City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

2023

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Standard Specifications:

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

General Provisions

2023

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General Provisions:

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1.1 Definitions:

1.1.1 The word "Owner" means the City of Germantown.

1.1.2 The word "Engineer" means the City Engineer of Germantown.

1.1.3 The word "Contractor" means the successful Bidder to whom the contract is awarded.

1.1.4 The words “install", "furnish", "provide", or words of like import mean the Contractor shall install, furnish, or provide, and similarly the words "approved", "authorized", “required", "satisfactory", "acceptable", or words of like import mean approved by, authorized by, required by, satisfactory to, or acceptable to the Engineer, unless otherwise expressly stated.

1.1.5 The words "indicated", "shown", "detailed", or "scheduled" mean indicated, shown, detailed, or scheduled on the contract drawings, unless otherwise expressly stated.

1.1.6 The word "work" means the labor, materials, equipment, supplies, and services to be furnished under the contract, and the performing of all duties and obligations required by the contract documents.

1.1.7 The word "submit" means the Contractor shall submit to the Engineer for approval, unless otherwise expressly stated.

1.1.8 The word "Provide" means the Contractor shall furnish and install, complete and ready for use, unless otherwise expressly stated.

1.1.9 The word "selected" means selected by the Engineer, unless otherwise expressly stated.

1.2 Engineer’s Decision:

1.2.1 The Engineer shall in all cases determine the amount, quantity, acceptability, and fitness of the several kinds of finished work and materials which are to be paid for hereunder, and shall decide all questions which may arise as to fulfillment of a contract on the part of the Contractor. The Engineer’s interpretation of the contract and the Engineer’s determination and decision thereto shall be final and conclusive; such determinations and decisions, in case any question arises, shall be a condition precedent to the Contractor’s right to receive any money hereunder. The Engineer shall have the right to correct all clerical, mathematical, or minor errors or emissions in the specifications when such corrections are necessary for the proper coordination of the contract documents.

1.3 Contractor’s Responsibility:

1.3.1 From commencement until completion and final acceptance by the Owner, the work under this Contract shall be under the charge and control of the Contractor, and during such period of control by the Contractor all risks in connection with the construction of the work and the materials to be used therein shall be borne by the Contractor.

1.3.2 The Contractor shall be fully responsible for the safety and protection of all persons and of all work and material connected with his contract until the project is finally accepted by the Owner. The Contractor shall use proper precaution to fully protect all persons, his own work, and the property of the Owner and others from injury and damage, and at his own expense he shall be liable for injury to all persons and shall make good all damage and injury to property belonging to the Owner and others caused by himself and his employees through negligence, carelessness, or any other cause.

1.3.3 The Owner and Engineer shall not be responsible for the methods and means employed by the Contractor in the performance of the Contractor's work. The Engineer shall have no responsibility for the safety of the workmen and others who may be injured during the course of the Contractor's work.

1.4 Site of the Work:

1.4.1 Each Contractor submitting a proposal on this project, and each Subcontractor estimating and furnishing a bid under any division and/or section of this specification to the Contractor, shall visit the site of the work and examine its present condition to inform himself as to the nature and scope of all work to be done, and all difficulties that may be involved therein.

1.4.2 The submission of a proposal by the Contractor to the Owner, or a bid furnished by a Subcontractor to the Contractor shall be accepted as evidence that such an examination has been made, and that all difficulties encountered have been provided for in his proposal or bid. Later claims for extra compensation for labor, materials, and equipment, which could have been foreseen, will therefore not be recognized by the Owner.

1.5 Contractor's Supervision:

1.5.1 The Contractor, or his duly authorized agent with authority to control the work, shall be present at the site whenever the work is in progress. The Contractor's authorized agent shall meet with the approval of the Engineer.

1.5.2 The Owner reserves the right to require the removal from the Project of the Superintendent or any other employee of the Contractor if, in the Engineer's judgment, such removal is necessary to protect the Owner's interest.

1.6 Care of the Work:

1.6.1 The Contractor shall indemnify and save harmless the Owner, the Engineer, their agents, and their employees from all claims, suits, or proceedings of any nature whatsoever which may be brought against the Owner, the Engineer, their agents, or their employees on account of any injuries to persons or property received from the Contractor or his agents or servants. See also Section 1.23.3.

1.6.2 The Contractor shall be responsible for the proper care and protection of all materials delivered and work performed until completion and final acceptance of the project. The Contractor shall provide adequate barricades and warning signs to properly protect his work and to safeguard the life and property of others. Barricades, open trenches, etc., shall be properly illuminated with flares and/or blinking lights at night. All Traffic Control/warning devices used shall conform with Section VI of the Manual of Uniform Traffic Control Devices (MUTCD).

1.7 Schedule of Work:

1.7.1 Before beginning work, the Contractor shall submit to the Engineer for approval, a construction schedule. In general, the Contractor's work shall be so scheduled as to interfere as little as possible with the operations of the Owner and other contractors. All work shall be performed during normal working hours unless a specific requirement for overtime work is included elsewhere in the Contract Documents.

1.7.2 The City will use the Contractor's work schedule to prepare notification to individual property owners of the general date(s) that they may expect work to be performed in areas adjoining their property. It will be the Contractor's responsibility to keep the City advised of any significant changes in the work schedule in a timely manner so that the affected private property owners may be kept informed.

1.8 Workmanship, Tools and Construction Equipment:

1.8.1 All work shall be performed in a finished and workmanlike manner, and in accordance with the best recognized trade practices.

1.8.2 The Contractor shall provide and maintain in good operating condition all tools and construction equipment necessary for the satisfactory performance of the work. Inadequate, unsuitable, defective, worn out, or otherwise unsatisfactory tools and construction equipment shall be removed from the site and replaced with satisfactory tools and construction equipment, or the proper repairs shall be made, or the unsatisfactory conditions shall be remedied.

1.9 Codes, Ordinances, Regulations, Laws, Permits, Licenses and Fees:

1.9.1 The Contractor shall comply with all City, County, State and Federal codes, ordinances, regulations and laws applicable to the work to be done and applicable to the use of public streets, alleys and highways. Such codes, ordinances, regulations and laws shall be considered as Minimum requirements, and everything shown or specified in excess of these minimum requirements shall be installed in excess thereof, as shown or specified. No instructions given in the Contract Documents shall be construed as an authorization to violate any code, ordinance, regulation or law.

1.9.2 Before beginning work, the Contractor shall obtain and pay for all licenses and permits required to perform work covered by this contract, shall obtain and pay for all necessary inspections by all applicable authorities, and shall include their cost in the bid price. Whereas certain parts of the work may require the approval of public or other authorities, all work shall be subject to the Engineer's decision before proceeding with the portion of the work involved.

1.10 Drawings and Specifications:

1.10.1 The drawings accompanying these specifications and forming a part thereof are listed elsewhere and together with the specifications they cover the work to be performed under the Contract. The Contractor and each Subcontractor employed on this work shall carefully examine all contract drawings and read all specifications. They will be bound by all things therein affecting their special work no matter under what heading they may appear.

1.10.2 The drawings and specifications are intended to cover a complete project ready for use, and all items necessary for a complete and workable job shall be furnished and installed. All minor items not specifically covered by the drawings and specifications but required in the construction of the project shall be furnished and installed as though shown or specified. This is not intended to cover major items of equipment or labor not shown or specified, but it is intended and will be interpreted to cover all miscellaneous labor, parts, devices, accessories, controls, and appurtenances which are required by all applicable codes, ordinances, laws, and regulations; required to complete and place the project in satisfactory operation; and required for a first class job which is complete in every respect.

1.10.3 The drawings and specifications are mutually explanatory and supplementary, and all features covered in one and not in the other shall have the same force and effect as though covered in both. In the event of any conflicts between the drawings and specifications, the Engineer's decision shall govern. Should any error, discrepancy, or variance be discovered in the drawings or specifications by the Contractor or his Subcontractor, the Contractor shall immediately notify the Engineer before beginning the work and submit the question to the Engineer for his interpretation and decision. The Engineer will be governed by overall meaning of the documents.

1.10.4 The Contractor shall keep at least one copy of all drawings and specifications on the project site in good condition, available to the Engineer and to his representatives at all times.

1.10.5 No deviations from the drawings and specifications shall be made without the Engineer's prior written approval.

1.10.6 The General Provisions and the Special Conditions shall apply to each and every division and/or section of the Standard Specifications, as fully as if quoted verbatim therein.

1.11 Standard Publications:

1.11.1 Wherever in these documents reference is made to standard specifications, standards, codes, or other standard publications, such as "ASTM" (American Society for Testing and Materials), "AASHTO" (American Association of State Highway and Transportation Officials), "ANSI" (American National Standards Institute), "AWWA" (American Waterworks Association), "ACI" (American Concrete Institute), "AISC" (American Institute of Steel Construction), "AWS" (American Welding Society), Federal Specifications, "NEC" (National Electrical Code), or others, in all cases the latest published editions of such referenced standard publications in effect at the time of receipt of bids shall apply.

1.12 Standard Equipment and Equipment Installation:

1.12.1 Except where special equipment is required, it is the general intent of the Standard Specifications that manufacturers' standard equipment shall be furnished, and minor variations from the Technical Specifications to accommodate manufacturers' standard equipment will be permissible, provided that the proposed equipment complies substantially with the Standard Specifications, and that it will accomplish the required results, all to the Engineer's satisfaction.

1.13 Standards for Materials:

1.13.1 All materials shall be new, unless used or salvaged materials are authorized by the Engineer.

1.13.2 The use of manufacturers' names and catalog numbers in these specifications or on the drawings indicates the type, size, rating, capacity, design, quality, or kind of materials required, and a closed specification is not intended, and similar and equal products of any reputable manufacturer which will satisfactorily perform the required functions will be acceptable, unless otherwise indicated by the words NO SUBSTITUTES, or unless otherwise specifically stated. The Engineer reserves the right to reject all materials which he deems not equal to those specified, or which he decides will not satisfactorily perform the required functions.

1.13.3 As promptly as possible after award of contract, and prior to the purchase of materials, the Contractor shall submit to the Engineer for approval a complete list of all proposed materials. The Contractor shall include with the list complete catalog data and descriptive literature of all materials.

1.14 Samples:

1.14.1 The Contractor shall furnish for approval all samples as specified or requested. Unless otherwise specified, submit samples in duplicate, of adequate size showing quality, type color range, finish, texture, or other specified features. The work shall be in accordance with approved samples.

1.15 Materials, Services and Facilities:

1.15.1 Except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete and deliver the work within the specified time.

1.16 Inspection and Testing of Materials:

1.16.1 Where specifically provided for in the specifications, the inspection and testing of materials and finished articles to be incorporated in the work at the site shall be made by bureaus, laboratories, or agencies approved by the Engineer. Unless otherwise expressly stated, the cost of such inspection and testing shall be paid by the Contractor. The Contractor shall furnish evidence satisfactory to the Engineer that the materials and finished articles have passed the required tests prior to the incorporation of such materials and finished articles in the work. The Contractor shall promptly segregate and remove rejected materials and rejected finished articles from the site of the work.

1.17 Patents:

1.17.1 The Contractor shall hold and save harmless the Owner and its officers, agents, and employees from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise stipulated in the Contract Documents.

1.18 Accuracy of Data:

1.18.1 Before beginning any work, the Contractor shall examine the site of the work and all contract drawings, and shall verify all dimensions, elevations, and all existing conditions.

1.18.2 All work shall be installed to conform as nearly as possible with the dimensions, elevations, locations, and arrangements indicated, with only such minor adjustments as necessary to coordinate the work of the various trades and specification divisions and/or sections; to coordinate the work of this contract with that of other contracts; to accommodate the actual equipment furnished; to avoid all interferences between the various parts of the work; and to accommodate existing conditions which may differ from those indicated. Any and all parts of the work installed under this contract which interfere with other parts of the work or other contracts, or which deviate from the drawings and specifications without the Engineer's prior approval shall be altered by the Contractor at his own expense, to clear such interferences, or to comply with the drawings and specifications. All interferences or discrepancies which may be discovered or anticipated shall be reported promptly to the Engineer for decision before proceeding with the work. The Engineer shall have the privilege of authorizing minor changes without additional cost, provided that such changes are made prior to the commencing of work on the item involved.

1.19 Lines, Grades, Stakes and Templates:

1.19.1 At his own expense, the Contractor shall furnish all stakes, templates, patterns, platforms, and labor which may be required in setting and cutting or laying out each part of the work.

1.19.2 Upon Contractor's request, the Engineer will furnish locations and bench marks reasonably necessary for the execution of the work. The Contractor shall furnish all lines and grades and will be held responsible for the proper execution of the work to such lines and grades. Lines and grade stakes which are destroyed shall be replaced by the Contractor at his own expense.

1.20 Land Acquisitions and Rights of Way:

1.20.1 The properties on which the items included in the contract are to be located will be provided by the Owner without cost to the Contractor, and all rights-of-way and easements across private or public property required for the installation of the work will be obtained by the Owner. The Owner will make every effort to obtain easements and rights-of-way in sufficient time to allow work to progress in an orderly and expeditious manner. Failure on the Owner's part to obtain rights-of-way and easements in sufficient time to cause no interference with the progress of the work will be considered as just cause for allowing extensions of time to the Contractor in accordance with the time lost because of the lack of rights-of-way and easements.

1.21 Contract Security:

1.21.1 The Contractor shall furnish Performance and Payment Bonds as security for the faithful performance and payment of all his obligations under the contract documents. These bonds shall be in amounts as shown in the Instructions to Bidders and in the form and with sureties as acceptable to the Owner.

1.21.2 The Owner shall have the right to waive the surety bond requirements, in which case the Contractor shall reduce his bid price in the amount of the Contractor's cost for such security.

1.22 Wage Rates:

1.22.1 The Contractor shall pay at least the minimum wage rates established by law. Such wage rates are minimum rates only, and the Owner will not consider any claims for additional compensation made by their Contractor because of payment by the Contractor of any wage rates in excess of minimum rates, nor will the Owner consider any claim for additional compensation made by the Contractor because of wage increases established by law during the life of the contract.

1.23 Subcontracting:

1.23.1 The Contractor shall not award any subcontract to any Subcontractor without the Engineer's prior approval. Only those Subcontractors of proven ability, whose reputation is known to the Engineer for executing first-class work, will be approved. The Engineer's approval will not be given until the Contractor submits to the Engineer an itemized written statement designating the name of each Subcontractor, and the amount of each subcontract. This statement shall also designate the items of the contract which the Contractor proposes to execute directly with his own organization. The amount of these items, combined with the amounts of the various subcontract proposals, shall correspond to the contract price for the entire project. The contract will not be signed until all subcontractors have been approved.

1.23.2 The Contractor shall be as fully responsible to the Owner for the acts and omissions of his Subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

1.23.3 The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind Subcontractors to the Contractor by the terms of the General Provisions and other Contract Documents insofar as applicable to the work of Subcontractors, and give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provisions of the Contract Documents.

