760-5.27.___	PAVEMENT MARKING DESIGN (DESCRIPTION)	Each
02760-5.28.___	EXISTING STRIPING REMOVAL AS PER PLAN	LumpSum
02760-5.29.___	LANE STRIPING & PAVEMENT MARKNGS IN PALCE AS PER PLANING REMOVAL AS PER PLAN	Lump Sum

END OF SECTION 02760

PART 1 - SCOPE

1.01 Traffic control signs include all regulatory, warning, and guidance signs designed to convey a message to users of the streets and highways. The work covered by this Specification Section shall consist of the construction of foundations and supports and the fabrication, furnishing, assembly, and erection of traffic control signs on the supports.

PART 2 - MATERIALS AND EQUIPMENT

2.01 GENERAL REQUIREMENTS

A. Traffic control and traffic information signs shall be constructed and erected in accordance with these Specifications and at such locations and in conformity with the lines and grades indicated on the Plans or as otherwise directed by the Owner.

B. All signs shall be of the size, dimensions, shape, and legend as indicated on the Plans and/or as shown in the Tennessee Department of Transportation Manual on Uniform Traffic Control Devices, Current Edition (MUTCD). All materials and construction of traffic control signs furnished, fabricated, and/or installed under these Specifications shall be certified and/or guaranteed to the City by the Contractor according to the requirements of Specification Section 00710 Article 18.

2.02 SIGNS

A. All signs shall be fabricated from flat aluminum sheets meeting the requirements of these Specifications and covered with the reflective sheeting material specified herein, unless otherwise specified. Sign message color and dimensions shall conform to the requirements of the MUTCD. Sign legends shall be screened with process inks compatible with the Reflective Sheeting.

B. All colors for signs, when thoroughly dry, shall match the Standard Interstate Colors (AASHTO Manual) when compared in natural daylight. Black paint for nonreflectorized message application shall be high quality opaque process paste made with synthetic resin as manufactured or recommended by the manufacturer of the reflective sheeting. Transparent blue, red, and green paint and thinner for the application on the silver reflective sheeting for signs and reflectorized backgrounds shall be as recommended by the manufacturer of the reflective sheeting.

C. Flat Sheet Aluminum For Signs. All traffic control signs shall be fabricated of a single piece of flat sheet 0.080 gauge aluminum meeting the requirements of ASTM B 209 without joints and without supporting frame, unless otherwise specified. The aluminum sign blanks shall be of Alloy 6061-T6 or as specified, vapor degreased and etched or treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product in strict accordance with the recommendations of the manufacturer of the chemical used. All corner radii shall be cut and holes shall be punched as required by the MUTCD.

D. Extruded Aluminum Sign Blades. All street name signs shall be fabricated from extruded aluminum meeting the requirements of ASTM B 221, Alloy 6061-T6, 0.250 bulk, 0.091 web, vapor degreased and etched or treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product, in strict accordance with the recommendations of the manufacturer of the chemical.

E. Hardware. All bolts, nuts, washers, and other hardware shall conform to the requirements of the following specifications:

1. Aluminum

a. Bolts.
Bolts shall meet the requirements of ASTM B 211, Alloy 2024-T4. Chromated sealed anodic coating at least 0.0002 inch thick shall be applied to all finished bolts

b. Nuts.
Nuts shall meet the requirements of ASTM B 211, Alloy 6262-T9 for 5/16 inch and larger, and Alloy 2024-T4 for ¼ inch and under, tamper proof type.

c. Washers.
Washers shall meet the requirements of ASTM B 209, Alloy Alclad 2024-T4.

d. Caps, Clamps, Clips, Brackets, and Other Hardware.
Caps, clamps, clips, brackets, and other hardware shall meet the requirements of the following specifications: ASTM B 308, Alloy 6061-T6 for structural shapes; ASTM B 221, Alloy 6063-T6 for extruded shapes; and ASTM B 26, Alloy SG-70A-F for cast shapes.

2. Steel.

a. Bolts, Nuts, and Washers.
Bolts, nuts, and washers shall be cadmium plated meeting the requirements of ASTM A 307.

b. Other Hardware.
Other hardware shall meet the requirements of ASTM A 36, galvanized in accordance with ASTM A 123, for structural shapes and plates and ASTM A 27, galvanized in accordance with ASTM 123, for cast shapes.

3. Stainless Steel.

a. Bolts and Washers.
Bolts and washers shall meet the requirements of ASTM A 193, Austenitic Steel.

b. Nuts.
Nuts shall meet the requirements of ASTM A 194, Grade 8F, except that the nuts shall be lock nuts with semi-finished hex nuts equivalent to American Standard Heavy Series.

F. Reflective Sheeting Materials. Sign face materials shall be of Reflective Sheeting Material (Glass Bead Retroreflective Element Material) conforming to the following requirements unless otherwise specified.

1. Description.

a. Reflective sheeting shall consist of a Retroreflective lens system having a smoother outer surface. When adhesive backing is used the sheeting shall have a precoated adhesive on the backside protected by an easily removable liner. Types I – IV refer to levels of performance in terms of reflective intensity. Type III Reflective Sheeting Material with Class 2 adhesive backing shall be used unless otherwise specified.

2. Color Requirements.

a. The colors specified shall be matched visually and shall by within the color tolerance limits shown on the appropriate Highway Color Tolerance Charts issued by the Federal Highway Administration utilizing the instruction thereon. Certification as to conformance with this requirement shall be provided by the Contractor.

(or)

b. Through instrumental color testing the diffuse day color of the reflective material shall conform to the requirements of Table I or II and shall be determined in accordance with ASTM E 97, “Standard Method of Test for 45 Degree, 0 Degree Directional Reflectance of

Opaque Specimens by Filter Photometry." (Geometric characteristics must be confined to illumination within 10 degrees of, and centered about, a direction of 45 degrees from the perpendicular to the test surface; viewing is within 15 degrees of , and centered about, the perpendicular to the test surface. Condition of illumination and observation must not be interchanged.) The standards to be used for reference shall be the MUNSELL PAPERS designated in Tables 02891-1 and 02891-2. The papers must be recently calibrated on a spectrophotometer. The test instrument shall be one of the following or approved equal:

(1) GARDNER Multipurpose Reflectometer or Model XL20 Color Difference Meter.

(2) GARDNER Model AC-2a Color Difference Meter or Model XL30 Color Difference Meters.

(3) MEECO Model V Colormaster.

(4) HUNTERLAB D25 Color Difference Meter.