1.23.4 Nothing contained in this contract shall create any contractual relation between any Subcontractor and the Owner. It is specifically pointed out that the contractual relationship shall exist between the **Owner and the Contractor** only. It is the Contractor's duty, in his own interest, to enter into sub-contractual agreements in strict accordance with all provisions of the Contract Documents. The failure of the Contractor to make the proper agreements with his Subcontractors and suppliers shall in no way relieve the Contractor of his responsibilities and obligations to the Owner.

1.23.5 The Standard Specifications are grouped under the various divisions and/or sections for convenience of reference only, and each trade involved is not necessarily represented by a separate specification division and/or section but such divisions and/or sections are arbitrary, and the Contractor will be permitted to allot portions of the work to Subcontractors at his own discretion, subject to the requirements of Section 1.23 of the General Provisions, regardless of grouping of the specifications. It shall be the sole responsibility of the Contractor to settle definitely with each Subcontractor the portion of the work which each will be required to do. Neither the Owner nor the Engineer will assume any responsibility whatsoever for any claims or disclaims by any of the Subcontractors or trades concerning the responsibility for performing any particular portion of the work, or jurisdiction over any particular type of work.

1.23.6 The Contractor and all Subcontractors for the various branches of work employed on the project shall cooperate fully with each other to facilitate the progress of the work, and to avoid all interferences between the various parts of the work.

1.23.7 Whenever his work is in progress, each Subcontractor shall have present at the job site a Job Superintendent, foreman, or other duly authorized agent with authority to control the Subcontractor's work. This duly authorized agent shall meet with the approval of the Engineer. The Engineer reserves the right to remove from the project the Subcontractor's agent or any other employee of the Subcontractor, if, in the Engineer's judgment, such removal is necessary to protect the Owner's interest.

1.24 Payments by Contractors:

1.24.1 **The Contractor Shall Pay.**

1.24.1.1 For all transportation and utility services not later than the twentieth (20^{th}) day of the calendar month following that in which such services are rendered.

1.24.1.2 For all materials, tools, and other expendable equipment to the extent of ninety (90%) percent of cost thereof not later than the twentieth (20^{th}) day of the calendar month following that in which such materials, tools, and equipment are delivered to the project site, and the balance of the cost thereof not later than the thirtieth (30^{th}) day following the completion of that part of the work in or on which such materials, tools, and equipment are incorporated or used.

1.24.1.3 To each of his Subcontractors, not later than the fifth (5^{th}) day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his Subcontractor, to the extent of each Subcontractor's interest therein.

1.25 Liquidated Damages:

1.25.1 If so stated in the Proposal, the time of completion of the construction is of the essence of the contract and should the Contractor neglect, refuse, or fail to complete the work to be done under the contract within the time stated in the Proposal, after all extensions of time granted by the Owner have been added, then in that event the Owner shall have and is hereby given the right to deduct and retain out of such monies which may then be due, or which may become due and payable to the Contractor for the work to be done under this contract, the amount stated in the Proposal per calendar day for each and every day that the work is delayed in its completion beyond the specified time.

1.26 Notices and Services Thereof:

1.26.1 All notices, demands, requests, instructions, approvals and claims shall be in writing.

1.26.2 Each notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor shown by him in the Bid (or at such other office as the Contractor may from time to time designate to the Owner in Writing), or if deposited in the United States mail in a sealed postage-prepaid envelope, or if delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office.

1.26.3 Unless otherwise specified in writing to the Contractor, all papers required to be delivered to the Owner shall be delivered to the Engineer, and each notice to or demand upon the Owner shall be sufficiently given if delivered to the Engineer's office, or if deposited in the United States mail in a sealed postage-prepaid envelope, or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to the Engineer, or to such other representative of the Owner or to such other address as the Owner may subsequently specify in writing to the Contractor for such purposes.

1.26.4 Each such notice or demand shall be deemed to have been given or made as of the time of actual delivery, or (in the case of mailing) when it should have been received in due course of post, or (in case of telegrams) at the time of actual receipt, as the case may be.

1.27 Rights of the Owner to Terminate Contract:

1.27.1 If the Contractor should be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed for the Contractor or any of his property, or if he should persistently or repeatedly refuse or fail to supply enough properly skilled workmen or proper material, or if he should refuse or fail to make prompt payment to persons supplying labor or material for the work under the Contract, or persistently disregard instructions or fail to observe or perform any provisions of the Owner's instructions, or fail to observe or perform any provisions of the Contract Documents, or otherwise be guilty of a substantial violation of any provision of the Contract Documents, then the Owner may, by at least five (5) days prior written notice to the Contractor without prejudice to any other rights or remedies of the Owner in the premises, terminate the Contractor's right to proceed with the work. In such event, the Surety shall take over the work and prosecute it to completion, by contract or otherwise, and the Surety shall be liable for all costs in excess of the contract price; and in such case the Surety may take possession of and utilize in completing the work such materials, appliances, and plant as may be on the site of the work and necessary therefore. The foregoing provisions are in addition to, and not in limitation of, the rights of the Owner under all other provisions of the Contract Documents.

1.28 Assignment of Contract:

1.28.1 The Contractor shall not assign the whole or any part of this contract or any monies due or to become due hereunder without the Owner's written consent. In case the Contractor assigns all or any part of any monies due or to become due under this contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior liens of all persons, firms, and corporations for services rendered or materials supplied for the performance of the work called for in this contract.

1.29 Claims for Extra Cost:

1.29.1 If the Contractor claims that any instructions by drawings or otherwise involve extra cost or an extension of time, he shall so notify the Owner in writing within ten (10) days after the receipt of such instructions, and in all cases before proceeding to execute the work. Thereafter the procedure shall be the same as that described in Section 1.30 Changes in Work. No such claim shall be valid unless it is made in accordance with the terms of Section 1.30.

1.30 Changes in Work:

1.30.1 At any time by a written order and without notice to the sureties, the Owner may make changes in the drawings and specifications of this contract and within the general scope thereof. In making any change, the charge or credit for the change will be determined by the Owner by one of the following methods prior to the issuance of the order for the changed work:

1.30.1.1 **Method (1):** The order shall fix the total lump sum value of the change, and shall establish the amount which shall be added to or deducted from the contract price. On all changes involving extras which will be added to the contract price, the price of the extras shall include the Contractor's overhead and profit, which shall be as described in Method (4) below. On all changes which involve a new credit to the Owner, no allowance for overhead and profit shall be figured, except as otherwise noted in Method (2) below.

1.30.1.2 **Method (2):** If the change involves construction items for which unit bid prices are shown in the Proposal, the amount to be added to or deducted from the contract price shall be determined by multiplying the unit quantities of the items to be added or omitted by the corresponding unit bid prices for the items involved, without further allowance for Contractor's overhead and profit.

1.30.1.3 **Method (3):** If the work is performed on a unit price basis and the change involves adding construction items for which no unit prices are shown in the Proposal, the unit prices for the items involved shall be estimated by Method (1) above or Method (4) below, based upon cost data of similar bid items. The amount to be added to the contract price shall be determined by multiplying the unit quantities of the item to be added by this estimated unit price.

1.30.1.4 **Method (4):** By ordering the Contractor to proceed with the work and to keep and present, in such form as the Owner may authorize, a correct account of the total cost of the change, together with all vouchers therefore. The total cost shall be determined as follows:

1.30.1.4.1 Compute the net cost of the change, which shall include: direct labor and items incidental to labor, such as public liability insurance, workmen's compensation insurance, and social security; materials and sales taxes on materials; the

actual use of power tools and equipment; power; and pro-rata charges for foremen.

1.30.1.4.2 Except as otherwise specified in Section 1.30.2 below, compute an allowance for overhead and profit. This allowance shall not exceed the following percentages of the net cost of the change as determined in Section 1.30.1.4.1 above: For all work performed, an allowance of 10% overhead and ten (10%) percent profit shall be allowed; and an additional allowance of a five (5%) percent handling charge may be allowed for work performed by a sub-contractor. In no case shall the ten (10%) percent overhead and ten (10%) percent profit be applied to any work which has previously had these allowances added, nor shall the five (5%) percent handling charge be applied to any work which is not Subcontracted. The five (5%) percent handling charge may be applied to the net cost of the change plus its allowable overhead and profit. Among the items which may be considered as overhead are: bond or bonds; supervision; superintendents; time-keepers; clerks; watchmen; small tools; incidental job burdens; general office expenses; and insurance other than that noted in Section 1.30.1.4.1 above.

1.30.1.4.3 The sum of the amounts computed in accordance with Sections 1.30.1.4.1 and 1.30.1.4.2 above shall constitute the total cost of the Change Order, except as otherwise specified in Section 1.30.2 below.

1.30.2 Where a cash allowance is included in the Proposal for authorized Contract Amendments or other purposes, the Contractor shall include in his total bid price all overhead, profit, and handling charges on the stated amount of the allowance. On all changes in the work which are to be paid for by this allowance, the Contractor shall not add to the net cost of the change any additional overhead and profit, or any handling charges. However, if any part of such work is subcontracted, each Subcontractor and Sub-subcontractor may allow himself not more than ten (10%) percent overhead and ten (10%) percent profit, as described in Section 1.30.1.4.2 above, but shall not include any handling charges.

1.30.3 Where required by the Owner, the Contractor shall furnish to the Owner an itemized breakdown of the quantities and prices used in computing the value of each change that may be authorized.

1.30.4 In figuring changes, instructions for measurement of quantities as set forth in the specifications shall be followed.

1.30.5 During the progress of the work, should the Contractor encounter, or the Engineer or Owner discover subsurface or latent conditions at the site differing materially from those shown on the drawings or indicated in the specifications, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the drawings and specifications, the Engineer's attention shall be called immediately to such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions, and if he finds that they do materially differ, with the written approval of the Owner the contract will be modified to provide for the increase or decrease of cost and difference in time resulting from such conditions.

1.31 Sanitary Facilities:

1.31.1 Where satisfactory sanitary facilities are not available to the job, the Contractor shall construct and maintain temporary toilet facilities complying with all local health department requirements and satisfactory to the Engineer, and shall remove them after completion of the project.

1.32 Cutting and Patching:

1.32.1 Generally, cutting of new construction shall be avoided wherever possible by the proper coordination between the various trades, and by the placing of proper sleeves, inserts, bolts, and other items in the construction as the work progresses.

1.32.2 However, where subsequent cutting of new construction or cutting of existing construction is required, it shall be done in a neat, careful, and approved manner, without unnecessary or extensive damage to the construction involved, and only to such an extent that is reasonably necessary for the installation of the work.

1.32.3 All patching, repairing, and altering shall be done only by mechanics skilled in the various trades involved, using materials and workmanship to match those of the original construction in type and quality.

1.32.4 All existing construction which is disturbed or damaged in any way by the Contractor's operations shall be restored at least to the conditions which existed before work was begun, unless otherwise indicated.

1.33 Removal of Debris:

1.33.1 During the progress of the work, the Contractor shall remove and properly dispose of the resultant dirt and debris and keep the premises reasonably clear thereof. Upon completion of the work he shall remove all construction equipment and unused materials provided for the work, and put all the buildings, structures, and premises in a neat and clean condition, and do all cleaning and washing required by the specifications.

1.34 Use of Completed Work:

1.34.1 The Engineer may accept a section or sections of a project before the entire project is completed. Such section(s) shall be of reasonable length, as determined by the Engineer, and shall be completed in full accordance with the Plans, Specifications and all other applicable provisions of the Contract. No section(s) shall be accepted unless the Contractor has received payment of at least ninety (90%) percent of the value of the work from the Owner. The acceptance of a section or sections of a project shall in no way void or alter any of the terms of the Contract.

1.34.2 Upon written request to the Contractor, the Owner may elect to place any one or more of the approved completed portions of the work in operation, in which event the Owner shall assume complete and sole responsibility for those portions of the work covered in the written request, provided-however, that nothing contained herein shall relieve the Contractor of any liability with respect to defective workmanship and materials as provided for under Section 1.35 below.

1.35 Starting, Testing and Adjusting:

1.35.1 Upon substantial completion of all work under this contract and after the Engineer's preliminary inspection thereof, the Contractor shall maintain one or more qualified competent workers on the job as required: to put the project in operation; to conduct all specified tests; to make all necessary corrections and adjustments to obtain specified, indicated, and satisfactory operation; and if a

trial run is specified in Special Conditions or the Technical Specifications, to cooperate with, assist, and instruct the Owner's representatives during the required trial run. Failure of the Contractor to comply with this requirement of the contract shall be considered just cause for delaying final approval and acceptance of the work, delaying the commencement of the guarantee period, and withholding any and all funds which may then be due the Contractor.

1.36 Taxes:

1.36.1 The Contractor shall pay all applicable Federal, State and Local taxes and shall include the total amount of the taxes in the bid price.

1.37 Guarantee:

1.37.1 All labor and material furnished by the Contractor, covered by the drawings and specifications and official modifications thereof, shall be guaranteed by the Contractor for a period of one year from the date of final acceptance of the completed project by the Owner. All necessary repairs required during this period due to defective workmanship or material shall be made promptly by the Contractor without cost to the Owner, at times convenient to the Owner.

1.37.2 The Engineer shall have the sole right to establish the beginning of the guarantee period for all portions of the project, and if so stated in the Special Conditions or the Standard Specifications, the guarantee period shall not begin until a trial run has been completed with satisfactory operation for the period of time stated in the Special Conditions or the Standard Specifications. It shall be the Contractor's duty to make all final adjustments, perform all miscellaneous clean-up work, and conduct all specified performance tests. Final acceptance will not be given until the completion of all final adjustments, clean-up work, and tests.

1.37.3 Where certain portions of the project are placed in use before the entire project is completed, the guarantee period for the equipment or items placed in use shall begin prior to the acceptance date of the entire project.

1.38 Safety and Health Regulations:

1.38.1 The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).

1.38.2 Authorized representatives of the Department of Labor shall be permitted free access to the project for inspections.

1.39 Modifications to General Provisions:

1.39.1 Modifications to these General Provisions, if any, shall be as specified in The City of Germantown Standard Specifications Section 2: Special Conditions.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Special Conditions

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Special Conditions:

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2.1 Scope of the Contract:

2.1.1 The work required under a City of Germantown contract includes furnishing and paying for all necessary materials, labor, tools, equipment and other items, and constructing improvements, complete in every detail, ready for the City's beneficial use, as specified herein, and/or indicated on the contract drawings. Typical projects shall consist generally of, but not limited to, the following items:

2.1.1.1 Demolition of Existing Structures

2.1.1.2 Concrete Curbs & Gutters

2.1.1.3 Concrete Sidewalks and Driveways

2.1.1.4 Aggregate Cement Base

2.1.1.5 Asphalt Leveling Courses

2.1.1.6 Asphaltic Concrete Binder and Surface Courses

2.1.1.7 Storm Drainage Inlets, Manholes and Pipe

2.1.1.8 Adjustment to Appurtenances to City Owned Utilities (Water Distribution and Sewer Collection)

2.1.1.9 Traffic Control Marking & Signing

2.1.1.10 Install vehicle detector loops, conduit, pull boxes and connect to controller.

2.1.1.11 Other Related Work.

2.1.2 See Sections 1.1 and 1.10 of Section 1, General Provisions.

2.2 Work items and Material NOT listed in the Proposal:

2.2.1 Cost of work and/or materials not specifically listed in the Proposal, but needed for a complete product as set forth in the Plans and Specifications, shall be incidental to the pay items listed unless otherwise noted on the drawings or specified herein.