TABLE 02891-1
Color Specification Limits and Reference Standards
Types I and II Sheeting

	Chromaticity Coordinates* (Corner Points)								Reflectance Limits			
	1		2		3		4		(% Y) Y		Ref Std***	
Color	x	y	x	y	x	y	x	y	Min	Max	(Munsell Papers)	
White**	.305	.290	.350	.342	.321	.361	.276	.308	35	--	6.3GY	6.77/0.8
Red	.602	.317	.664	.336	.644	.356	.575	.356	8	12	8.2R	3.78/14.0
Orange	.535	.375	.607	.393	.582	.417	.535	.399	18	30	2.5YR	5.5/14.0
Brown	.445	.353	.604	.396	.556	.443	.445	.386	4	9	5.0YR	3/6
Yellow	.482	.450	.532	.465	.505	.494	.475	.485	29	45	1.25Y	6/12
Green	.107	.439	.155	.460	.130	.369	.180	.391	3.5	9	0.65BG	2.84/8.45
Blue	.147	.075	.176	.091	.176	.151	.106	.113	1	4	5.8PB	1.32/6.8

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illumination source C.
**Silver white is an acceptable color designation.
***Available from Munsell Color Co., 2441 Calvert St., Baltimore, MD 21218

TABLE 02891-2
Color Specification Limits and Reference Standards
Types III and IV Sheeting

	Chromaticity Coordinates* (Corner Points)								Reflectance Limits			
	1		2		3		4		(% Y) Y		Ref Std***	
Color	x	y	x	y	x	y	x	y	Min	Max	(Munsell Papers)	
White**	.303	.287	.368	.353	.340	.380	.274	.316	27	--	5.0PB	7/1
Red	.613	.297	.708	.292	.636	.364	.558	.352	2.5	11	7.5R	3/12
Orange	.550	.360	.630	.370	.581	.418	.516	.394	14	30	2.5YR	5.5/14.0
Yellow	.498	.412	.557	.442	.479	.520	.538	.472	15	40	1.25Y	6/12
Green	.030	.380	.166	.346	.286	.428	.201	.776	3	8	10G	3/8
Blue	.144	.030	.244	.202	.190	.247	.066	.208	1	10	5.8PB	1.32/8.8

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illumination source C.
**Silver white is an acceptable color designation.
***Available from Munsell Color Co., 2441 Calvert St., Baltimore, MD 21218

3. Reflective Intensity. The reflective sheeting shall have minimum Specific Intensity per unit area (SIA) as shown in Tables 02891-3 through 02891-6 expressed as "candelas per footcandle per square foot" ((Cd $1c^{-1}$) $ft.^{-2}$). Measurement of SIA shall be conducted in accordance with the method detailed in Section 718, Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (Federal Highway Specifications).

TABLE 02891-3
Minimum Specific Intensity Per Unit area (SIA)
(Candelas Per Footcandle Per Square Foot)
Type I Sheeting

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Brown	Yellow	Green	Blue
0.2	-4	50	10	13.0	1.0	25	5	3.8
0.2	+30	12	3	4.0	0.3	7	2	1.0
0.5	-4	15	15	6.5	0.3	10	3	2.0
0.5	+30	6	1	2.5	0.2	3	1	0.8

TABLE 02891-4
Minimum Specific Intensity Per Unit area (SIA)
(Candelas Per Footcandle Per Square Foot)
Type II Sheeting

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Brown	Yellow	Green	Blue
0.2	-4	70	14.5	25.0	1.0	50	9.0	4.0
0.2	+30	30	6.0	7.0	0.3	22	3.5	1.75
0.5	-4	30	7.5	13.5	0.3	25	4.5	2.0
0.5	+30	15	3.0	4.0	0.2	13	2.2	0.8

TABLE 02891-5
Minimum Specific Intensity Per Unit area (SIA)
(Candelas Per Footcandle Per Square Foot)
Type III Sheeting
A – Glass Bead Retroreflective Element Material

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45	20.0
0.2	+30	150	25	60	100	25	11.0
0.5	-4	95	15	30	82	15	7.5
0.5	+30	65	10	25	45	10	5.0

B – Prismatic Retroreflective Element Material

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45.0	100	170	45.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	10	25	45	10	5.0

TABLE 02891-6
Minimum Specific Intensity Per Unit area (SIA)
(Candelas Per Footcandle Per Square Foot)
Type IV Sheeting

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	35.0	70	170	30.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	60	8.4	17	40	7.2	4.8

*Test samples are to be mounted in accordance with manufacturer's recommendation.

4. Specular Gloss. The reflective sheeting shall have an 85 degree specular gloss of not less than 40 for Types I and II, and not less than 50 for III and IV, when tested in accordance with ASTM D 523.

5. Color Processing. The sheeting shall permit cutting and color processing with compatible transparent and opaque process inks in accordance with the Manufacturer's recommendation at temperatures of 60^0 F to 100^0 F and relative humidity at 20 to 80 percent. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures as recommended by the manufacturer. Color processing for Type III material shall be restricted to sheeting with heat activated adhesive backing unless otherwise recommended by the manufacturer.

6. Shrinkage. A 9 inch by 9 inch reflective sheeting specimen with liner shall be conditioned a minimum of 1 hour at 72^0 F and 50 percent relative humidity. The liner shall be removed and the specimen placed on a flat surface with the adhesive side up. Ten minutes after liner is removed and again after 24 hours, the specimen shall be measured to determine the amount of dimensional change. The reflective sheeting shall not shrink in any dimension more than 1/32 inch in 10 minutes nor more than 1/8 inch in 24 hours.

7. Flexibility.

a. Types I and II Sheeting Material applied according to the manufacturer's recommendations to a clean, etched 0.020 inch by 2 inch by 8 inch aluminum panel of alloy 6061-T6 conditioned a minimum of 48 hours and tested at 72^0F and 50 percent relative humidity shall be sufficiently flexible to show no cracking when bent around a ¾ inch mandrel.

b. Types III and IV sheeting material, with the liner removed and conditioned for 24 hours at 72^0F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when

slowly bent, in one second's time, around a 1/8 inch mandrel with adhesive contacting the mandrel. NOTE: For ease of testing, spread talcum powder on adhesive to prevent sticking to the mandrel.

c. Non-adhesive sheetings shall show no signs of cracking or crazing when flexed repeatedly over a 1/16 inch mandrel to 180^0 at 72^0F.

8. Adhesive.

a. The reflective sheeting shall include a precoated pressure sensitive adhesive backing (Class 1) or a tack free heat activated adhesive backing (Class 2) either of which may be applied without necessity of additional adhesive coats on either the reflective sheeting or application surface. The Class 1 adhesive shall be a pressure sensitive adhesive of the aggressive tack type requiring no heat solvent or other preparation for adhesion to smooth clean surfaces. The Class 2 adhesive backing shall be a tack free adhesive activated by applying heat in excess of 175^0F to the material as in the heat vacuum process of sign fabrication.

b. The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solvents without breaking, tearing, or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at 160^0F under a weight of 2.5 pounds per square inch.

c. The adhesive backing of the reflective sheeting shall produce a bond to support a 1 ¾ pound weight for 5 minutes, without the bond peeling for a distance of more than 2.0 inches when applied to a smooth aluminum surface and tested as specified in Section 718, Federal Highway Specifications.

9. Impact Resistance. Types I, II, III, and IV reflective sheeting material, applied according to the manufacturer's recommendations to a cleaned, etched aluminum panel of alloy 6061-T6, 0.04inches by 3.0 inches by 5.0 inches and conditioned for 24 hours at 72^0F and 50 percent relative humidity shall show no cracking when the face of the panel is subjected to an impact of a 2.0 pound weight with a 5/8 inch rounded tip dropped from a 10 inch pound setting on a Gardner Variable Impact Tester, IG-1120.

10. Accelerated Weathering. When applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning in accordance with manufacturer's recommendations, shall show no appreciable discoloration, cracking, blistering or dimensional change. Following exposure, the panels shall be washed with a 5% HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth, brought to equilibrium at standard conditions and tested. It shall have not less than the percent of the minimum SIA specified in Table 02891-7 when subjected to an accelerated weathering test of the specified duration in accordance with ASTM G 23, Type E or EH Weatherometer with the humidifier off.