2.3 Award of Contract:

2.3.1 See Information for Bidders and Information for Successful Bidder.

2.3.2 Instances of conflict between unit price and amount shown in the Proposal shall be governed by the unit price. The amount to be considered in the bid will be the product of the estimated quantity shown multiplied by the unit price shown by the bidder.

2.4 Pre-Construction Meeting:

2.4.1 After contract award, the Engineer shall schedule/conduct a pre-construction meeting.

2.4.2 At the pre-construction meeting, the Engineer will issue a Notice to Proceed.

2.4.3 The contractor shall be prepared during the conference to:

2.4.3.1 Submit the Contractor's proposed general sequence of operations, including major work items along with anticipated completion dates for each item.

2.4.3.2 Submit a list of all sub-contractors to be used in the execution of the work under the contract.

2.4.3.3 Discuss any of the submittals and/or respond to any questions the City may have regarding the submittals.

2.4.3.4 Advise the owner of all anticipated construction problems and difficulties with the Owner's operations, and present plans to avoid unnecessary interferences therewith.

2.4.3.5 Discuss conflicts between the proposed work and any existing utilities with the representative of the affected utilities. Determine the relocation plans, if required, of the utilities and develop a schedule that will coordinate the relocation plans of the utility with the work.

2.4.3.6 Obtain the interpretation, clarification and/or Owner's decision concerning requirements of the drawings, specifications, or other contract documents which the Contractor finds unclear.

2.4.3.7 Discuss any other items pertaining to the work, as desired.

2.4.4 The Engineer will furnish to the Contractor written minutes of the Pre-Construction Meeting, verifying the interpretations, clarifications, instructions, agreements and other information pertinent to the project resulting from this meeting.

2.5 Lines, Grades, Stakes and Templates:

2.5.1 The construction control staking shall be performed by a licensed Engineer or Land Surveyor acceptable to the City of Germantown.

2.5.2 The following shall be the minimum requirements of the project for construction control staking:

2.5.2.1 Establish Centerline or Baseline Control.

2.5.2.2 Establish in field all control points, P.I.'s, P.C.'s, P.T.'s, P.O.T.'s, etc.

2.5.2.3 Establish in field points on line of Centerline or Baseline.

2.5.2.4 Max one-hundred (100) foot intervals for straight tangents.

2.5.2.5 Max fifty (50) foot intervals for horizontal curves.

2.5.3 The stationing used shall correspond to the Centerline or Baseline stationing used in the plans. All points shall be labeled with the appropriate station.

2.5.4 All control points shall be referenced so they may be easily and accurately re-established.

2.5.5 The establishment of the centerline and baseline control for the entire project shall be established before any other construction staking will be undertaken.

2.5.6 The establishment of Horizontal and vertical control for curb and gutter, structures, etc.

2.5.7 Curb inlets shall have at least two (2) control points set to accurately establish line and grade of the curb iron. The points shall be set so that they will not be disturbed during the construction of the inlets.

2.5.8 Gravity sewer lines & storm-drain lines shall have cut stakes provided at maximum 50 intervals and set at the appropriate offset.

2.5.9 Curb and Gutter (Line and Grade):

2.5.9.1 Cut stakes, set at the appropriate offset shall be provided at a maximum interval of twenty-five (25) feet.

2.5.9.2 Control stakes on curb returns shall be set at maximum ten (10) feet intervals.

2.5.9.3 Vertical curves shall have the control stakes set at maximum ten (10) foot intervals for half the total length of the vertical curve, measured equally from the P.V.I.

2.5.9.4 Earthwork slope stakes shall be set five (5) feet beyond the appropriate top or toe of slope. The interval shall be a maximum of fifty (50) feet.

2.5.10 All control staking shall be labeled with the Centerline or Baseline station it is opposite and the offset from said Centerline or Baseline that the control point is set.

2.5.11 Field notes shall be kept in a Surveyor's Field Book of all construction and staking performed. The Field book shall be available for review or reference by the Engineer or the Contractor at all times.

2.5.12 Prior to final acceptance, the Engineer or Land Surveyor shall certify that the work has been constructed and completed essentially to the lines and grades shown on the contract drawings. Receipt of said certification under the signed seal of the Engineer or Land Surveyor shall be a condition of release of the final payment for the contract.

2.6 Water and Electricity for Construction:

2.6.1 At no cost to the Contractor, the Owner will furnish all necessary water for testing, sterilizing, flushing and other construction purposes, subject to the following conditions:

2.6.1.1 Carefully conserve all water, and do not waste is unnecessarily. If, in the opinion of the City, the Contractor is using excessive amounts of water, they may require that the Contractor begin paying for all water used thereafter.

2.6.1.2 The Contractor shall provide all necessary hoses, temporary pipework, portable tanks and other equipment to convey and use the water.

2.6.1.3 For Dust Control and other uses not described above, The Contractor shall obtain a fire hydrant use permit and a fire hydrant meter. The Contractor shall obtain the Fire Hydrant Meter form the City of Germantown Public Works Department.

2.6.1.4 Fire Hydrant Meters issued by the City of Memphis (yellow painted meters) will **NOT** be allowed.

2.6.1.5 The Contractor shall provide all necessary electric power for the project construction at his own expense.

2.7 Laboratory Testing:

2.7.1 The cost of laboratory testing services specified for the concrete work, paving materials and base course, and the cost of laboratory inspection and stamping of pipe, fittings, equipment and other materials shall be included in the various unit prices; no separate payment shall be made.

2.7.2 The cost of quality control testing services for the earthwork is included in the Pay Item Allowance for testing. The Contractor shall be responsible for ensuring that a technician is present each and every time earthwork activities associated with the construction of the roadway subgrade and embankment are underway. Satisfactory test results shall be obtained for each lift before additional earthwork proceeds. Payment for the testing services shall be made based upon invoices submitted to the Contractor for actual testing services rendered. Evidence of satisfactory test results being achieved shall be presented with all requests of payment for earthwork.

2.7.3 The City may, at its own expense, make arrangements for any additional testing services that it may deem appropriate. These tests shall, in no way, release the Contractor of his responsibility of providing a quality product meeting the specification requirements for the materials and workmanship of the project.

2.8 Existing Utilities, Structures, and Other Property:

2.8.1 The position of pole lines, conduits, water mains, sewers, storm drains, natural gas lines and other underground and above ground utilities and structures is not necessarily shown on the contract drawings and, where shown, the accuracy of the position of such utilities and structures is not guaranteed. Before starting work, the Contractor shall inform himself of the exact location of all such utilities and structures, and shall assume all liability for damage to them. Unless otherwise specified, the Contractor shall support all such utilities and structures, or temporarily remove them, and restore them to the satisfaction of the Owners of the utilities and/or structures.

2.8.2 After commencing work, the Contractor shall use every precaution to avoid interferences with existing underground and surface utilities and structures, and protect them from damage.

2.8.3 The Contractor shall contact owners of underground utilities to determine the exact locations of these utilities before performing any construction in the immediate vicinity of these respective utilities. Contract for relocation shall be made through the Tennessee One Call service, telephone number 1-800-351-1111. The location of services must be requested at least three (3) days prior to digging.

2.8.4 The Contractor shall repair or pay for all damage caused by his operations to all utility property, and private property whether it is below ground or above ground, and he shall settle in total cost all damage suits which may arise as a result of his operations.

2.9 Existing Utility Relocations and/or Adjustments:

2.9.1 All relocations and/or adjustments required for electrical facilities, natural gas mains and service lines, and related appurtenances shall be performed by Memphis Light, Gas and Water Division.

2.9.2 Telephone lines and cables, above and below ground, shall be relocated and/or adjusted as needed by the respective Telephone Company Owner.

2.9.3 Television cable lines shall be relocated and/or adjusted as necessary by the respective Cable Company Owner's forces.

2.9.4 All sanitary sewer and service lines and storm drainage facilities shall be relocated and/or adjusted, as required, by the Contractor. Cost required for this work shall be incidental to the pay items listed in the Proposal.

2.9.5 The Contractor shall cooperate fully with each of the utilities named in Sections 2.9.1, 2.9.2, and 2.9.3 above. The Contractor shall coordinate and schedule his work with these utilities to avoid all unnecessary interference with each utility's and Contractor's work.

2.10 Access to Properties During Construction:

2.10.1 Each property affected by the roadway will be provided with continuous access to their property. The Contractor shall so plan his work as to ensure this. When the situation requires, the Contractor shall provide temporary driveways while permanent driveway aprons are being constructed. The cost of temporary drives shall be incidental to the costs of driveway aprons, driveway base and driveway paving.

2.10.2 Failure to provide adequate access to any property affected by this project shall be reason for the City to stop work on all activities not directly associated with the proper restoration of said access.

2.11 Traffic Control Warnings:

2.11.1 Schedule and perform all work to interfere as little as possible with vehicular traffic flow. Poor planning and gross inconsideration of traffic flow will be just cause to stop the Contractor's work until the unsatisfactory conditions have been remedied.

2.11.2 Mark clearly all open ditches, open excavations, soft backfill, parked equipment, etc., with signs and fences and/or barricades during day hours, and, in addition, with flares at night. Maintain all flares, signs and fences and/or barricades during weekends, holidays and at other times when work is not in progress.

2.11.3 Provide adequate signs, barricades, fences and watchmen to comply with the requirements of all authorities having jurisdiction, and as necessary, for the safety and inconvenience of the general public.

2.11.4 On all contracted or permitted work, Full lane closures on 'Major' roads (Poplar Ave., Germantown Pkwy, Wolf River Blvd, etc.) within the city limits can only commence between the hours of 9am – 4pm (Monday – Friday). Any variance on this Special Condition must be approved by the City of Germantown Engineering Department.

2.11.5 All traffic control shall conform to Section VI of the Manual on Uniform Traffic Control Devices (MUTCD) as adopted by the Federal Highway Administration and the Tennessee Department of Transportation.

2.12 Erosion and Siltation:

2.12.1 During project construction, use every precaution and make all provisions as required to minimize erosion/siltation and to prevent damage to adjacent property by erosion/siltation resulting from the Contract.

2.12.2 At Contractor's expense, restore to at least the conditions which existed prior to commencement of this project, all adjacent property which may have been damaged by siltation and erosion resulting from work under the Contract.

2.13 Air Quality Protection:

2.13.1 **General.** The Contractor shall use suitable precautions to minimize air pollution during the progress of the work. He shall maintain all excavations, stockpiles and all other work areas within and without the project boundaries free from dust which would cause the standards for air pollution to be exceeded, thus causing a hazard or nuisance to others. All equipment utilized for dust control shall be of safe design and or sufficient capacity for the intended work. Perform dust control as the work proceeds and when a dust hazard or nuisance occurs.

2.13.2 **Burning.** No burning will be permitted unless written permission is granted from the City of Germantown Fire Marshal.

2.14 Protection of Water Resources:

2.14.1 **General.** The Contractor shall not pollute waterways with fuel, oil, bitumen, acid or other harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable federal, state and municipal laws concerning pollution of rivers and streams or other waterways. All work under this Contract shall be performed in such a manner that objectionable conditions will not be created in streams through or adjacent to the project areas.

2.14.2 **Spillage.** The Contractor shall take special measures to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides, insecticides, cement and surface drainage from entering public water.

2.14.3 **Wastes.** Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., will not be permitted in areas adjacent to waterways. The location for the disposal of these materials will be subject to the approval of the Engineer. If any waste material is dumped in unauthorized areas, the Contractor shall remove the materials and restore the area to the condition of the adjacent undisturbed area. If necessary, he shall excavate contaminated ground, dispose of it as directed by the Engineer and replace with suitable fill materials, compacted and finished with topsoil, all at the expense of the Contractor.

2.14.4 During the term of the Contract, the Contractor shall maintain all facilities provided for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned with has become stabilized to the extent that pollution is no longer being created.

2.15 Changes in Work:

2.15.1 See Section 1.30 of Section 1, General Provisions.

2.15.2 If conditions described in Section 1.30.5 of General Provisions are encountered and the Contractor fails to notify the engineer and/or proceeds to work in the area(s) without written permission from the engineer, the Contractor shall assume full responsibility for all work performed. Any failure to other unacceptable work under these conditions shall be promptly repaired or replaced at the Contractor's expense with no cost to the Owner. No extra cost shall be allowed for any work performed in the area(s) described in Section 1.30.5 without written approval from the engineer.

2.16 Cleaning Up:

2.16.1 In addition to the requirements of Section 1.30.5 of General Provisions, the site and the structures to be constructed thereon shall be maintained and kept clean and free from rubbish, unused materials and equipment during the construction period. From time to time, remove all dirt, rubbish and surplus materials of all descriptions, including equipment not in use, and maintain the site in a neat and orderly condition, all as approved. Materials or equipment known to belong to others shall not be removed from the site without duly notifying the Owner thereof.

2.17 Final Inspection and Acceptance:

2.17.1 When the total project is substantially complete, representatives of the City and Contractor will make a thorough inspection of the entire project and prepare a "Punch List" of all items requiring correction or additional work. After the Contractor has corrected all Punch List items to the satisfaction of the engineer, the engineer will notify the Contractor, in writing, that the project is accepted and final payment will be made to the Contractor. The Contractor's one year guarantee period will commence with the date of the Notice of Acceptance.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Concrete Structures

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Concrete Structures:

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3.1 Scope:

3.1.1 This work shall consist of all structures, or parts of structures composed of Portland cement concrete whether plain, reinforced, or a combination of both. Concrete structures shall be constructed of Class 'A' Concrete, unless otherwise specified. They shall be constructed on prepared foundations, at the locations indicated or directed in conformity with the dimensions, lines and grades shown on the Plans or as directed by the Engineer and in accordance with these Specifications.

3.1.2 The Concrete used in this type construction, unless stated in the project drawings, shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate, air-entraining agents and chemical additives (when approved) all conforming to applicable ASTM specifications.

3.1.2.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

3.1.2.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

3.1.2.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

3.1.3 Parts of a structure, or structures, indicated to be constructed with materials other than Portland cement concrete and concrete reinforcement steel shall be constructed in accordance with the provisions set out in the Section of these Specifications covering the particular type of construction.

3.2 Materials:

3.2.1 **Materials.** Materials used in this construction shall meet the requirements of the applicable Sections or Subsections of Section 23, Portland Cement Concrete, of these specifications and the following:

3.2.2 **Waterstops.** Waterstops shall be of the type, shape and dimensions shown on the plans.

3.2.2.1 Metallic waterstops shall be sheet copper conforming to the requirements as specified in the current Specifications for Copper Sheet, Strip, Plate, and Rolled Bar, Type ETP, ASTM Designation B152. The weight per square foot shall be as specified on the Plans.

3.2.2.2 Nonmetallic waterstops shall be manufactured from either a natural rubber, synthetic rubber, or polyvinylchloride (PVC) at the option of the Contractor. Waterstops shall be produced by such a process that, as supplied for use, they will be dense, homogeneous, and free from holes and other imperfections. The cross-section of the waterstop shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop will be uniform.