TABLE 02891-7
MINIMUM SIA AFTER WEATHEROMETER TEST

Type of Material	Hours Tested	Minimum Specific Intensity Per Unit Area
I	1,000	50% of Table 02891-3
II	1,000	50% of Table 02891-4
III	2,200*	80% of Table 02891-5
IV	250	50% of Table 02891-6

* For orange material having glass bead retroreflective elements, the hours tested shall be 500.

11. Intended Use. The reflective sheeting specified herein is intended for use on surfaces of highway signs and other traffic control devices to assure their optimum visibility by day and at night when exposed to a light source and whether dry or totally wet by rain.

2.03 SIGN SUPPORTS.

Sign supports for traffic control signs shall be furnished and installed as specified herin, unless otherwise specified.

A. Steel Stanchions. Steel stanchions of one continuous length meeting the requirements of ASTM A 499, U.S. Highway Type, shall be used for all ground mounted traffic control signs. Stanchions shall have a weight of 3.00 pounds per foot and shall have drilled a minimum of 58 3/8 inch holes on one inch centers. The stanchions shall be painted green.

B. Steel Tubes. Steel tubes of one continuous length meeting the requirements of ASTM A 53, galvanized in accordance with ASTM A 123, shall be used for all ground mounted street name signs. Steel tubes shall have a 2-3/8 inch outside diameter, minimum 12 gauge.

C. Steel Strain Poles. Steel strain poles furnished and installed for span mounted overhead signs shall meet the requirements of Specification Section 02890 Paragraph 2.02.F. Clamps shall be sized to fit each pole at a point eighteen inches from the top of the pole and 21.5 feet above the roadway crown. The poles shall be installed according to the requirements of Specification Section 02890 Paragraph 3.02.F.

D. Wood Strain Poles. Wood strain poles furnished and installed for span mounted overhead signs shall meet the requirements of Specification Section 02890 Paragraph 2.05.D. Guy assemblies shall meet the requirements of Specification Section 02890 Paragraph 2.02.L and 3.02.L.

E. Span Wire Assembly. The span wire assembly furnished and installed for span mounted overhead signs shall include span wire, tether line, and all appurtenances required to complete sign installation. The materials used shall meet or exceed ASTM standards. All 3/8" diameter dead ends, pole clamps, and overhead sign mounting devices shall be galvanized in accordance with ASTM A 123. All 5/16" diameter dead ends shall be copper clad steel. All structural steel shall have a minimum yield stress of 36,000 psi.

1. Span Wire and Tether Line. All wire rope used for span wire and tether line at locations other than signalized intersections shall be utility grade 3/8 inch diameter steel having a minimum breaking strength of 11,500 pounds. Each individual wire within the wire rope shall be protected by a uniform coating (galvanized) of pure zinc in accordance with ASTM A 123.

2. Spiral Dead Ends. Spiral Dead Ends shall be of the same material, size and strength as the connecting span wire and/or tether line and of a design similar to that shown in the Design Standards.

3. Strain Insulator. Strain insulator shall be fiberglass, shall be capable of transmitting a minimum force of 15,000 pounds, and shall be of a design similar to that shown in the Design Standards.

4. Overhead Sign Mounting Devices.

a. Span Wire Clamp Assembly. Span wire clamp assembly shall consist of two 3/8 inch U-bolts with nuts and washers, one 5/8 inch pin with cotter pin and one clamp (two-piece) assembly for 3/8 inch wire rope as shown in the Design Standards.

b. Balance Adjuster. Balance adjusters shall be malleable iron.

c. Galvanized Conduit, Galvanized Steel Tubing, Galvanized Bars, and Angles. Galvanized bars and angels shall be the size and types shown in the Design Standards.

d. Overhead Sign Mounting Bracket. Overhead sign mounting brackets shall be of the type and shape shown on the Plans or Design Standards.

e. Signs. Signs shall be of the type and size shown on the Plans and called for in these Specifications.

f. Clamp for Existing Concrete Poles. Clamp shall be galvanized steel as shown in the Design Standards.

g. Clamp for Steel Poles. Clamp shall be galvanized steel as shown in the Design Standards.

h. Fastening Device for Span & Tether Line. Fastening device for span on tether line shall be as shown on the Plans or Design Standards.

2.04 CONSTRUCTION EQUIPMENT.

All equipment required for the satisfactory performance of the Work shall be on hand and approved by the Owner before construction will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 GENERAL REQUIREMENTS.

A. Before beginning any excavation or driving any sign posts, the Contractor shall determine the location of any underground electrical lines, drainage, or other utility lines in the vicinity and shall conduct his work in such manner as to avoid damage to same.

B. All signs are numbered or otherwise identified and shall be located as indicated on the Plans. Any changes in locations shall be approved by the Owner prior to erection.

C. The Owner will identify in the field the location of all sign supports and each sign to be mounted. The Contractor shall install the signs at the approved locations and complete the work.

3.02 SIGNS.

A. Traffic signs shall be furnished, fabricated, and erected on their supports as specified herein. The reflective sheeting shall be applied to the properly prepared aluminum with the equipment and in a manner prescribed by the sheeting manufacturer.

B. All completed signs shall be free from defects in materials and workmanship and effectively present the specified message under conditions of both day and night viewing. Reflectorized sign surfaces shall exhibit uniform color and brightness over the entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or the incident beam of an automobile headlamp.

C. The reflectorized legend optical performance shall be such that incident light from motor vehicle headlamps will be uniformly reflected back to the eyes of the operator at entrance angles up to 30 degrees without gaps or irregularities.

D. Signs shall be positioned on and fastened to the support as shown on the Plans, or as directed by the Owner. All signs, once erected, shall be clean and free of any substance which would hide or otherwise obscure any portion of the sign face.

3.03 SIGN SUPPORTS.

A. Stanchion and Tube Supports For Ground Mounted Signs.

1. Stanchion and tube supports to be furnished and erected shall consist of one or more posts of the type specified, set directly in the ground, embedded in concrete, or bolted to a foundation, ash shown on the Plans. All stanchions and tubes set directly in the ground shall be held in proper position, and backfilling shall be placed in 6 inch layer, each layer being thoroughly tamped. All stanchions and tubes shall be set, driven or embedded so that the sign face will be plumb, oriented and aligned as shown on the Plans and Design Standards. In driving stanchions or tubes, a method shall be used which will not damage or deface the top of the stanchions or tubes.

2. The excavation for sign stanchions or tubes that are to be embedded in or bolted to a concrete foundation shall be made as nearly to neat lines as possible and all parts of the sign post encasement shall generally be poured against the soil but forming below ground level shall be used in sandy soils or when directed by the Owner. Forming will be required for all concrete work above the finished ground level and the top 12 inches of all concrete work. Necessary braces shall be provided to keep anchor bolts and encased posts in proper position. Concrete for foundations and encasement shall be Class A, meeting the requirements of Specification Section 03050. Concrete placement shall be performed in accordance with the provisions of Specification Section 03310, Concrete Structures. The Contractor shall remove and dispose of all surplus excavated material.

3. All cracked, chipped, or scratched galvanized steel members shall be repaired with a "touch-up". Zinc powder, wire, or stick shall be used to repair the damaged areas. The zinc shall become completely liquid at a temperature no greater than 475^0F . The area to be regalvanized shall be thoroughly cleaned, including removal of slag on welds, the surface heated, and zinc applied in accordance with the recommendations of the manufacturer of the material being used.

B. Supports For Span Mounted Overhead Signs.

Construction requirements for supports for span mounted overhead signs shall include all excavation and backfill; disposal of surplus or unsuitable material; forming, placement of reinforcement, conduit, concrete, and anchor bolts; finishing; and curing. This construction shall meet the requirements of Specification Section 02890 Paragraph 3.02.F. Signs shall be placed on the span according to the Plans.

PART 4 - MEASUREMENT

Accepted installed items related to traffic control sign installation shall be measured as described herein. Construction work required for the installation of a traffic control sign shall be measured according to the respective paragraph of these Specifications.

Supports for span mounted signs will not be measured as a unit but will be measured according to their components. Steel and wood strain poles will be measured as specified in Specification Section 02890 Paragraph 4.06.

The span wire assembly will be measured as specified in Specification Section 02890 Paragraph 4.12.

All other work shall be considered incidental to the installation of the traffic control signs and shall not be measured separately from the items described herein.

4.01 FLAT SHEET ALUMINUM SIGNS.

Accepted field installed flat sheet aluminum signs shall be measured in square feet to the nearest tenth of one square foot for each gauge aluminum sign black used.

4.02 EXTRUDED ALUMINUM SIGNS

Accepted field installed extruded aluminum signs shall be measured in square feet to the nearest tenth of one

square foot for each gauge aluminum sign blade used.

4.03 STEEL STANCHIONS
Accepted field installed steel stanchions of each unit weight and length shall be measured as one complete installed unit, per each.

4.04 STEEL TUBES
Accepted field installed steel tubes of each unit weight and length shall be measured as one complete installed unit, per each.

PART 5 - PAYMENT
Payment for accepted work, measured as above, shall be made at the appropriate contract unit price which shall be payment in full for all work required to complete the installation. Payment shall be made for quantities as shown on the Plans unless a field measurement is requested by the Contractor, in which case payment shall be for approved field measured quantities. Payment shall be made under the pay items listed at the end of this section.

5.01 FLAT SHEET ALUMINUM SIGNS.
Payment for the area of accepted and installed flat sheet aluminum signs for each gauge will be made at the contract unit price. Payment shall include the aluminum sign black with reflective sheeting applied and bands and brackets required for a complete installation according to the Plans.

5.02 EXTRUDED ALUMINUM SIGNS.
Payment for the area of accepted and installed extruded aluminum signs for each gauge will be made at the contract unit price. Payment shall include the aluminum sign blades with reflective sheeting applied and all bolts, nuts, washers, clamps, and brackets required for a complete installation according to the Plans.

5.03 STEEL STANCHIONS.
Payment for each accepted and installed steel stanchion of cross section weight and length installed according to the Plans as a complete unit will be made at the contract unit price. This payment shall be compensation for any excavation, backfilling, drilling, removal, and replacement of concrete and other items required for the complete installation of the stanchions.

5.04 STEEL TUBES.
Payment for each accepted and installed steel tube of each cross section and length installed according to the Plans as a completed unit will be made at the contract unit price. This payment shall be compensation for any excavation, backfilling, drilling, removal, and replacement of concrete, and other items required for the complete installation of the stanchions.

5.05 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02891-01	FLAT SHEET ALUMINUM SIGNS	Sq. Ft.
02891-01.01	Flat Sheet Aluminum Sign, 0.080”	Sq. Ft.
02891-02	EXTRUDED ALUMINUM SIGNS	Sq. Ft.
02891-02.01	Extruded Aluminum Sign, 0.080”	Sq. Ft.
02891-03	STEEL STANCHIONS	Each
02891-03.___.___	Steel Stanchions, Length (feet) Unit weight (tenth of lb/ft,)	Each
02891-04	STEEL TUBES	Each
02891-04.01.___	Steel Tubes, 2-3/8” O.D., 12 gauge,	Each

Length (feet)

END OF SECTION 02891

SECTION 02920 SEEDING

PART 1 - SCOPE

This work shall consist of furnishing and placing seed, commercial fertilizer, agricultural limestone, erosion control fabric, and mulch material when specified, and of caring for such areas until acceptance, all in accordance with these Specifications, on all newly graded earthen areas that are not to be paved, stabilized, or sodded, unless otherwise indicated on the plans or directed by the Owner.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIALS.

A. Grass Seed.

1. The seed shall meet the requirements of the Tennessee Department of Agriculture and no "Below Standard" seed will be accepted. Grass seed furnished under these Specifications shall be packed in new bags or bags that are sound and not mended.

2. The Contractor shall furnish the Owner a certified laboratory report from an accredited commercial seed laboratory or from a State seed laboratory showing the analysis of the seed to be furnished and approving the seed for purity and germination. The report from an accredited commercial seed laboratory shall be signed by a Senior Member of the Society of Commercial Seed Technologists. At the discretion of the Owner, samples of the seed may be taken for a check against the certified laboratory report. Sampling and testing will be in accordance with the requirements of the Tennessee Department of Agriculture.

3. When a seed group is used, the percentages forming the group shall be as set out below, unless otherwise specified.

Name	Quantity, Percent by Weight
Group A	
Lespedeza (Common or Korean)	20
Sericea Lespedeza	15
Ky. 31 Fescue	40
English Rye	15
White Dutch Clover	5
Weeping Love Grass	5
Group B	
Ky. 31 Fescue	55
Redtop	15
English Rye	20
White Dutch Clover	5
Weeping Love Grass	5
Group C	
Sericea Lespedeza	50
Ky. 31 Fescue	30
English Rye	15
White Dutch Clover	5

4. In mixing or forming "Groups" of seed, they shall be uniformly mixed. "Group" seed shall not be mixed until after each type seed that is used to form the "Group" has been tested and inspected separately and approved for purity and germination. Seed mixed before tests and inspection are made will not be accepted.

B. Fertilizer.
Manufactured fertilizer shall be a standard commercial fertilizer containing the specified percentages by weight of nitrogen (N), phosphoric acid (P_2O_5) and potash (K_2O). The fertilizer shall be furnished in standard containers with the name, weight, and guaranteed analysis of the contents clearly marked. The containers shall insure proper protection in handling and transporting the fertilizer. All commercial fertilizer shall comply with local, state, and federal fertilizer laws.

C. Agricultural Limestone.
Agricultural limestone shall contain not less than eighty-five (85%) of calcium carbonate and magnesium carbonate combined and shall be crushed so that at least 85 percent will pass the No. 10 mesh sieve and 100 percent will pass the 3/8 inch sieve.

D. Mulch Material.
All mulch material shall be air dried and virtually free of noxious weeds and weed seeds or other materials detrimental to plant growth on the work site or on adjacent agricultural lands. Hay shall be stalks of approved grasses, sedges, or legumes seasoned before baling or loading. Straw shall be stalks of rye, oats, wheat, or other approved grain crops. Both hay and straw shall be suitable for spreading with standard mulch blower equipment. Biodegradable fabric as specified in this section may be used as an alternate to mulch material at the Contractor's option.

E. Inoculants for Legumes.
Inoculants for treating legume seed shall be standard cultures of nitrogen fixing bacteria that are adapted to the particular kind of seed to be treated. The inoculant shall be supplied in convenient containers of a size sufficient to treat the amount of seed to be planted. The label on the container shall indicate the specified legume seed to be inoculated and the date period to be used.