3.2.2.3 Rubber waterstops shall be fabricated from a high grade thread-type compound. The basic polymer shall be natural rubber or a copolymer of butadiene and styrene, or a blend of both. The compound shall contain not less than seventy (70%) percent by volume of the basic polymer, and the remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizer.

Samples taken from the finished rubber waterstop shall meet the following requirements when tested in accordance with the current specified ASTM method of test:

ASTM title	Requirement	Method of Test
Tensile Strength (Die 'C')	2500 psi (min.)	ASTM D412
Ultimate Elongation (Die 'C')	450 % (min.)	ASTM D412
Shore Durometer Hardness	60-70	ASTM D2240
Specific Gravity	1.15 (+0.03)	ASTM D297 (Sec. 17)
Water Absorption (% by weight)	5% max.	ASTM D570
Tensile Strength after accelerated aging, oxygen-pressure method	80% max.	ASTM D572

3.2.2.4 Polyvinylchloride waterstops shall be extruded from an elastomeric plastic material. The material shall be a plastic compound, the basic resin of which shall be polyvinylchloride. The compound shall contain any additional resins, plasticizers, stabilizers, or other materials needed to ensure than when the material is compounded it will meet the performance requirements of this Specification. No reclaimed polyvinylchloride shall be used.

Samples taken from the finished Polyvinylchloride waterstop shall meet the following requirements when tested in accordance with the current specified ASTM method of test:

ASTM title	Requirement	Method of Test
Tensile Strength (Die 'C') – Sheet Material	2000 psi (min.)	ASTM D412
Ultimate Elongation (Die 'C') – Sheet Material	350 % (min.)	ASTM D412
Tensile Strength (Die 'C') – Finished Waterstop	1700 psi (min.)	ASTM D412
Ultimate Elongation (Die 'C') – Finished Waterstop	300 % (min.)	ASTM D412
Stiffness in Flexure	750 psi (min.)	ASTM D747
Accelerated Extraction - Tensile Strength (Die 'C')	1700 psi (min.)	ASTM D412
Accelerated Extraction - Elongation (Die 'C')	300 % (min.)	ASTM D412
Effect on Alkali – Change in Weight (after 7 days)	-0.1 to +0.25%	
Effect on Alkali – Change in Hardness, shore Durometer (after 7 days)	± 5%	
Low Temperature Brittleness	-35°	ASTM D746
Specific Gravity	1.3	ASTM D792

3.2.2.5 For polyvinylchloride waterstops, the supplier shall submit a certificate stating that all of the performance requirements specified for the sheet material under Polyvinylchloride Waterstops have been complied with. Field splices for Polyvinylchloride waterstops shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations. Waterstops shall be manufactured with an integral cross-section which shall be uniform within plus or minus 1/8 inch in width, and the web thickness or bulb diameter within plus 1/16 inch and minus 1/32 inch.

3.2.2.6 The Contractor shall furnish the Engineer at his request and at no cost to the city a certified test report from an approved laboratory covering each lot or unit of finished waterstops. These test reports shall contain the numerical laboratory test data of the required tests.

3.2.3 **Epoxy Resin Systems.** Two component epoxy resin systems shall conform to the requirements of the appropriate class designation of AASHTO M 200, M234, M235, unless otherwise designated on the Plans or in the Contract. The appropriate class designation is determined by the proposed use of the material.

3.2.3.1 Requirements for Specific Uses.

3.2.3.1.1 Bonding fresh concrete to cured concrete. Requirements: The material shall meet the compositional specifications of AASHTO M 235, Class I and applicable requirements of the Class Ill performance specification.

3.2.3.1.2 Bonding Cured concrete to cured concrete. Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class Ill performance specification.

3.2.3.1.3 Binder in epoxy resin concrete and mortar for repairing spalls and other defects in concrete. Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class Ill performance specification.

3.2.3.2 Quality Assurance. The Contractor shall furnish the following documentation showing compliance with these Specifications:

3.2.3.2.1 A certified statement from the formulator of the epoxy stating that each component material used in the formulation of Component A (Epoxy Resin) and Component B (Hardener) was purchased to conform to the requirements of the AASHTO Specifications.

3.2.3.2.2 A certified formulation from the formulator of the epoxy resin showing the composition of Component A (Epoxy Resin) and Component B (Hardener). The parts by weight of each ingredient shall be shown.

3.2.3.2.3 An infrared spectrum of each Component.

3.2.3.2.4 A sample of Component A and Component B sufficient in quality to yield one quart of the mixed epoxy.

3.2.4 **Bar Reinforcement.** Unless otherwise specified, all steel reinforcement for concrete shall be billet steel bars conforming to the requirements of ASTM A615.

3.2.5 **Dowel Bars.** Dowel bars shall be plain and shall conform to the requirements of ASTM A306, Grade 55, 60, 65, or 70.

3.2.6 **Welded Wire Fabric.** Fabric for reinforcement shall conform to ASTM A185, or as indicated on the plans, and shall be supplied in mats of the size, design and weight shown on the Plans.

3.3 Equipment:

3.3.1 Equipment and tools necessary for handling materials and performing all parts of the work shall be subject to approval by the engineer as to design, capacity, and mechanical condition. Equipment shall be on hand sufficiently ahead of the start of construction operations to be examined and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Engineer.

3.3.2 Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than five (5) feet. Where steep slopes are required, the chutes shall be equipped with Baffle boards or shall be in short lengths that will enable the direction of movement to be reversed.

3.3.3 Concrete vibrators shall be of an approved type and design and shall operate under load at a rate as recommended by the manufacturer and approved by the Engineer.

3.4 Construction:

3.4.1 **Forms (Formwork).**

3.4.1.1 Forms shall be mortar-tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other stresses incidental to the construction operations, including vibration. Forms shall be so constructed and maintained as to prevent the opening of joints due to shrinkage of the lumber.

3.4.1.2 The forms shall be built true to line and grade and shall be held in place by means of studs or uprights, and waling, which shall be sufficiently and substantially braced and tied.

3.4.1.3 All forms and studding shall be cut off and capped with not less than a two (2) inch by four (4) inch piece so that the top of the cap will be at the elevation of the finished exposed surface of the concrete.

3.4.1.4 All edges shall be chamfered with three-quarter (¾) inch material, unless otherwise specified. All chamfer strips shall be straight, of uniform width, and dressed. Wood devices of any kind used to separate forms shall be removed before placing concrete within four (4) inches of such devices.

3.4.2 **Form Lumber.**

3.4.2.1 Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be so constructed as to produce mortar-tight joints and smooth, even concrete surfaces.

3.4.2.2 Plywood forms, or forms face-lined with plywood, masonite, or other approved similar material may be used, provided the plywood forms and form linings are substantial, of uniform thickness, and are mortar-tight when in position.

3.4.3 **Metal Ties.** Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least one inch from the face without injury to the concrete. In case wire ties are permitted, the wires shall be cut back at least one-quarter (¼) inch from the surface of the concrete, and the surface left sound, smooth, even, and uniform in color.

3.4.4 **Walls.** Sufficient openings shall be provided at intervals along the bottom of wall forms to permit thorough cleaning prior to concrete placement. Such openings shall be closed before placing concrete in the forms.

3.4.5 **Surface Treatment.** Prior to placing reinforcement, all forms shall be treated to prevent the adherence of concrete. Forms not provided with a special treatment shall be treated with an approved form-oil. Any material that will adhere to or discolor the concrete shall not be used.

3.4.6 **Metal Forms.** The specifications for forms, as regards design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, and reuse and oiling apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk on the face forming the concrete surface. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up properly shall not be used. Care shall be exercised to keep metal forms free from rust, grease, or other foreign matter. When the Contractor wishes to utilize a special forming system not specifically authorized in this Specification, he shall submit his design and calculation to the Engineer for review and approval.

3.4.7 **Falsework.**

3.4.7.1 The false work used to support the forms and concrete for concrete structures shall be supported on sills resting on rigid foundations composed of piles driven until the bearing capacity of each pile is sufficient to support the load to which it will be subjected, or earth-borne footings as hereinafter provided.

3.4.7.2 Earth-borne footings will be permitted only when, in the opinion of the Engineer, the soil can adequately support the superimposed loads and the following conditions are met:

3.4.7.2.1 Spread footings will only be permitted on table ground, capable of supporting the superimposed load.

3.4.7.2.2 The site is graded and so maintained to prohibit ponding of water or erosion of soil in the proximity of the spread footings.

3.4.7.2.3 The falsework system shall be designed and constructed to preclude exceeding the bearing capacity of the soil, but in no case shall exceed 3,000 pounds per square foot.

3.4.7.2.4 The footings shall be designed and constructed to carry the superimposed loads.

3.4.7.2.5 All footings shall be constructed on a level plane.

3.4.7.3 The falsework shall be designed and constructed to support the required loading without distortion or settlement of the forms.

3.4.7.4 The Contractor shall place "tell-tales" for observation of the amount of falsework settlement at locations designated by the Engineer.

3.4.7.5 The Engineer may require the Contractor to submit detailed falsework plans, together with a soils report, design calculations or any other information necessary for a thorough review. The Contractor is totally responsible for the design and construction of the falsework system and shall repair, or remove and replace, as directed and at his expense, any concrete, other material or portions of the structure which are damaged or destroyed due to failure of the falsework.

3.4.8 **Reinforcement.**

3.4.8.1 All reinforcement shall consist of deformed steel bars, unless otherwise indicated or directed. Deformed steel bars shall have a net area at all sections equivalent to that of plain round or square bars of the corresponding nominal size.

3.4.8.2 Structural steel shapes shall conform strictly to the slopes indicated or required.

3.4.8.3 Steel wire fabric may be furnished in rolls or sheets.

3.4.8.4 Reinforcing steel shall be stored above the ground surface upon platforms, skids or other supports located without the scope of the active construction operations and shall be protected at all times from injury and damage. All brush and weeds shall be removed from the area immediately prior to storing reinforcing steel thereon.

3.4.8.5 Reinforcing steel, where indicated, shall be accurately bent, without heating, to the forms and dimensions indicated on the Plans. Minimum bend diameters shall be in accordance with the requirements of the American Concrete Institute. Unless otherwise indicated, all bends shall be in one plane. Bars three-quarters (¾) of inch or less which have only hooks or a single bend may be bent in the field, provided satisfactory equipment for proper and accurate work is used and provided the bending is accomplished true to form and dimensions without damage to the bars. All other bending shall be done in the shop before shipment.

3.4.8.6 Substitution of bars of different sizes from those indicated on the Plans may only be made with the written permission of the Engineer. If substitution is permitted, the following shall apply:

3.4.8.6.1 The total area of steel in any one (1) linear foot in each direction shall not be reduced.

3.4.8.6.2 For anycast-in-place concrete the clear distance between parallel bars in a layer shall not be less than one and one-half (1½) bar diameters, one and one-half (1.5) times the maximum size of the coarse aggregate, or one and one-half (1½) inch minimum.

3.4.8.6.3 Where positive or negative reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with the clear distance between layers not less than one (1) inch.

3.4.8.6.4 Clear distance limitation between bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars. Groups of parallel reinforcing bars bundled in contact to act as a unit shall be limited to four (4) in any one bundle. Bars larger than #11 shall be limited to two (2) in any one (1) bundle in beams. Bundled bars shall be located within stirrups or ties. Individual bars in a bundle cut off within the span of a member shall terminate at different points with at

least forty (40) bar diameters stagger. Where spacing limitations are based on bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.

3.4.8.6.5 In walls and slabs, the primary flexural reinforcement shall be spaced not farther apart than one and one-half (1.5) times the wall or slab thickness, or eighteen (18) inches.

3.4.8.7 All reinforcement shall be furnished in the full lengths shown on the Plans, unless otherwise approved in writing by the Engineer. No splices shall be made unless indicated on the Plans or authorized by the Engineer. Splices shall be so arranged and manipulated as to provide a minimum of two (2) inches net clearance between the splices and the surface of the complete concrete work, unless otherwise indicated or directed. Splices of tension reinforcement at points of maximum stress shall be avoided. The members at all splices shall be rigidly clamped by means of at least two approved metal clips located approximately three (3) inches from the ends of the bars and bolted around them or securely wired in a manner satisfactory to the Engineer.

3.4.8.8 Steel shapes shall be spliced only as indicated on the Plans.

3.4.8.9 Steel fabric shall be spliced by overlapping of the sheets by not less than twelve (12) inches; by matching at least three transverse members; and by securely wiring the overlapped sections in a manner satisfactory to the Engineer.

3.4.8.10 All reinforcing steel before being placed shall be thoroughly cleaned of mill scale, rust, dirt, paint, oil, or other foreign substances of coating of any character that will reduce the bond. If reinforcement which has been placed becomes dirty, rusty, or spattered with mortar which dries before concrete is placed around it, such reinforcement, or part affected, shall be thoroughly cleaned before being covered with concrete.

3.4.8.11 Reinforcement shall be accurately placed and firmly held in position as indicated on the Plans. Steel bars shall be securely fastened together with metal clips or wire at each intersection, except where spacing is less than on one (1) foot in each direction then alternate intersections shall be fastened. All reinforcing steel shall be securely spaced from the forms and between adjacent reinforcement by means of precast mortar blocks, metal spacers or other approved devices or methods, and where possible, all spacer devices shall be so arranged that their use cannot be detected in the completed structure. Spacer blocks shall be cast of mortar mixed in the same proportions as that in the concrete mixture and shall not have a length or width greater than the depth required for proper spacing from the forms or between adjacent reinforcement. The use of gravel, concrete, brick, or wooden blocks is prohibited.

3.4.8.12 All the reinforcing steel necessary for a section of concrete structure shall be accurately and securely placed and the placement approved by the Engineer before any concrete is deposited in the section, and care shall be observed not to disturb it during the placing of the concrete.

3.4.8.13 All dimensions relating to reinforcing bars are to the centers of the bars, unless otherwise indicated.

3.4.8.14 Tolerances for bending and cutting during fabrication shall be in accordance with the “Manual of Standard Practice" published by the Concrete Reinforcing Steel Institute.

3.4.9 **Drainage and Weep Holes.** Drainage openings and weep holes shall be constructed using materials in the manner and at the locations shown on the Plans or established by the Engineer. Ports or vents for equalizing hydrostatic pressure, when required, shall be placed as directed.

3.4.10 **Placing Pipes, Conduits, Anchors, Castings and other Appurtenances.** Pipes, conduits, anchors, castings, bolts, plates, grillages, and other appurtenances which are necessary or desirable to be placed in the concrete of a structure, whether indicated on the Plans or not, shall be placed by the Contractor during construction, as directed. Unless otherwise stipulated, pipes and conduits will be delivered to the Contractor at the site of the structure by the City or by other parties for whose use the pipes and conduits are intended. No compensation will be allowed for placing such pipes, conduits, and other appurtenances, except that no deductions will be made for the volume of concrete displaced by those items.

3.4.11 **Expansion Joints.**

3.4.11.1 Expansion devices shall be as indicated on the Plans. The devices shall be securely anchored in correct position. All sliding surfaces shall be true and smooth and shall form complete contact throughout. Movement shall not be impeded by the concrete in which they are embedded.