F. Mulch Binder.
Cut back asphalt, Grade RC-70 or RC-250 conforming to AASHTO Specifications shall be used.

G. Water.
Water shall be free from any harmful or objectionable qualities or organisms.

H. Biodegradable Fabric.

1. Biodegradable fabric shall consist of a knitted or bonded construction of yarn with uniform openings interwoven with strips of biodegradable paper. The fabric shall be degradable by exposure to ultraviolet light. The fabric shall be "Hold/Gro" as manufactured by Gulf States Paper Corporation of Tuscaloosa, Alabama, or equal. The fabric shall be furnished in rolls and shall conform to the following requirements:

   a. Roll Widths: 5 feet minimum and 10 feet maximum.

   b. Roll Length: Approximately 360 feet.

   c. Weight: Approximately 0.2 pounds per square yard of fabric.

2. Fabric shall be secured in a place with wood pegs or other biodegradable materials.

3. The manufacturer shall provide moisture proof bags comparable to 4 to 6 mil opaque polyethylene bags for protection of the fabric prior to installation.

2.02 EQUIPMENT.
All equipment necessary for the satisfactory performance of this construction shall be on the project and inspected before work will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 GENERAL

The Contractor shall notify the Owner at least 48 hours in advance of the time he intends to begin sowing seed and shall not proceed with such work until permission to do so has been granted by the Owner. Before starting seeding operations on any area, final dressing and the placing of topsoil shall have been completed in accordance with the project requirements. All seeding and related operations shall be continuous operations.

3.02 PREPARING THE SEEDBED.

Each area to be seeded shall be scarified, disked, harrowed, raked, or otherwise worked until it has been loosened and pulverized to a depth of not less than one inch. This operation shall be performed only when the soil is in a tillable and workable condition. Fertilizer, at the rate of not less than 23 pounds of Grade 6-12-12 or equivalent, per 1,000 square feet, and agricultural limestone, at the rate of not less than 100 pounds per 1,000 square feet, shall be distributed evenly over the seedbed, unless other are specified on the plans or in the Contract Documents. The limestone and fertilizer shall be lightly harrowed, raked, or otherwise incorporated into the soil as specified above when mixed with seed in water and applied with power sprayer equipment.

3.03 TIME OF SEEDING.

Group "A" seed shall be used for seeding from February 1 to August 1, and Group "B" seed shall be used from August 1 to December 1, except that either Group "A" or "B" may be used during the month of August. Group "C" seed shall be used from February 1 to December 1 and only when specified on the Plans or in the Contract Documents. Seeding shall be performed only when the soil is in a tillable and workable condition, and no seeding shall be performed between December 1 and February 1, unless otherwise permitted.

3.04 SEEDING.

Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed and thoroughly watered after seeding. Care shall be exercised to not wash seeding by over watering. Seed shall be sown uniformly by means of a rotary seeder, wheelbarrow seeders, hydraulic equipment, or other satisfactory means, and unless otherwise specified on the Plans or in the Contract Documents, at the rate of 1 ½ pounds per 1,000 square feet. Group "C" seed and seeds of legumes when sown alone shall be inoculated before sowing in accordance with the recommendations of the manufacturer of the inoculant and as directed by the Owner. No seeding shall be done during windy weather, or when the ground surface is frozen, wet, or otherwise nontillable.

3.05 BIODEGRADABLE FABRIC.

A. When biodegradable fabric is specified, the fabric shall be loosely draped over the seeded area. The seed bed to be covered shall be prepared, fertilized, limed, seeded, and watered prior t installation of the fabric. If the slope is greater than 3 to 1, fabric shall be applied vertically with paper strips oriented parallel to the slope.

B. The Contractor shall dig a 4 inch deep check ditch 1 foot back from the slope crown, then fold, place and peg fabric every 9 inches in the check ditch, and cover with soil. An identical check ditch shall be provided 1 foot away from the bottom of the slope. When 2 or more lengths of fabric are required to be installed side by side to cover an area, they shall overlap 4 inches minimum. Fabric installed end to end shall overlap 4 inches minimum with the upgrade section on top of the lower grade section. End to end overlaps of adjacent rows of fabric shall be staggered a minimum of 5 feet. Each length of fabric shall be pegged in 3 rows, each edge and the center, with pegs placed on 3 foot centers maximum. Overlapped ends shall be pegged on 9 inch centers across the fabric overlap. Pegs shall be driven flush with the ground. The Contractor shall strictly adhere to the installation directions provided by the manufacturer of the fabric.

C. The Contractor shall maintain and protect the biodegradable fabric until Final Acceptance or until the Owner has determined that the fabric has served its useful life, whichever occurs first. Maintenance shall consist of watering as required, repairs made necessary by erosion, wind, fire, or any other cause until Final Acceptance. Following the restoration of damaged areas under plant establishment requirements for applicable underlying items, the fabric shall be repaired or replaced to

meet the original requirements and maintained until Final Acceptance of the Project.

3.06 MULCHING.
When seeding with mulch is specified, the mulch material shall be spread evenly over the seeded areas at an approximate rate of 75 pounds per 1,000 square feet immediately following the seeding operations. This rate may be varied by the Owner, depending on the texture and condition of the mulch material and the characteristics of the area seeded. All portions of the seeded areas shall be covered with a uniform layer of mulch, so that approximately 25 percent of the ground is visible. The mulch shall be held in place by the use of an approved mulch binder. Cutback asphalt or emulsified asphalt shall be applied at the approximate rate of 4 gallons per 1,000 square feet as required to hold the mulch in place. Mulch in medians and other areas affected by traffic shall be held in place by applying asphalt binder at the approximate rate of 11 gallons per unit. The Contractor shall cover exposed structures, guardrails, signs, and appurtenances, if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

3.07 MAINTENANCE AND REPAIR.
All seeded areas shall be cared for and maintained properly to the Owner's satisfaction until Final Acceptance of the Work and for the duration of the warranty period. Such care shall include, but not be limited to watering as necessary, fertilizing, and mowing the seeded areas when required by the Owner. When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth. Areas which have been previously seeded and mulched in accordance with this Specification Section but which have been eroded, damaged or failed to successfully establish a stand of grasses or legumes shall be repaired as directed by the Owner. All material and labor required to maintain and repair seeded areas shall be furnished by the Contractor at no cost to the City. If the Owner directs the Contractor to place additional fertilizer on the area to be reseeded, and additional 4 pounds of agricultural limestone will be required for each additional pound of fertilizer.

PART 4 – MEASUREMENT
The furnishing of seeding as specified herein may be incidental to the work of the Contract, or may be measured and payment made under the Pay Items described herein, as defined by the Pay Items in the Proposal Sheet(s) and/or as included in the Plans and Contract Documents. If payment is made separately, measurement for the work of this Specification will be as described below.

4.01 SEEDING (WITH MULCH).
The area of seeding (with mulch) to measured for payment will be the number of seeding units, with mulch, in accordance with these Specifications. Each unit will consist of 1,000 square feet measured along the surface.

4.02 SEEDING (WITHOUT MULCH).
The area of seeding (without mulch) to be measured for payment will be the number of seeding units in accordance with these Specifications. Each unit will consist of 1,000 square feet measured along the surface.

4.03 BIODEGRADABLE FABRIC.
Biodegradable fabric to be measured for payment will be the number of 1,000 square foot units for which biodegradable fabric has been applied over seeded areas. Measurement will be along the surface.

4.04 GENERAL.
All work and materials for seed bed preparation, application of fertilizer and limestone, application of mulch binder, watering and maintenance and repair of work, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered as a subsidiary obligation of the Contractor under other items of the Contract.

PART 5 – PAYMENT

5.01 SEEDING (WITH MULCH).
Seeding (with mulch) will be paid for at the contract unit price per unit (1,000 square feet), for the accepted quantities, which price will be full payment for preparing the seedbed, and for furnishing and placing all materials including fertilizer, water, agricultural limestone, seed, mulch materials, mulch binder and inoculant,

complete in place; and for maintenance and repair of the seeded and grassed area.

5.02 SEEDING (WITHOUT MULCH).
Seeding (without mulch) will be paid for at the contract unit price per unit (1,000 square feet) for the accepted quantities, which price will be full payment for preparing the seedbed, and for furnishing and placing all materials including fertilizer, water, agricultural limestone, seed, and inoculant, complete in place; and for maintenance and repair of the seeded and grassed areas.

5.03 BIODEGRADABLE FABRIC.
Biodegradable fabric will be paid for at the contract unit price per unit (1,000 square feet) for furnishing, installing, maintaining, and protecting the fabric, which price will be full payment for accomplishing the above.

5.04 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02920-5.01	SEEDING (WITH MULCH)	Unit of 1,000 SF
02920-5.02	SEEDING (WITHOUT MULCH)	Unit of 1,000 SF
02920-5.03	BIODEGRADABLE FABRIC	Unit of 1,000 SF

END OF SECTION 02920

SECTION 02921 SODDING

PART 1 - SCOPE

This work shall consist of furnishing and placing sod at all locations shown on the Plans or where directed by the Owner, and in conformity with these Specifications. Ordinarily, the work will consist of the furnishing and placing of new sod originating from sources outside the rights-of-way and easement limits. In some cases, however, the work will include removing sod from areas where the requirements of the project would destroy existing sod, storing the sod so removed, and resetting it in areas shown on the Plans or designated by the Owner.

PART 2 - MATERIALS AND EQUIPMENT

2.01 MATERIALS.

A. Sod.

1. New sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, nutgrass, and other obnoxious grasses or weeds, well suited for the intended purpose and for the soil in which it is to be planted. All sod shall be cleanly cut in strips having a reasonably uniform thickness of not less than 2 inches and cut in 10 to 12 inch squares.

2. The sale or movement of sod for propagation is controlled by Tennessee Plant Pest Act of 1955, TCA 43-55 et. Seq., and the Contractor shall be responsible for obtaining all inspections, authorizations, and permits which may be required by such law and the Tennessee Department of Agriculture.

B. Fertilizer.
Manufactured fertilizer shall meet the requirements of Specification Section 02920 Paragraph 2.01.B and shall be Grade 15-15-15 unless otherwise specified on the Plans or in the Contract Documents.

C. Ammonium Nitrate.
Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified in Specification Section 02920 Paragraph 2.01.B, and shall have a minimum of 33 ½ percent nitrogen.

D. Agricultural Limestone.
Agricultural limestone shall meet the requirements of Specification Section 02920 Paragraph 2.01.C.

2.02 EQUIPMENT.
All equipment necessary for the satisfactory performance of this work shall be on the project and approved before work will be permitted to begin.

PART 3 - CONSTRUCTION REQUIREMENTS

3.01 WEATHER LIMITATIONS.
Sod shall be set or reset only when the soil if most and favorable to growth. No setting or resetting shall be done between December 1 and February 1, unless weather and soil conditions are considered favorable and permission is granted by the Owner.

3.02 REMOVING AND STORING SOD FOR RESETTING.
If specified, sod removed from such areas as lawns, yards, and lots shall be so cut, handled, and stored that the sod can be reset in the same locations from which it was removed. No exchange of sod will be permitted unless approved by the Owner. Unless reset immediately after cutting, sod shall be stacked in piles and kept moist until reset. Sod shall be reset within 7 days after removal, unless otherwise specifically permitted by the Owner. Reset sod shall show vitality and growth at the time of acceptance by the City and for duration of the warranty period.

3.03 SODDING.

A. The area to be sodded shall be brought to the lines and grades shown on the Plans or as directed by the Owner. The surface of the ground to be sodded shall be loosened to a depth of not less than one inch with a rake or other device. If necessary, it shall be sprinkled until saturated for a minimum depth of one inch and kept moist until the sod is placed. Immediately before placing the sod, fertilizer and lime shall be applied uniformly to the prepared surface of the ground. Fertilizer shall be applied at the rate of 8 pounds of Grade 15-15-15, or equivalent per 1,000 square feet. Agricultural limestone shall be applied at the rate of 100 pounds per 1,000 square feet.

B. Sod shall be placed as soon as practical after removal from the point of origin and shall be kept in a moist condition during the interim. The sod shall be carefully placed by hand on the prepared ground surface with the edges in close contact and, as far as possible, in a position to break joints. Each strip of sod laid shall be fitted and rolled using a roller of sufficient size and weight to fix the sod into place. Immediately after placing, the sod shall be thoroughly wetted and rolled with an approved roller or hand tamped, as approved by the Owner. Pinning or pegging shall be required on slopes greater than 2 to 1 to hold the sod in place or in other instances at the direction of the Owner.

3.04 MAINTENANCE AND REPAIR.
The sod shall be watered as frequently as necessary for a period of two weeks, after which, ammonium nitrate shall be applied at the rate of 3.5 pounds per 1,000 square feet, and the sod given an additional watering. The Contractor shall not allow any equipment or material placed on any planted area and shall erect suitable barricades and guards to prevent his equipment, labor, or the public from traveling on or over any area planted with sod. Care shall include periodic watering, fertilizing and mowing necessary to maintain the vitality and appearance of the sod. When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth. Sodded areas that become eroded, damaged or fail to successfully establish a stand of grass shall be repaired and/or replaced as directed by the Owner. All material and labor required to maintain and repair seeded areas shall be furnished by the Contractor at no cost to the City. Sod must be living at the time of final acceptance of the project and through the duration of the warranty period.

3.05 DISPOSAL OF SURPLUS MATERIAL.
All surplus material shall be disposed of off-site.

PART 4 – MEASUREMENT
The furnishing and setting of sodding as specified herein may be incidental to the work of the Contract, or may be measured and payment made under the Pay Items described herein, as defined by the Pay Items in the Proposal Sheet(s), and/or as included in the Plans and Contract Documents. If payment is made separately, measurement for the work of this Specification shall be as described below.

4.01 SODDING.
Sod will be measured for payment by the square yard of surface upon which the sod has been set.

4.02 REMOVING, STORING, AND RESETTING SOD.
Sod to be removed, stored, and reset will be measured for payment by the square yard of surface upon which the removed sod has been reset.

PART 5 – PAYMENT

5.01 SODDING.
Sodding will be paid for at the contract unit price per square yard for the accepted quantities, which price will be full payment for furnishing, setting, pinning and pegging if required, fertilizing, watering, mowing, providing and placing agricultural limestone, and for the maintenance and repair of the sodded area.