3.4.11.2 Unless otherwise provided, where portions of concrete bridge superstructure rest on the substructure, the contact area shall be separated by at least two layers of three-ply bituminous-saturated paper.

3.4.11.3 Open joints shall be constructed using forms which will permit removal without injury to the concrete. After removal of the forms, the joints shall be cleaned thoroughly. Filled joints shall be constructed with premolded filler, unless otherwise indicated. Joints requiring a sealant shall be thoroughly cleaned and sealed with one of the specified joint sealing materials before the structure is opened to traffic. Edges of open and filled joints shall be chamfered or edged, as directed. Mortised joints shall be constructed as shown on the Plans or as directed.

3.4.12 **Placing Concrete.**

3.4.12.1 Concrete shall not be placed until forms and reinforcing steel have been checked and approved. The forms shall be clean of all debris and kept wet immediately before concrete is placed. The method and sequence of placing concrete shall be approved by the Engineer. Unless otherwise permitted, all concrete shall be placed in daylight, and the placing of concrete in any portion of the structure shall not be started unless it can be entirely completed in daylight. When the placing of concrete is permitted during other than daylight hours, an adequate and approved artificial lighting system shall be provided and operated.

3.4.12.2 All concrete shall be thoroughly worked during the placing by means of tools of approved type. The working shall be such as to force all coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycomb.

3.4.12.3 If the forms show building or settlement while concrete is being placed, the placing shall be stopped until correction has been made.

3.4.12.4 T-beam girders, slabs, arch rings, and all horizontal sections of bridges except curbs and sidewalks shall be constructed monolithically and continuously, unless otherwise permitted. Curbs and sidewalks shall be constructed after the bridge deck is completed unless otherwise indicated on the Plans.

3.4.12.5 After initial set and prior to final set of the concrete, the forms shall not be jarred, and no strain shall be placed on the ends of projecting reinforcement. Piles shall not be driven closer than twenty (20) feet to footings less than seven (7) days old nor to foundations supporting concrete less than seven (7) days old.

3.4.13 **Railings and Curbing.** When constructing curb, careful attention shall be given to the installation of railing steel or anchoring devices. Concrete railings shall not be constructed on any structure until the falsework has been struck.

3.4.14 **Chutes and Troughs.** Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the concrete already in place. Care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the forms and around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

3.4.15 **Concrete Testing.** Concrete for structures shall be tested as shown on the Plans or directed by the Engineer. Concrete test specimens shall be made and cured in accordance with AASHTO Designation T233. A minimum of three (3) test cylinders shall be made for each Structure concrete pour. For each day's pour, no less than three (3) test cylinders shall be made. The Contractor shall be responsible for obtaining the services of a testing laboratory to make, handle, cure and break the test cylinders. To ensure that the cylinders are representative of the concrete being placed, fresh concrete shall be sampled in accordance to ASTM C172 (from middle of batch). Each group of test specimens shall have one cylinder subjected to seven (7) day compressive strength tests and a second cylinder twenty-eight (28) day test. Should the value of either of the first two test breaks be below the expected values, the third cylinder shall be tested for compressive strength. Low cylinder breaks may be cause to have the concrete represented by the test specimens removed and replaced. At the time the test cylinder specimens are made, the testing laboratory will check the concrete slump and the air entrained.

3.4.16 **Concrete Vibrating.**

3.4.16.1 Unless otherwise directed, the concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When required, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction.

3.4.16.2 Vibrators shall be so manipulated as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Vibrators shall not be used as a means to cause concrete to flow or run into position in lieu of placing. The vibration at any point shall be of sufficient duration to accomplish compacting but shall not be prolonged to the point where segregation occurs.

3.4.16.3 At least one additional standby vibrating unit shall be available for all individual pours in excess of ten (10) cubic yards.

3.4.17 **Joints.**

3.4.17.1 Feather-edge construction joints will not be permitted. Transverse or longitudinal joints through spans will not be permitted, except where specified.

3.4.17.2 In no case shall the concreting of any section or layer be stopped or temporarily discontinued within eighteen (18) inches of any finished surface, unless the details of the structure provide for a coping having a thickness of less than eighteen (18) inches, in which case, at the option of the Engineer, the construction joint may be made at the underside of the coping.

3.4.17.3 Layers completing a day's work or placed just prior to temporarily discontinuing operations shall be cleaned of all laitance or other objectionable material as soon as the surface has become sufficiently firm to retain its form.

3.4.18 **Bonding Construction Joints.**

3.4.18.1 When dowels, reinforcing bars, or other adequate ties are not indicated on the Plans, keys of a directed size shall be made by constructing projections above the concrete and monolithically with the concrete.

3.4.18.2 In resuming work, the forms shall be drawn tightly against the face of the concrete. The entire surface of the concrete to be bonded shall be cleaned thoroughly and roughened with a steel tool. In addition, if directed, the surface to be bonded shall be cleaned and roughened by sandblasting. The surface shall then be soaked with clean water, after which concreting may proceed.

3.4.19 **Removal of Forms and Falsework.**

3.4.19.1 Forms for ornamental work, railings, parapets, columns, and vertical surfaces that do not carry loads shall be removed in from twelve (12) to forty-eight (48) hours, unless otherwise directed by the Engineer. In cold, damp, or freezing weather, all vertical forms shall remain in place until the concrete has set sufficiently to withstand damage when the forms are removed. In removing forms, care shall be exercised neither to mar the surface of the concrete nor to subject it to any undue pressure.

3.4.19.2 Projecting wires or other metal devices used for holding forms in place and which pass through the body of the concrete shall be removed or cut as specified in Section 3.4.3, and the holes or depressions thus made and all other holes, depressions, and small voids which show upon the removal of the forms shall be filled with cement mortar mixed in the same proportions as that which was used in the body of the concrete which is being repaired.

3.4.19.3 Falsework and supports under slab or girder spans, any length, may be released and removed when representative specimens of the concrete in the spans, cured by the methods and in the manner the concrete which the test specimens represent is cured, attain a compressive strength of three-thousand (3,000) pounds per square inch (psi). In addition to the above requirement, the concrete shall have been placed a minimum of ten (10) days, not counting the days of twenty-four (24) hours each in which the temperature falls below forty (40°) degrees Fahrenheit, or twenty-one (21) calendar days, whichever occurs first.

3.4.19.4 For continuous concrete girder or slab units, any length, the falsework, and supports shall not be released or removed from any span in the continuous unit until the concrete in all spans in the unit has been placed a sufficient length of time to meet all requirements for the removal of falsework and supports as set forth above.

3.4.19.5 Forms supporting bridge decks between girders and outside curb overhangs may be removed after seven (7) days.

3.4.20 **Defective Concrete.**

3.4.20.1 Any defective concrete discovered after the forms have been removed shall be removed immediately and replaced. If the surface of the concrete is bulged, uneven, or shows honeycombing which cannot be repaired satisfactorily, the entire section shall be removed and replaced.

3.4.20.2 Concrete having a twenty-eight (28) day strength of less than the minimum specified shall be removed and disposed of by the Contractor, at his expense, unless specifically authorized by the Engineer, in writing, to remain in place. The removal shall be in such manner as will not cause damage to the remaining concrete or to other structural units or other facilities and property.

3.4.21 **Concrete Surface Finishes.**

3.4.21.1 Unless otherwise authorized, the surface of the concrete shall be finished immediately after form removal.

3.4.21.2 All concrete surfaces shall be given a Class 1 Finish. The following surfaces of all structures shall be given a Class 2 Finish: roadway face and top of curbs, vertical outside face of curb overhang or sidewalks slab, bottom surface of slab overhang, bridge railings, barrier railings, all vertical surfaces of the superstructure of dual bridges exposes to view from either structure, all surfaces of retaining wall, wingwalls, and end walls which are visible from passing vehicles.

3.4.21.2.1 **Class 1 (Ordinary Surface Finish):** Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces which are to be exposed or waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, saturated with water, and carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the Class of the concrete being finished. Mortar used in pointing shall not be more than forty-five (45) minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length and clean and true edges. All surfaces which cannot be repaired to the satisfaction of the Engineer shall be "rubbed" as specified for a Class 2 finish.

3.4.21.2.2 **Class 2 (Rubbed Finish):** After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting the work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a wetted wooden

block or a medium coarse carborundum stone. The carborundum stone shall not be used until the concrete has hardened to the state where the sand will grind, rather than ravel or roll. Rubbing shall be continued until all form marks, projections, and irregularities have been removed; all voids filled; and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place. A brush finish or painting with grout will not be permitted. After all concrete above the surface being finished has been placed; the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.

3.4.21.2.3 **Class 3 (Float Finish):** This finish, for unformed surfaces, except slab surfaces for pavements or bases, shall be achieved by placing an excess of material in the form and removing or striking off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of concave surfaces shall be avoided. After the concrete has been has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool of wood, canvas, or cork. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

3.4.22 **Finishing Slab Surfaces for Pavements or Bases.**

3.4.22.1 Bridge floors or top slabs of structures serving as finished pavements or bases shall be finished either by hand methods or approved mechanical finishing machines.

3.4.22.2 When the hand method is used, the bridge floors or slabs shall be struck off with a screed which is parallel to the centerline of the roadway, resting on bulkheads or screed strips cut or set to the required cross-section of the roadway. This screed shall be so constructed as to have sufficient strength to retain its shape and that the cutting edge may be adjusted to conform to the profile of the roadway. Screeds shall be of sufficient length to finish the full length of spans forty (40) feet or less in length. Spans over forty (40) feet in length shall be finished in two or more sections, but no section shall be less than twenty (20) feet in length. Screed strips or headers shall be accurately set to the specified grades, checked, and adjusted as necessary prior to the final screeding operation. The screed shall be worked back and forth over the surface until the proper profile and cross-section is obtained.

3.4.22.3 When mechanical finishing machines are used, they shall be approved power driven machines, traveling on rails adjusted to conform to the profile of the roadway. The machines shall be equipped with oscillating or vibrating transverse or longitudinal screeds that may be adjusted to conform to the profile or the required cross-section of the roadway. The screeds shall have sufficient strength to retain their shape after adjustment. The finishing machine shall go over each area of the bridge floor as many times as is required to obtain the required profile and cross-section.

3.4.22.4 Regardless of the method of finishing, the Contractor shall maintain a minimum rate of placement of twenty (20) linear feet of bridge deck per hour when concrete is placed in a longitudinal section.

3.4.22.5 After finishing as described above, the surface shall be checked with a twelve (12) foot straightedge and shall show no deviation in excess of one-eighth (⅛) inch from the testing edge of the straightedge when placed parallel to the centerline. Deviations in excess of this requirement shall be corrected before the concrete sets.

3.4.22.6 The surface shall be finished by dragging a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap to slightly groove the surface and shall be moved forward with a minimum bow of the lead edge. The drag shall be kept damp, clean, and free of particles of hardened concrete. A light broom or brush herringbone finish that leaves a texture similar to that obtained by the burlap drag may be used when permitted by the Engineer. For bases, the surface shall be finished by grooving lightly with a wire broom at an angle of sixty (60°) degrees Fahrenheit with the centerline. All strokes shall begin at the center and end at the edge. After the slab has been finished by the burlap drag, surfaces which will become traffic lanes shall be textured by the formation of transverse grooves. The grooves shall be formed in the surface at an appropriate time during the stiffening of the concrete, so that in the hardened concrete the grooves will be between 0.09 inch and 0.13 inch in width; between 0.12 inch to 0.19 inch in depth; and spaced at random intervals between 0.3 inch and 1.0 inch. The grooves shall terminate approximately eighteen (18) inches from curbs, parapets, barrier walls, and other vertical walls. The grooves shall be relatively smooth and uniform; shall be formed without tearing the surface and without bringing pieces of coarse aggregate to the top of the surface; and shall be formed to drain transversely. All areas which do not conform to these requirements shall be corrected at the Contractor's expense by approved methods.

3.4.22.7 As soon as the surface has set sufficiently to withstand damage when walking on it and not later than the morning following the placing of the concrete, it shall be straightened with the twelve (12) foot straightedge and all variations exceeding one-eighth (⅛) inch shall be plainly marked. The Contractor shall correct and seal such variations in the same manner as specified for Portland Cement Concrete Pavement.

3.4.23 **Concrete Curing.**

3.4.23.1 All concrete surfaces, except those surfaces protected by forms that remain in place seven days or longer as required under the provisions of Section 3.4.19, Removal of Forms and Falsework, shall be cured as specified below. Curing shall begin as soon as the concrete has hardened sufficiently to withstand surface damage to unformed surfaces and immediately after the forms have been removed from formed surfaces.

3.4.23.2 When the temperature is expected to fall below thirty-five (35°) degrees Fahrenheit, the concrete shall be protected in accordance with the provisions of Section 3.4.24.

3.4.23.3 The initial curing period for concrete surfaces shall be by the "Water Method" for a period of not less than twenty-four (24) hours, or until the concrete surfaces have been prepared for the application of curing compound, in accordance with the provisions under 3.4.23.4.2 below.

During the initial curing period, the concrete shall be protected from the sun by burlap mats or other approved materials and kept completely and continuously moist.

3.4.23.4 The "water Method" and membrane-forming compound method of curing will be required for all bridge decks and on all concrete slabs when the temperature exceeds ninety (90°) degrees Fahrenheit during placement.

3.4.23.4.1 **Water Method:** All concrete slabs shall be covered immediately with material suitable for use with the water cure and kept thoroughly wet for at least one-hundred twenty (120) hours from the beginning of the initial curing period. All surfaces other than slabs shall be protected from the sun and shall be kept wet for a period of at least seventy-two (72) hours from the beginning of the initial curing period. Curbs, walls, handrails, and other surfaces requiring a Class 2 finish may have the covering temporarily removed for finishing, but the covering shall be restored as soon as possible.

3.4.23.4.2 **Membrane-Forming Compound Method:** All surfaces shall be given the required surface finish prior to application of the curing compound. Prior to the application of curing compound, the surface shall be kept moist. The rate of application of curing compound shall be as recommended by the manufacturer, but shall not be less than one (1) gallon for one-hundred fifty (150) square feet of concrete surface. The curing compound shall be applied, under pressure, immediately after completion of the initial curing period or acceptance of the concrete finish. If the surface is dry, the concrete shall be thoroughly wet with water and the curing compound applied just as the surface film of water disappears. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. If the application of the compound results in a streaked or blotchy appearance, the method shall be stopped and water curing, as set out above, applied until the cause of the defective appearance is corrected. The coating shall be protected against marring for a period of seven days from date of application. Any coating marred or otherwise disturbed within the seven day period shall be replaced at once.

3.4.24 **Protection of Concrete in Cold Weather.** If, after the concrete has been placed, the ambient temperature is expected to drop below thirty-five (35°) degrees Fahrenheit, provide insulation blankets, sufficient canvas, and framework, or other types of housing, to enclose and protect the structure in such a way that the air surrounding the fresh concrete can be maintained at a temperature of at least forty-five (45°) degrees Fahrenheit and the surface temperature of the concrete will not exceed eighty (80°) degrees Fahrenheit. Maintain the above conditions for a period of one-hundred twenty (120) hours after the concrete is placed. Furnish a maximum-minimum thermometer to the Engineer for temperature documentation.