5.02 REMOVING, STORING, AND RESETTING SOD.
This work will be paid for at the contract unit price per square yard for the accepted quantities, which price will be full payment for removing and storing the sod or turf, setting, pinning and pegging if required, fertilizing,

watering, mowing, providing and placing agricultural limestone, and for the maintenance and repair of the sodded area.

5.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02921-5.01	SODDING (NEW SOD)	Square Yard
02921-5.02	REMOVING, STORING, AND RESETTING SOD	Square Yard

END OF SECTION 02921

PART 1 – SCOPE

This Work shall consist of the removal and replacement of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs made necessary by the construction of drainage facilities, sanitary sewers, traffic control conduit, and other items of construction that require temporary cuts. Such replacement shall be to a condition at least equal to the condition existing prior to removal and of in-kind material and shall be compliance with the Plans, these Specifications, or as directed by the Owner. The Work which will be included in the Contract and for which the Contractor shall be compensated therefore is limited to that area within the rights-of-way and construction easements for the Project. The Contractor will not be compensated for the removal and replacement of facilities outside the rights-of-way, easements, and limits of construction of the Project.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIALS

A. Concrete: Concrete materials shall meet the requirements of Specification Section 03050, Portland Cement Concrete for Class A concrete.

B. Curing Material: Curing materials shall conform to the applicable provisions of Specification Section 02750 Paragraph 2.01 C.

C. Asphaltic Concrete Wearing Surface and Asphalt Curb: Asphaltic concrete wearing surfaces and asphalt curb shall meet the requirements of Specification Section 02741 Paragraph 2.01 D., “Composition of Mixtures”, for Mix No. 1.

D. Asphalt Driveway Pavement: Asphalt driveway pavement shall meet the requirements of Specification Section 02741 Paragraph 2.01 D., “Composition of Mixtures”, for Mix No. 2.

E. Expansion Joint Filler: Preformed expansion joint filler shall be of the bituminous type, shall conform to eh requirements of AASHTO M 213 and shall not be more than 1 inch or less than 1/2 inch in thickness. The filler shall be cut to the full depth of pavement, curb and gutter, sidewalk, or driveway being replaced.

F. Gravel Pavement or Base: Camden gravel or crushed limestone meeting the requirements of Specification Section 02720 Paragraph 2.01, Aggregates for Gradation No. 1, 2 or 3 shall be used to replace graveled areas disturbed by construction.

2.02 EQUIPMENT

A. Equipment and tools necessary for cutting, removal, and hauling of existing items; handling and placement of new material; and all equipment necessary to perform all parts of the Work shall be at the job site sufficiently ahead of the start of construction operations to be examined and approved by the Owner.

B. When saws are used to cut pavement, the Contractor shall provide sawing equipment adequate in power to complete the sawing to a minimum of 1-1/2 inches below the pavement surface in one pass. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations.

C. Other types of pavement cutting equipment shall be capable of cutting the pavement to a neat straight line of 1-1/2 inch minimum depth below the pavement surface in one pass.

D. The Contractor shall provide equipment capable of removal of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs without disturbance of adjacent items to remain in place.

E. Equipment necessary for the handling, placement, and finishing of concrete shall meet the applicable requirements of Specification Section 02750 Paragraph 2.02, "Portland Cement Concrete Pavement"; Specification Section 02775 Paragraph 2.02, "Portland Cement Concrete Sidewalks and Driveways"; and Specification Section 02770 Paragraph 2.02, "Curb, Curb and Gutter, and Water Table" .

F. Equipment necessary for the handling, placement, and compaction of asphalt shall meet the requirements of Specification Section 02741 Paragraph 2.02.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 REMOVAL OF ASPHALT PAVEMENT

Asphalt pavement shall be removed to a clean straight line as detailed on the Plans. Pavement shall be cut by saw or other equipment approved by the Owner in advance. Edges of existing asphalt pavement adjacent to trenches where damaged shall be recut in a clean straight line within the limits of damaged pavement only. Such recuts shall be parallel to the original cuts and perpendicular to the pavement surface.

3.02 REMOVAL OF CONCRETE PAVEMENT

A. Concrete pavement shall be removed to a neat straight line as detailed on the Plans. Care shall be used to avoid damage to pavements and to the pavement base remaining in place.

B. Concrete pavement may, at the Contractor's option, be removed by saw cutting to a neat straight line. Saw cuts shall be made to a minimum depth of 1-1/2 inches and at a location to provide a cutback edge in accordance with the Design Standards. The edges of the existing concrete pavement adjacent to trenches where damaged subsequent to saw cutting of pavement shall again be saw cut in a neat straight line to remove the damaged pavement areas. Such saw cuts shall be parallel to the original saw cuts and perpendicular to the pavement surface.

3.03 REMOVAL OF CONCRETE SIDEWALK, CURB AND GUTTER, AND DRIVEWAY

Concrete sidewalks, curbs and gutters, and driveways shall be removed to the nearest contraction or expansion joint. Care shall be used to avoid damage to sidewalks, curbs and gutters, and driveways remaining in place.

3.04 REMOVAL OF GRAVEL PAVEMENT

Gravel surfaces encountered in construction shall be removed to the limits shown on the Plans.

3.05 REPLACEMENT OF PAVEMENT

A. Asphalt or Surface Treated Pavements: Replacement of asphalt or surface treated pavement and base shall consist of 8 inches of Class A concrete base and 1 inch of asphaltic concrete surface course Mix No. 1 for the entire cross-section of pavement removal area, including all areas where pavement was re-cut subsequent to the initial pavement removal.

B. Concrete Pavements

1. Concrete pavement shall be replaced with Class A concrete pavement equal in thickness to the pavement removed but not less than 8 inches thick. Concrete pavement and base replacement shall be constructed for the entire cross-section of pavement removal area including all areas where pavement was re-cut subsequent to the initial pavement removal.

2. Reasonable efforts shall be made to avoid contrast in the color and texture of existing and restored surfaces.

C. Placing, Curing, and Protection of Concrete

1. After the backfill in the trench has been brought to the appropriate subgrade elevation shown on the Plans, compacted to the specified density, and permission has been given by the Owner, a concrete slab of the appropriate thickness shall be placed within the entire disturbed area.

2. Any loose or disturbed pavement or base shall be removed prior to placement of the concrete. Concrete shall be placed only on a moist subgrade and shall not be placed unless the ambient temperature is 35^{o} F and rising. In no case shall concrete be placed on a frozen or frosty subgrade. After the concrete is placed, it shall be struck off in an approved manner to the appropriate grade as shown on the Plans and shall be finished with floats and straight edges until the required surface texture has been obtained.

3. Curing and cold weather protection shall be performed as provided for under Specification Section 02750 Paragraph 3.11. No vehicles or loads shall be permitted on any concrete until the Owner has determined that the concrete has obtained sufficient strength for such loads. The contractor shall construct and place such barricades and protection devices as are necessary to protect the concrete.

D. Placing Asphaltic Concrete Wearing Surface: After the concrete base has been placed and adequately cured, an asphaltic concrete wearing surface of the minimum specified thickness shall be placed and compacted as specified in Specification Section 02710.4 Paragraphs 3.01 – 3.11, Asphaltic Concrete, Construction Requirements.