3.5 Measurement.

3.5.1 All concrete will be measured for payment as stipulated under the Section specifying each individual type of construction.

3.5.2 No allowance will be made for furnishing the material and the construction of drainage openings and weep holes as indicated or as directed, provided such openings are six (6) inches in diameter or less, except that no deduction will be made for such openings in the computation of concrete quantities. Allowance will be made for other openings as indicated.

3.5.3 No allowance will be made for additional cement used in depositing concrete underwater; for use of calcium chloride or chemical additives; for fillers, sealers, and tar paper used in expansion joints; for dowels or other materials used in bonding construction joints; for waterstops; and for painting metals.

3.5.4 No allowance will be made for concrete placed below the foundation elevation shown on the Plans or as directed by the Engineer.

3.5.5 No additional compensation will be made for high-early-strength concrete substituted by the Contractor.

3.6 Payment. All concrete will be paid for as stipulated under the Section specifying each individual type of construction.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Water Distribution & Construction

2023

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Water Distribution & Construction:

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4.1 Scope:

4.1.1 This section includes the furnishing of and paying for all materials, labor, tools, equipment and other items required for the complete water main extensions consisting generally of: pipe; valves; fire hydrants; fittings; connections to existing water system; and other items as herein specified and indicated.

4.1.2 Read carefully GENERAL PROVISIONS and SPECIAL CONDITIONS, all of which shall apply to all work included in this section.

4.2 General Design Information:

4.2.1 **Pipe Alignment.** The water system shall be designed to minimize as much as practical the number of bends requiring mechanical fittings.

4.2.2 **Pipe Cover.** The minimum specified cover for water systems is based upon the final finished surface, including any pavement, and is measured from the top of the pipe.

4.2.2.1 All water mains and hydrant leads shall have a minimum cover of thirty six (36) inches unless otherwise specified or directed.

4.2.2.2 Hydrant Leads (where they cross side ditches ONLY): eighteen (18) inches minimum cover.

4.2.2.3 Hydrant Leads (all other locations): thirty six (36) inches minimum cover.

4.2.2.4 Water service lines shall have a minimum of eighteen (18) inches of cover unless otherwise specified or directed.

4.2.3 **As-Built Water Plans.** At the completion of construction, as-built water plans are required to be provided to the Department of Engineering. As-built plans will include, as a minimum, the following information, and other information as may be requested by the City Engineer:

4.2.3.1 Distance of water services from property lines. When services are not located directly between the curb and sidewalk, as-builts will also include the distance of the end of the service line to the water main.

4.2.3.2 Locations where rodding has been used for anchorage using property lines or other fixed points as a reference point for measurements.

4.2.3.3 Location of plugs and caps using property lines or other fixed points as a reference point for measurements.

4.2.3.4 Location of valves using property lines or other fixed points as a reference point for measurements. When valves are not located in a street where they can be easily found, distances between valves shall be included.

4.3 Types of Pipe: All pipe used for construction of the water system and water services four (4) inches or larger shall be ductile iron pipe (D.I.P.). Water services three (3) inches in size or smaller shall be copper tubing (Type K).

4.3.1 **Ductile Iron Pipe (D.I.P.).** Unless otherwise specified on the drawings, D.I.P. used for City of Germantown water systems shall conform to ANSI/AWWA Standard C151 and shall have a minimum working pressure of at least 150 psi. The minimum pipe thickness class of all ductile Iron pipe shall be as indicated in *Table 8, Ductile Iron Pipe Minimum Thickness*. All pipe shall have ANSI/AWWA Standard C104 standard thickness bituminous sealed cement-mortar lining, bituminous outside coating, and ends as required for the types of joints specified.

4.3.1.1 Pipe interiors, sealing surfaces, fittings, etc... Shall be kept clean.

4.3.1.2 Pipe bundles shall be stored on elevated flat surfaces with uniform support.

4.3.1.3 Fittings for D.I.P. shall be ANSI/AWWA C110 cast iron or ductile short body pattern, class 250, bituminous coated inside and out, with ends as required for the type of joint specified. Push on fittings are not permitted.

4.3.1.4 Tees for connecting fire hydrants to water mains shall be mechanical joint anchoring types, each with a six (6) inch spigot outlet and a locked-on rotating mechanical joint gland ring.

4.3.1.5 Except as otherwise specified or indicated, all joints in ductile iron pipe shall be AWWA Standard C111 mechanical or push on type with plain rubber gaskets.

4.3.1.6 Comply with the manufacturer's specific storage and handling requirements.

4.3.1.7 Upon demand by the City Engineer, the contractor shall furnish certificates of inspection made by an approved testing laboratory for any type of material used on a project.

Pipe Sizes	Wall Thickness	Pressure Class
4" Ø	0.26"	350
6" Ø	0.25"	350
8" Ø	0.27"	350
10" Ø	0.29"	350
12" Ø	0.31"	350
14" Ø	0.33"	350
16" Ø	0.34"	350
18" Ø	0.35"	350
20" Ø	0.36"	350
24" Ø	0.38"	350
30" Ø	0.39"	350
36" Ø	0.43"	350
42" Ø	0.47"	350
48" Ø	0.51"	350
54" Ø	0.57"	350

Table 8, Ductile Iron Pipe Minimum Thickness

4.3.2 **Copper Tubing.** All copper tubing shall be Type K copper and installed without couplings when the required lengths are commercially available. All connections between the copper tube and fittings shall be compression type. Sweating or soldering of joints is not permitted.

4.4 Cut-Off Valves and Roadway Boxes: All valves for the City of Germantown water systems shall be opened by turning in a COUNTER-CLOCKWISE direction of rotation (left-hand open) and provided with a valve box for accessing the valve operating nut.

4.4.1 Gate Valves: All gate-valves shall be Mueller 2300 series, or an approved equivalent consisting of a ductile iron body, bronze mounted, resilient wedge, parallel seat, non-rising stem gate type.

4.4.1.1 Valves shall conform to AWWA Specification C515.

4.4.1.2 Valves shall have a minimum working pressure of 175 PSI.

4.4.1.3 Valves shall have "O" ring type stem seals with a two (2) inch operating nut w/COUNTER-CLOCKWISE operation (left-hand open).

4.4.1.4 Valves shall have AWWA Specification C111 mechanical joint ends with plain rubber gaskets.

4.4.1.5 The Valve body shall be coated inside and out with an epoxy coating conforming to AWWA specification C550.

4.4.2 Butterfly Valves: All butterfly-valves shall be Pratt "Groundhog", Dresser 450, American Darling or an approved equivalent resilient seated type

4.4.2.1 Valves shall conform to AWWA Specification C504.

4.4.2.2 Valves shall have a minimum working pressure of 150 PSI.

4.4.2.3 Valves shall have a two (2) inch operating nut w/COUNTER-CLOCKWISE operation (left-hand open).

4.4.2.4 Valves shall have AWWA Specification C111 mechanical joint ends with plain rubber gaskets.

4.4.3 Valve Boxes: Provide over each valve operating stem a standard two-piece coal tar coated five and one-quarter (5¼) inch inside shaft diameter screw type adjustable cast iron roadway valve box.

4.4.3.1 Each box shall be a SIGMA VB260 series (or approved equal) consisting of a cover marked 'WATER', an upper telescoping section and a lower section.

4.4.3.2 Where necessary to provide extra depth, extension pieces shall be provided as required to allow the box to be set at finished grade.

4.5 Fire Hydrants: Fire hydrants shall be Mueller A-423 Super Centurion 250 (lubricated dry-top, break-away traffic type), conforming to the AWWA Specification C502. Substitutions are allowed ONLY with approval from the Germantown Water Department.

4.5.1 Each hydrant shall be complete with a five (5) inch minimum valve opening, a six (6) inch AWWA Specification C111 mechanical joint inlet connection, a three (3) or four (4) foot bury, two (each) - two and one half (2½) inch National Standard fire hose thread nozzle, one - four (4) inch City of Germantown, TN standard pumper connection nozzle with 15/16" (square cross section), 1⅛" high operating nut and cap nuts.

4.5.2 Each hydrant shall be opened by turning in a CLOCKWISE direction of rotation (right hand open).

4.5.3 All interior working parts of the hydrant shall be solid bronze or bronze mounted.

4.5.4 All nozzles shall be equipped with caps anchored to the standpipe with chains.

4.5.5 The hydrant shall be designed that all interior parts can be removed without removing the stand pipe from the set position.

4.5.6 Each hydrant shall be equipped with a drain (drip) valve that will positively drain the lower barrel (standpipe) when the main valve is closed.

4.5.7 Each hydrant shall be factory painted on the outside below grade line with black asphalt paint and above grade line with silver enamel paint.

4.6 Existing Meter Relocations and Service Connectors or Reconnections:

4.6.1 If an existing water main is to be removed from service, it shall remain in service until the new water main has been sterilized, pressure tested and placed in service.

4.6.2 Relocate all existing water meters affected by construction as required or as directed by the City Engineering Department.

4.6.3 Reconnect all existing services along the new water main to the new main.

4.6.4 Where water meters are to be relocated, each service unit shall consist of one Mueller H-15000 (or approved equal) corporation stop with straight coupling nut; one Type K soft copper tubing service pipe from street to meter location; one Mueller H-15175 (or approved equal) curb stop. Connect each service to the relocated meter.

4.6.5 For new service line extensions, furnish all items noted above. Service Line to run to future meter location with curb stop.

4.6.6 All joints between copper tubing and fittings shall be flared type. Couplings for copper tubing shall be Mueller H-1500 (or approved equal); use these ONLY in open trenches where allowed by the City Engineer.

4.6.7 Set the corporation stop in the main at an angle of 45 degrees (45°) with the vertical.

4.6.8 All service lines (pipe) shall have eighteen (18) inches minimum cover.

4.6.9 Where meters are NOT relocated, reconnect existing services to the new main using a corporation stop and service pipe, length as required, as specified in section 4.6.4 using same materials as the existing service connection.

4.6.10 Connect services to main by tapping directly into the wall of the main in accordance with the MAXIMUM permissible direct tapping sizes for various sizes of mains listed below; where service size exceeds the maximum allowable size direct tapping for the main involved, use approved service clamp or tee fitting.

4" Main: ¾" maximum size direct tapping
8" Main: 1¼" maximum size direct tapping
10" Main: 1½ maximum size direct tapping
12" Main (& larger): 2" maximum size direct tapping

4.7 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material:

4.7.1 **Granular Drain.** Drain rock material for trench drainage and pipe support shall be washed gravel, washed crushed rock, or washed crushed stone evenly graded from one-half (½) to two (2) inches in size, installed to the dimensions shown on the drawings or specified by the City Engineer.

4.7.2 **Pipe Embedment.** Unless otherwise indicated on the drawings or directed by the City Engineer, the D.I.P. may be laid directly on the excavated trench bottom with holes excavated in the bottom to facilitate the bell of pipes. When the use of granular embedment is directed, it shall be crushed rock, crushed stone or washed gravel with one-hundred (100%) percent passing a one-half (½) inch screen and ninety-five (95%) percent retained on a No. 4 sieve, installed to the dimensions specified by the City Engineer.

4.7.3 **Concrete Encasement.** Concrete encasement shall consist of concrete meeting the requirements in section 4.8 Concrete and shall be used in the locations shown on the drawings, as specified in these specifications or as directed by the City Engineer. When used, concrete encasement shall be rectangular in section with a thickness of six (6) inches between the outside edge of the pipe and the outside of encasement at the closest point.

4.7.4 **Concrete Foundation.** Concrete foundations for pipe support shall consist of concrete meeting the requirements in section 4.8 Concrete, poured the full width of the trench bottom, extending to a depth of not less than one-quarter (¼) of the pipe diameter below the outside bottom of the pipe and no less than one-quarter (¼) of the pipe diameter above the outside bottom of the pipe or to the dimensions directed by the City Engineer.

4.7.5 **Backfill Materials (except sand).** All backfill shall meet the requirements of Section 4.18. Except where sand backfill is indicated on the drawings, specified herein, or approved by the City of Germantown, backfill materials shall be:

4.7.5.1 Up to six (6) inches above pipe tops: Selected earth, free of rocks, stones, bricks, cinders, broken concrete, rubbish, organic materials and other unapproved materials.

4.7.5.2 From six (6) inches above pipe tops to finished grade or paving subgrade: Any materials removed from the excavation and suitable for backfill. Do NOT use as backfill material any pieces of the following materials which are larger than six (6) inches in their greatest dimension: Rock, stone, concrete, asphalt paving, or masonry.

4.7.5.3 All backfill materials shall be subject to the City of Germantown's approval. Dispose of all excavated material not to be used as backfill, as approved.

4.7.6 **Sand Backfill.** All backfill shall meet the requirements of Section 4.18. Use sand backfill ONLY as backfill at the following locations:

4.7.6.1 For all pipes in tunneled holes and for all mains in bored holes without casings; thoroughly tamp or otherwise place the backfill in an approved manner to prevent caving or settling.

4.7.6.2 At all locations where indicated on the drawings or authorized by the City of Germantown, from pipe laying subgrade up to paving subgrade: Same backfill shall be compacted with a vibratory plate compactor.

4.7.7 **Settling of Backfill.** Refill and smooth off as required all backfill which settles, so that all backfill finally conforms to the original ground surfaces, not only at the time of project acceptance, but also for the duration of the guarantee period. This includes removing and repairing all pavement which may be damaged by settlement.

4.8 Concrete: Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications.

4.8.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

4.8.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

4.8.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

4.9 Trenching: All trenches shall be open cut unless shown otherwise on the drawings or set out elsewhere in these specifications.

4.9.1 Excavate trenches to the indicated lines and locations to provide uniform and continuous bearing and support of each pipe barrel on firm, undisturbed earth at every point between bell holes.

4.9.2 Trench depths shall be as required to:

4.9.2.1 Provide the specified minimum cover over the tops of pipes.

4.9.2.2 Permit pipes to pass under culverts, railroads, highways, existing pipelines and other obstructions.

4.9.2.3 Accommodate valves and boxes.

4.9.3 Trench widths shall as required for the proper laying and jointing of pipes, and the proper placing and compacting of backfill, but in no case shall a trench be more than twenty four (24) inches wider than the inside diameter of the pipe to be laid herein.

4.9.4 Machine or Hand-Cut Trenches subgrade will be prepared with hand tools.

4.9.5 Where excavation is carried below proper subgrade, before laying pipe, bring the trench bottom up to the proper subgrade by backfilling with approved material placed in three (3) inch maximum thickness loose layers. Thoroughly compact each layer to meet the requirements of Section 4.18 to provide uniform and continuous bearing and support for the pipe barrel at every point between the bell holes.

4.9.6 Where trench conditions are unsuitable for pipe support, lay pipe on washed gravel bedding as authorized by the City Engineer.

4.9.7 Minimum cover over tops of pipes shall be as follows:

4.9.7.1 All water mains and hydrant leads shall have a minimum cover of thirty six (36) inches unless otherwise specified or directed.

4.9.7.2 Hydrant Leads (where they cross side ditches ONLY): eighteen (18) inches minimum cover.

4.9.7.3 Hydrant Leads (all other locations): thirty six (36) inches minimum cover.

4.9.7.4 Special Conditions: minimum cover as indicated on the drawings.

4.9.8 IN ALL CASES, THE SPECIFIED MINMUM COVER OVER PIPES SHALL BE BASED UPON FINAL FINISHED SURFACES, INCLUDING PAVING (IF APPLICABLE). Where grading is involved do not cut trenches under roads, streets or other areas until the final finish grading has been done, unless authorized.

4.9.9 The trenches shall follow lines parallel to and equal distance from the pipe centerline.

4.9.10 In areas requiring grading such as roads and streets, do not cut trenches until the final grading has been done unless directed otherwise in the drawings or by the City Engineer.

4.9.11 Shore and brace trenches as required. Where D.I.P. is laid along or across streets or roadways or adjacent to houses or buildings, the sides of the trenches shall be vertical and protected against caving with suitable bracing and sheeting. See section 4.12 Shoring, Sheeting and Bracing. Do all necessary cribbing up required for the proper operation of trenching machines.

4.9.12 Provide and maintain in proper working order all necessary dewatering equipment required to remove water from the excavated trenches. Where quicksand or other water bearing strata are encountered, install and connect the

necessary number of well points with pumping equipment of sufficient capacity to prevent rise of water in the excavation until the work has been installed properly and will be unaffected by submersion.

4.9.13 Do not install any work until excavations are free of water, mud, and loose dirt. Do not install any work on frozen ground.

4.9.14 Where pipe crosses concrete or paved driveways, sidewalks or other areas as specified in the drawings or directed by the City Engineer, pipe shall be installed by tunneling or boring as authorized. Install pipes crossing dirt or gravel drives by open cut (unless otherwise authorized).

4.9.15 No more than two-hundred (200) feet of trench shall be opened at any time in advance of the completed water main nor shall more than one-hundred (100) feet be left unfilled except by approval from the City Engineer.

4.9.16 Where a sewer pipe, gas pipe, drain pipe or similar structure comes within the limits of the trench, such structures shall be supported properly. The City Engineer may direct the manner in which such structures shall be supported.

4.9.17 The contractor shall at all times be responsible for the condition of the trenches

4.9.17.1 The contractor shall maintain frequent inspections of the trenches and repair settled or sunken places as soon as they are discovered.

4.9.17.2 All soft or dangerous trenches shall be marked or barricaded and lighted at night for protection of the public.

4.9.18 Placing of house service connections, installation of fire hydrants, pouring of thrust blocks (kickers), removal of excess excavated material, building of access bridges and general clean-up operations will be kept close behind the laying of the water main. The City Engineer may direct that the laying of the water main cease until these auxiliary operations are caught up.

4.10 Unsatisfactory Subgrade: Where indicated and/or where the subgrade material will not provide a sufficiently firm foundation to support the pipes and superimposed loads or contains ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material that in the City's opinion should be removed, remove the unsatisfactory material down to the depth indicated or required. See section 4.7 Granular Drain, Pipe Embedment, Concrete Encasement, Concrete Foundation and Backfill Material.

4.10.1 Replace the unsatisfactory material with the specified drain rock, granular pipe embedment, granular backfill material, concrete encasement or concrete foundation.

4.10.2 No material shall be used until approved by the City Engineer. Material used prior to obtaining approval or measurement by the City representative shall not be paid for.

4.11 Maintaining Drainage: Provide and maintain in proper working order all necessary de-watering equipment for the removal of water from the excavation. Where the trench bottom is mucky or otherwise unstable because of ground water and in all cases where the static ground water elevation is above the bottom of the trench, lower the ground water level by using drain rock or other acceptable method as required to keep the trench free from water and the bottoms stable for pipe laying until the pipes have been installed properly and will be unaffected by submersion.

4.12 Shoring, Sheeting and Bracing: Adequately shore and brace trenches and other excavations as required to protect personnel, adjacent structures and adjacent property.

4.12.1 Where required by conditions encountered or as required by OSHA, brace trenches and excavations with suitable close sheeting or sheet piling.

4.12.2 Do all necessary cribbing up required for proper operation of trenching equipment.

4.12.3 Repair all damage resulting from inadequate or improper shoring, bracing, etc…

4.12.4 Sheeting or shoring that does not extend below the pipe centerline may be removed after the trench backfill has been placed and compacted to a level one (1) foot above the top of the pipe.

4.12.4.1 Immediately after removal, fill all resulting void spaces and re-compact the backfill.

4.12.4.2 Sheeting may be left in place only where specifically approved.

4.12.4.3 Cut the tops of sheeting left in place at an approved depth below finished grade.

4.13 Bedding for Ductile Iron Water Mains: Unless otherwise shown in the drawings, specified elsewhere in these specifications or directed by the City Engineer, bedding shall consist of the natural trench bottom providing firm support for the length of the joint with holes excavated in the bottom to facilitate the bell of pipes.

4.14 Installation of Ductile Iron Pipe (D.I.P.) Water Mains:

4.14.1 **General Requirements.**

4.14.1.1 Provide and use suitable equipment for safe and convenient handling of pipe, fittings, valves and other water piping material.

4.14.1.2 Provide suitable facilities and equipment for lowering the pipe into the trench without causing damage to the pipe or trench.

4.14.1.3 Do not drop or dump water piping material from transportation vehicles or into trenches.

4.14.1.4 Inspect each pipe and fitting for cracks and other defects prior to installation. Suspend each length above ground and ring with a light hammer to detect cracks. Remove defective material from the job site.

4.14.1.5 Spigot ends, the inside of bells, gasket grooves, gaskets, glands, bolts and nuts must be clean and free of any foreign matter before installation and prior to joining pipe.

4.14.1.6 Do not install any work until excavations are free of water, mud, and loose earth.

4.14.1.7 Do not install any work on frozen ground.

4.14.2 **Water and Sewer Separation.** No water pipe shall pass through or come in contact with any part of a sewer or sewer manhole.

4.14.2.1 **Horizontal Separation.**

4.14.2.1.1 Water mains shall be laid at least ten (10) feet from any sanitary sewer or sewer manhole.

4.14.2.1.2 If local conditions prevent the required horizontal separation, the water main may be installed closer if installed in a separate trench as the sewer main and the elevation of the top (crown) of the sewer is at least eighteen (18) inches lower than the bottom (invert) of the water main.

4.14.2.2 **Vertical Separation.**

4.14.2.2.1 Whenever water must cross sewer mains or sewer services, the water main shall be laid at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer lines.

4.14.2.2.2 The water main shall be relocated to provide this separation or reconstructed with mechanical joint pipe for a distance of ten (10) feet on each side of the sewer. One (1) full length of D.I.P. will be centered over the sewer so that both joints will be as far from the sewer as possible.

4.14.2.3 **Unable to Maintain Separation.** When local conditions prevent a vertical separation as stipulated above, the sewer main shall be constructed of mechanical joint ductile iron pipe (or encase pipe in concrete as directed by the City Engineer). Pipe shall be centered at the point of crossing so that joints will be as far from each other as possible. When water mains must pass under sewers, provide adequate support for the sewers to prevent excessive deflection of joints or settling on and breaking the water mains.

4.14.3 **Ductile Iron Pipe (D.I.P.) Installation.**

4.14.3.1 Before laying pipe and fittings: remove all lumps, blisters and excess tar coating from each spigot and the inside of each bell; wire brush and wipe all dirt and other foreign matter from the outside of each spigot and the inside of each bell; swab out the inside of each length of pipe and each fitting; and remove all dirt and other foreign matter from all gaskets, glands, bolts and nuts. Use every precaution to prevent dirt and other foreign matter from entering pipe and fittings while they are being laid. Spigot ends, insides of bells, gasket grooves, gaskets, glands, bolts, and nuts shall be kept free from dirt and other foreign matter after they have been cleaned and before the joints have been made up.

4.14.3.2 Lay pipe in finished trenches and on stable foundations utilizing the bedding method specified or required to accommodate the conditions encountered.

4.14.3.3 Provide uniform full length support of pipe barrel at every point between bell holes.

4.14.3.4 Provide suitable indents in the bedding to facilitate joining and prevent bells or groove ends from bearing on trench bottoms.

4.14.3.5 Comply with the pipe manufacturer's installation requirements.

4.14.3.6 Maintain the trenches water-free and as dry as practicable during bedding, laying and joining and until the work will not be adversely affected by submergence.

4.14.3.7 Do not "buckle-in" any pipe without prior approval from the City Engineer.

4.14.4 **Joining Pipes.**

4.14.4.1 All mating surfaces of each joint and all joint material shall be clean and dry.

4.14.4.2 Make all joints in strict accordance with the pipe and gasket manufacturer's printed directions, using the recommended lubricants, tools, jointing methods and laying methods.

4.14.4.3 Taper each field cut spigot end back approximately one-eighth (⅛) of an inch and at a thirty (30°) degree angle to prevent gasket damage.

4.14.4.4 Mechanical joints shall be built in strict accordance with manufacturer's printed directions, using the recommended lubricants, tools and methods. Retainer type glands shall have the set screws tightened once the joint has been built up and properly aligned.

4.14.4.5 As soon as possible after jointing, place sufficient backfill along each side of the pipe to prevent movement of the pipe.

4.14.5 **Pipe Alignment.** Lay the pipe in straight trenches to follow the centerline of the trench as closely as possible, using appropriate fittings at all sharp breaks in grade and using appropriate fittings or deflecting joints and using shorter lengths of pipe as necessary to make the required curves. Do not deflect any joint in excess of the pipe manufacturer's recommendation.

4.14.6 **Protection of Pipe.**

4.14.6.1 Keep all dirt, trash and other foreign materials cleared from inside of pipes as it is being laid.

4.14.6.2 When pipe installation is not in progress, open pipe ends will be kept securely closed with approved caps or plugs to prevent the entrance of water, mud, other foreign material or small animals into any part of the pipe work.

4.14.6.3 Secure pipe to prevent displacement by movement of backfill, flotation or other causes.

4.14.7 **Anchorage.** Provide anchorage for each bend, tee, plug, dead-end, and other fitting subject to blowing off of the line under pressure. Dry blocking is not permitted. All anchorage shall be in place prior to applying pressure to lines.

4.14.7.1 **Concrete Blocking (Thrust-Blocks)**. Unless otherwise specified or directed by the City Engineer, anchorage shall consist of concrete blocking poured between firm undisturbed earth and the unbalanced sides of the items to be anchored.

4.14.7.1.1 Provide sufficient earth bearing surface to prevent displacement of joints under pressure.

4.14.7.1.2 Provide a flexible plastic barrier between the concrete and any bolts or set screws to facilitate access for repairs.

4.14.7.1.3 Concrete shall meet the ALL requirements of section 4.8 Concrete.

4.14.7.1.4 Concrete blocking, in addition to the required retainer glands, shall be used for all fire hydrant installations.

4.14.7.2 **Wedge Type Retainer Glands**. These shall be "Megalug ", as manufactured EBAA Iron, Inc., Eastland Texas (or as approved), consisting of a specifically designed ductile iron mechanical joint follower gland with multiple wedging action restraining mechanisms with a minimum working pressure of two-hundred fifty (250) psi. Gland

shall be suitable for use with a standard mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11. Twist off nuts shall be used to indicate proper torque of the restraining wedges. Glands shall be installed in accordance with manufacturers written instructions and directions. This type of anchorage MAY be used at any location instead of concrete anchorage (subject to approval), and SHALL be used at the following locations:

4.14.7.2.1 Retaining glands shall be used where indicated on the drawings or as directed by the City Engineer.

4.14.7.2.2 Shall be used where concrete anchorage is not practicable.

4.14.7.3 **Anchoring Tees (Fire Hydrant Connections)**. Anchoring tees shall be as specified in section 4.3. Types of pipe. Anchor fire hydrant cut off valves directly to the locked-on gland rings of the tee outlet.

4.14.7.4 **Rodding**. Rodding may be used where the use of concrete may complicate future construction, such as the end of a line with a valve installed, or where added retention is desirable such as a series of vertical bends, and then only when shown on the drawings or directed by the City Engineer.

4.14.7.4.1 Approved retaining glands shall be used when using rodding as anchorage.

4.14.7.4.2 Only stainless steel rods, nuts and washers shall be used.

4.14.7.4.3 A concrete anchor shall be used to anchor the rod.

4.14.7.4.4 When the use of concrete is not practical, the rod shall be anchored to the next available fitting which provides positive retention.

4.14.7.4.5 As-built drawings shall reflect when rodding has been used.

4.15 Bored Pipe Installation: Water mains and services shall be installed in bores when directed or when it is not practical to use open cut methods.

4.15.1 Before commencing work thereon, obtain permission from the appropriate agency for each crossing of a facility not owned by the City of Germantown.

4.15.2 Provide a casing pipe around each water main and each service pipe where a bored pipe installation is required. Depths of casings and lengths of casings shall be as indicated or as required. Install casings for mains by dry boring, and jack them in place behind the cutter bit as the boring progresses. Install casings for service pipes by dry boring or jacking. Open cut will be permitted only beyond pavement and shoulders. Install pipes in casings by methods that will positively prevent separation of pipe joints and damage to pipes.

4.15.3 Casing for mains: These shall be one-forth (¼) inch minimum wall thickness ASTM A53, Class B steel pipe.

4.15.3.1 The inside diameter shall be as required for the satisfactory installation of the carrier pipes through the casings. The inside diameter of the casing shall be at least four (4) inches larger than the outside diameter of the water pipe bells.

4.15.3.2 All casing joints shall be welded.

4.15.3.3 Install pipes in the casings by using casing spacers that will positively prevent separation of pipe joints and damage to pipes.

4.15.3.4 If the casing is to be filled with grout or flowable fill, the spacers shall be such to preclude “floating” of the pipe.

4.15.3.5 Casing spacers shall be approved by the City of Germantown prior to use.

4.15.3.6 The ends of casings shall be positively sealed against water or dirt intrusion using brick and mortar or other approved methods.

4.15.4 Casing for service pipes: These shall be Schedule 40 galvanized steel pipe with threaded and coupled joints, with an inside diameter approximately one (1) inch larger than the outside diameter of the service pipe.

4.15.5 Water main and service bores shall be made at the depth and lengths specified on the drawings or as directed by the City Engineer or as required by the owning railroad company (for railroad crossings) or the TDOT (for highway crossings).

4.15.6 When no encasement is indicated on the drawings or required by others, bore holes shall be in the smallest practical diameter. Install the pipe through the hole in such a manner as to prevent damage to the pipes and separation or excessive deflection of pipe joints.

4.16 Installation of Valves and Roadway Boxes:

4.16.1 Install valves with their operating stems plumb and in the approximate position as indicated in the drawings or as directed by the City Engineer.

4.16.1.1 Fire hydrant cut off valves shall be installed directly on the spigot outlets of the anchoring tees in the water main.

4.16.1.2 All other valves shall be installed 3’-0” from centers of tees and crosses at intersections and at locations in runs where they will be easy to locate in the future.

4.16.1.3 Where the operating nut is more than three (3) feet below finished grade, an operating nut extension of sufficient length shall be installed.

4.16.1.4 Plug the outlet of each valve installed for future use, with a standard cast iron plug, anchored to prevent failure of plug.