3.06 REPLACEMENT OF SIDEWALKS, DRIVEWAY APRONS, CURBS AND GUTTERS, DRIVEWAYS AND OTHER PAVED AREAS, AND CURBS

A. Concrete sidewalks and driveway aprons shall be replaced in accordance with the requirements of Specification Section 02775 Paragraphs 3.01 – 3.08, “Portland Cement Concrete Sidewalks and Driveways, Construction Requirements”. Any expansion joint material removed shall be replaced at the original locations. Existing concrete edges shall be cleaned prior to placement of concrete. The finished concrete elevation, texture, and color shall conform to the adjacent concrete surfaces.

B. Unless otherwise directed, curb and gutter shall be replaced with new concrete curb and gutter of the same cross-section and at the same top of curb elevation and flow line as that removed. Where curb and gutter of a different type than existing is to be used for replacement, the replacement flow line shall match existing and a transitions section provided between the existing and replacement cross-sections. Curb heights shall be transitioned at a trate of 1 inch in 5 feet. Granite curb shall be replaced with new concrete curb whose height matches existing adjacent curb top elevations. New concrete curb and gutter construction shall conform to the requirements of Specification Section 02770 Paragraphs 3.01 – 3.10, “Curb, Curb and Gutter, and Water Table, Construction Requirements”. Any expansion joint material removed shall be replaced at the original locations. Existing concrete edges shall be cleaned prior to placement of concrete. The finished curb and gutter cross-section, elevations, texture, and color shall conform to the adjacent concrete surfaces.

C. Replacement of paved areas other than street pavement; concrete, asphalt, or gravel driveways; and asphalt or concrete curb within the right-of-way or construction easement limits shall be in kind for those cross-sections removed, unless directed otherwise by the Owner.

3.07 DAMAGE DUE TO SETTLEMENT

A. The Contractor shall be responsible for any damage caused by settlement of backfill placed beneath pavements, sidewalks, driveway aprons, curbs, curbs and gutters, driveways, paved areas other than street pavement, and asphalt or concrete curb within the right-of-way or construction easement limits. This includes any damage which may occur at any time prior to,

and during a period of one year from and after the date of Final Acceptance of the Work covered by the Contract.

B. During such period, the Contractor shall at his own cost and expense refill all excavations where settlement damage has occurred and replace damaged pavements, sidewalks, driveway aprons, curbs, curbs and gutters, paved areas, driveways, and all other damaged items to the satisfaction of the City. Should the Contractor fail to repair settlement damage which may occur as described above within 30 days after being given notice thereof, the City shall have the right to repair such settlement and charge the cost of such repairs to the Contractor.

3.08 DAMAGE OUTSIDE CONSTRUCTION EASEMENT LIMITS

A. The Contractor will be held responsible for all damage to roads, highways, shoulders, curbs and gutters, ditches, embankments, bridges, culverts, and other property, caused by him or any of this Subcontractors in hauling or otherwise transporting materials to and from the several sites of Work, regardless of the location of such damage. The Contractor shall make arrangements relative to the payment for, or repair or replacement of, such damage or damaged surfaces or structures which are satisfactory and acceptable to the owner or owners of such damaged surfaces or structures, or to their legally responsible officers, agents, or other representatives, at the Contractor's cost and expense.

PART 4 – MEASUREMENT

4.01 PAVEMENT REMOVAL AND REPLACEMENT
Pavement removal and replacement shall be measured for payment by the square yard, complete in place.

4.02 CONCRETE SIDEWALK REMOVAL AND REPLACEMENT
Sidewalk removal and replacement shall be measured for payment by the square foot, complete in place.

4.03 CONCRETE DRIVEWAY APRON REMOVAL AND REPLACEMENT
Driveway apron removal and replacement shall be measured for payment by the square foot, complete in place.

4.04 CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT
Curb and gutter removal and replacement shall be measured for payment by the linear foot, complete in place.

4.05 ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACEMENT
Asphalt or concrete driveway and paved area removal and replacement shall be measured for payment by the square foot, complete in place.

4.06 GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT
Gravel driveways and gravel area removal and replacement shall be measured for payment by the ton of Camden gravel or crushed limestone, complete in place.

4.07 ASPHALT AND CONCRETE CURB REMOVAL AND REPLACMENT
Asphalt and concrete curb removal and replacement shall be measured for payment by the linear foot along the face of curb, complete in place.

PART 5 – PAYMENT

5.01 PAVEMENT REMOVAL AND REPLACEMENT
The accepted quantities of pavement removal and replacement shall be paid for at the contract unit price per square yard for the type specified, which price will be full compensation for cutting and recutting pavement; removal and disposal of pavement and base; preparing the subgrade; placing, finishing,

curing, and protection of concrete; and placing and compacting asphaltic concrete wearing surfaces, complete in place.

5.02 CONCRETE SIDEWALK REMOVAL AND REPLACEMENT
The accepted quantities of sidewalk removal and replacement shall be paid for at the contract unit price per square foot, which price will be full compensation for removal and disposal of sidewalk; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

5.03 CONCRETE DRIVEWAY APRON REMOVAL AND REPLACEMENT
The accepted quantities of driveway apron removal and replacement shall be paid for at the contract unit price per square foot for the type specified, which price will be full compensation for removal and disposal of driveway apron; preparing the subgrade; and placing, finishing, curing, and protection of concrete, complete in place.

5.04 CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT.
The accepted quantities of curb and gutter removal and replacement shall be paid for at the contract unit price per linear foot for the type specified, which price will be full compensation for removal and disposal of curb and gutter; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

5.05 ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACMENT
The accepted quantities of asphalt or concrete driveway and paved area removal and replacement shall be paid for at the contract unit price per square foot for the type specified, which price will be full compensation for cutting and recutting; pavement removal and disposal of pavement and base; preparing the subgrade; placing, finishing, curing, and protection of concrete; and placing and compacting asphalt, complete in place.

5.06 GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT
The accepted quantities of gravel driveway and gravel area removal and replacement shall be paid for at the contract unit price per ton of Camden gravel or crushed limestone, which price will be full compensation for preparing the subgrade and replacing the gravel, complete in place.

5.07 ASPHALT AND CONCRETE CURB REMOVAL AND REPLACEMENT
The accepted quantities of asphalt and concrete curb removal and replacement shall be paid for at the contract unit price per linear foot, which price will be full compensation for removal and disposal of curb and placing new curb, complete in place.

5.08 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02950-01	PAVEMENT REMOVAL AND REPLACEMENT	Square Yard
02950-01.01	Asphaltic Concrete Pavement	Square Yard
02950-01-02	Concrete Pavement	Square Yard
02950-02	CONCRETE SIDEWALK REMOVAL AND REPLACEMENT	Square Foot
02950-03	CONCRETE DRIVEWAY APRON REMOVAL AND REPLACEMENT	Square Foot
02950-03.___	(Description)	Square Foot
02950-04	CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT	Linear Foot
02950-04.___	(Description)	Linear Foot

02950-05	ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACEMENT	Square Foot
02950-05.01	Asphalt Driveway and Paved Area	Square Foot
02950-05.02	Concrete Driveway and Paved Area	Square Foot
02950-06	GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT	Ton
02950-06.01	Replacement with Camden Gravel	Ton
02950-06.02	Replacement with Crushed Stone	Ton
02950-07	ASPHALT AND CONCRETE CURB REMOVAL AND REPLACEMENT	Linear Foot
02950-07.01	Concrete Curb	Linear Foot
02950-07.02	Asphalt Curb	Linear Foot

END OF SECTION 02950