4.16.2 Roadway boxes shall be installed for every valve regardless of its location.

4.16.2.1 Set and support each valve box so that no stress or shock can be transmitted to the valve.

4.16.2.2 The valve box shall be set centered and plumb over the valve operating nut.

4.16.2.3 The valve box shall be set flush with finished grade. For new subdivisions, it shall be set flush with the initial asphalt surface (base asphalt) and riser rings added at the time of final asphalt paving.

4.16.2.4 A concrete pad two (2) feet by two (2) feet square and eight (8) inches thick shall be used to secure the valve box regardless of location. For asphalt areas, the concrete shall be recessed below final grade enough to allow it to be covered by the final lift of asphalt. A precast concrete ring may be used for valve boxes located in unpaved areas outside the right of way.

4.17 Fire Hydrant Installation: Unless otherwise shown on the drawings or directed otherwise by the City Engineer, fire hydrants shall be located at the intersections of private property lines, between the curb and sidewalks.

4.17.1 All hydrant leads shall be six (6) inch ductile iron pipe (D.I.P.).

4.17.2 Each hydrant shall be set on concrete brick or eighteen (18) inch square concrete slab in true plumb position with the bury line flush with the proposed grade to assure proper breakaway.

4.17.3 Each hydrant shall have a minimum of 0.25 cubic yard (± 6 cubic feet) of washed rock or 57 stone placed around the base of the hydrant to approximately twelve (12) inches above and twelve (12) inches below the drain holes to facilitate proper drainage from the hydrant when the operating valve is closed. See 'Typical Fire Hydrant Installation Detail' for further information.

4.17.4 All joints between the anchor tee and the hydrant shall be restrained. Each hydrant shall be securely blocked or anchored to prevent it from blowing off of the lead. Concrete shall NOT obstruct the hydrant drain holes.

4.17.5 Hydrant extensions shall be used to adjust the hydrant to the required height.

4.17.5.1 When authorized, where extensions are required because of abnormal or adverse job conditions beyond the contractor's control, or when indicated in the drawings, extensions shall be paid at the unit bid price.

4.17.5.2 Where extensions are required as a result of contractor error or negligence, all such hydrant extensions necessary for satisfactory installation of the hydrant shall be provided by the contractor at his own expense.

4.17.6 Above ground portions of each hydrant shall be provided one coat of the highest quality, outside silver enamel paint after setting, testing and final clean up.

4.18 Backfill and Cleanup: Trenches and other excavations shall not be backfilled until the City of Germantown has inspected and approved the pipe. Test procedures, as specified under TESTING AND STERILIZATION, shall be followed after backfilling trenches.

4.18.1 Before placing any backfill, all rubbish, forms, blocks, wires or other unsuitable materials shall be removed from the excavation.

4.18.2 As soon as the pipe has been laid and jointed, the pipe is to be bedded in the trench and made secure against movement by backfilling to the top of the pipe with approved backfill material for the area being backfilled and compacted to ninety-five (95%) percent STD proctor (ASTM).

4.18.3 All Locations (except for sand backfill): After the pipework has been approved, thoroughly hand tamp all backfill into bell holes, around and over the pipe-work until a six (6) inch cover has been tamped over the tops of the pipes.

4.18.4 Pipe under Existing Paved Areas, Including Paved Driveways (except for sand backfill): Place all backfill from six (6) inches above the pipe-work to paving subgrade in six (6) inch maximum thickness loose layers. Compact each layer to ninety-five (95%) percent STD proctor as noted above.

4.18.5 Pipe under Areas Proposed to be Paved (except for sand backfill): Place all backfill from six (6) inches above the pipe-work to paving subgrade in six (6) inch maximum thickness loose layers. Compact each layer to ninety-five (95%) percent STD proctor as noted above.

4.18.6 Pipes Under Non-Paved Areas: Fill the trenches from six (6) inches above the pipe tops up to trench tops. After settlement satisfactory to the City has occurred, complete the surface dressing, surplus material removal and surface cleanup.

4.18.7 Vehicular Traffic: For all pipes crossing streets, roads, gravel driveways and dirt driveways which are in regular use, backfill the trenches and make the crossing usable by vehicle traffic immediately after laying pipe and obtaining approval from the City of Germantown. Maintain these crossings usable by vehicular traffic until acceptance of the water piping work by the City of Germantown. Do NOT, under any circumstances, leave a street, road crossing, or a private driveway unusable overnight.

4.18.8 At the end of each day's work, Do NOT leave more than two-hundred (200) feet of trench open without compacted backfill, unless otherwise approved by the City Engineer. Puddling or water settling will NOT be permitted. See also Section 4.9.15.

4.18.9 **From a point 12 inches above the top of the pipe**, backfill shall be placed in one of the following methods depending upon the location of the pipe.

4.18.9.1 **Water lines crossing streets, roads or driveways in regular use.** Water lines laid in areas that are paved, including gravel and dirt roads and driveways in regular use, shall be backfilled with sand or gravel meeting the requirements of Section 4.7.5 Backfill Material. Water jetting is not permitted.

4.18.9.1.1 Backfill to within 13½"–19½" (depending on Street Classification: See Typical repair of Utility Cut in Pavements detail) of the finished surface in lifts not exceeding six (6) inches in depth.

4.18.9.1.2 Each lift is to be compacted to ninety-five (95%) percent Standard Proctor (ASTM).

4.18.9.1.3 Immediately place concrete or cement treated base (CTB), to within 1.5" – 3.5" of the finished surface. Approved gravel can be used and brought up to finished surface. Gravel is to be compacted to ninety-five (95%) percent STD proctor (ASTM).

4.18.9.1.4 Concrete and CTB: Road plates will be required until the concrete or CTB has cured.

4.18.9.1.5 Concrete and CTB: If paving cannot be accomplished on the same working day, place two (2) inches of cold tar asphalt on the gravel base and level with the existing paved surface.

4.18.9.1.6 Approved Gravel: If paving cannot be accomplished on the same working day, maintain the gravel flush with the surface until asphaltic concrete (hot mix) can be installed.

4.18.9.1.7 Concrete and CTB: After a minimum of seven (7) days, remove the plates or cold tar asphalt and install asphaltic concrete (hot mix) compacted to a minimum of ninety (90%) percent of maximum laboratory density until flush with existing surface. The appropriate asphaltic prime coat shall be applied to the base and joints prior to laying the asphalt.

4.18.9.1.8 For gravel roads and driveways: Install limestone gravel until flush with the existing surface.

4.18.9.1.9 Concrete driveways will be repaired or replaced in kind.

4.18.9.1.10 Maintain these crossings usable to vehicle traffic until acceptance has been granted by the City of Germantown.

4.18.9.1.11 Do not leave a street, road or private driveway unusable overnight.

4.18.9.2 **Water lines in areas to be paved.** Unless otherwise directed in the drawings or by the City Engineer, the contractor is permitted to backfill the remaining trench using one or both of the methods described below.

4.18.9.2.1 The remaining trench may be backfilled in compacted lifts not exceeding six (6) inches.

4.18.9.2.1.1 Backfill material can be any material excavated from the trench complying with the requirements listed in Section 4.18.1.

4.18.9.2.1.2 Each lift is to be compacted to ninety-five (95%) percent Standard Proctor (ASTM).

4.18.9.2.2 The base material may NOT be placed over trenches that have not properly settled, have excessive moisture or have moderate to excessive pumping.

4.18.9.3 **Water lines in other areas.** Water lines laid in other areas shall continue to be backfilled to finished grade in compacted lifts not exceeding twelve (12) inches in depth.

4.18.9.3.1 The remaining backfill material can be any material excavated from the trench complying with the requirements listed in Section 4.18.1.

4.18.9.3.2 Avoid using pressures that may damage the water lines.

4.18.9.3.3 After sufficient settlement satisfactory to the City of Germantown has occurred, complete the surface dressing, removal of surplus material and surface clean-up.

4.18.10 After the trenches have been properly backfilled, all excess material shall be removed from the streets and roadways and from improved private property so that pavements may be replaced and properties cleaned up.

4.18.10.1 In open fields and unimproved property, the excess dirt shall be spread out or used to fill low spots on property adjacent to the right of way or easement.

4.18.10.2 Such spreading or filling shall be done in such a manner that it will not obstruct surface drainage and is satisfactory to the property owner.

4.18.11 Refill and smooth off, as required, all backfill which settles so that all backfill conforms to the original ground surfaces.

4.18.11.1 The contractor shall maintain frequent inspections of the backfill throughout the time of the project and the warranty period and repair any settlement as soon as it is discovered.

4.18.11.2 Repair shall include the removal and replacement of all damaged asphalt or concrete and installation of sod or seeding and mulch.

4.18.12 Cleanup shall be performed as the work progresses.

4.18.12.1 Negligence in proper cleaning up which causes undue inconvenience to citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials will be sufficient reason for rejection of construction estimates or work shut down until the unsatisfactory conditions have been remedied.

4.18.12.2 After all work is completed, make a final cleanup of all areas where work has been done and where equipment and materials have been stored and leave them in broom clean condition.

4.19 Railroad Crossings: Before commencing work within the railroad right of way, obtain permission from the railroad company involved for each required crossing of the railroad tracks by water lines or services.

4.19.1 Do all work within the railroad right of way under the supervision of the railroad company involved and in strict accordance with their requirements.

4.19.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the tracks or any other location within the railroad traffic clearance limits.

4.19.1.2 Arrange all work to conform to the railroad operating schedules and avoid all unnecessary interference therewith.

4.19.1.3 As soon as practical, after installation of each water line across the railroad tracks, restore all railroad property at those locations to at least the conditions existing prior to beginning work.

4.19.1.4 The contractor shall be responsible for all charges from the railroad company for supervising water work on their property.

4.19.2 Where indicated on the drawings or as directed by the railroad company, provide pipe casings around each water main and each service pipe which cross railroad tracks.

4.19.2.1 Length of casings shall be as indicated on the drawings or as required by the railroad company**.**

4.19.2.2 Bore holes under the railroad tracks and install the casings through these holes.

4.19.3 When casings are not indicated on the drawings or required by the railroad company, install the water main or service under the railroad tracks by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints.

4.20 Highway Crossings: Before commencing work within the highway right of way, obtain permission from the Tennessee Department of Transportation (TDOT) for each required crossing of the highway by water mains and services.

4.20.1 All work within the highway right of way shall be conducted under the supervision of TDOT and in strict accordance with their requirements.

4.20.1.1 Do not place any excavated material, construction material, construction equipment or any other items on the highway pavement or any other location within the highway traffic limits.

4.20.1.2 Arrange all work to avoid all unnecessary interference with highway traffic.

4.20.1.3 As soon as practical, after installation of each water line across the highway, restore all highway property at those locations to at least the conditions that existed prior to beginning work.

4.20.2 Where indicated on the drawings or as directed by TDOT, provide pipe casing around water mains and services which cross the highway.

4.20.2.1 Length of casings shall be as indicated on the drawings or as required by TDOT.

4.20.2.2 Bore holes under the pavement and shoulders and install casings through theses holes. Open cut will only be permitted beyond the limits of the pavement and shoulders.

4.20.3 When casings are not indicated on the drawings or required by the TDOT, install the water main or service under the highway by boring the smallest practical diameter hole and install the pipe through the hole by methods that will positively prevent damage to pipes and prevent separation or excessive deflection of pipe joints.

4.21 Connections to Existing Water Systems: Unless otherwise indicated on the drawings or authorized by the City of Germantown, make connections to existing water systems by removing plugs from an existing plugged fitting, inserting a tee and proper sleeve in the existing water main (non-pressure connection), or utilize an approved tapping sleeve and valve to tap an existing water main (pressure connection or wet tap).

4.21.1 Contractors shall not operate any valve connected to an existing water system without the approval and the presence of a City of Germantown representative.

4.21.2 There shall be no interruption of water service to make connections to existing water systems without prior notification to those who shall be affected by the interruption. When practical, provide a minimum of twenty four (24) hours notice. After shutting off service, do all necessary work and restore water service as quickly as possible.

4.21.3 Prior to shutting down existing water mains, obtain approval from the City of Germantown Water Department and the City of Germantown Fire Department. Under certain conditions, such as an inability to match the supply to the demand, water shutoffs may need to be delayed until conditions permit the water shutoff.

4.21.4 When existing water service must be interrupted to connect to existing water systems, the work shall be planned and the material to perform the work must be available on site in order to restore water service as quickly as possible.

4.21.5 All connections to existing water systems shall be performed with a City of Germantown representative present.

4.21.6 Pressure connections may be made by installing a mechanical joint split tapping sleeve and valve or a stainless steel, full circle gasket tapping tee and valve.

4.21.7 Install all tees, sleeves, tap sleeves and tap valves in accordance with the manufacturer's printed directions, using the recommended tools and materials.

4.21.8 Any damage occurring to the existing water system mains or services resulting from connecting to the system shall be repaired by the contractor, to the specifications and satisfaction of the City of Germantown, and at no expense to the City of Germantown.

4.22 Procedures for Abandoning Existing Mains: When called for in the plans, water main will be abandoned and left in place. Depth and locations of this main and other utilities along the proposed route of the 'NEW" main shall be verified, and the 'New' main installed at locations and depths to facilitate connections of existing service lines and fire hydrants and to expedite the interconnections with other water mains as detailed or as required.

4.22.1 If possible, the existing main is to be left in place full of water.

4.22.2 All existing valves on the services, hydrants, and interconnected mains shall be left in place in the 'CLOSED' position and the operating nuts removed.

4.22.3 All existing valve-boxes: Lower the tops of the valve boxes a minimum 1'-0" below finished grade and cover with pavement or suitable fill as applicable.

4.22.4 In the event that sections of the existing main have to be removed for proper connection of the new main to existing facilities, then the existing main shall be emptied. Extreme care shall be taken in discharging the water from the existing main to prevent damage and/or to create adverse conditions on adjacent properties, to interfere with traffic movements, or to create conditions detrimental to the construction of the project. Before draining the main, the Contractor shall present his 'procedure for operation' to the City of Germantown for approval. If the existing line is drained, plug all open end and other openings on the line. UNDER NO CIRCUNSTANCES SHALL THE EXISTING WATER MAIN BE DRAINED WITHOUT THE APPROVAL OF THE CITY OF GERMANTOWN.

4.23 In-Line Valve Installation (Insertion Valves): When called for in the plans, in-line valves may be required to isolate parts of the existing system to facilitate the work in progress without disruption of customers being served by the existing system.

4.23.1 Equipment and materials shall be suitable for making connections to cast iron and/or ductile iron pipe.

4.23.2 In-Line valve installation shall be accomplished using the line stopping system of Hydra-Stop, Inc., 144 Tower Drive Suite A, Burr Ridge, IL 60527, or other approved method.

4.23.3 Each in-line valve installation will require two (2) pressure taps spaced to allow for the removal of sufficient lengths of pipe for the installation of a valve, fittings, pipe plug and blocking as detailed for each specific connection; all work of which will be performed between the pressure taps. The Contractor shall investigate each connection site and plan the work for the incline valve installation to minimize the area needed to make the respective connection.

4.23.4 If the Contractor elects to make the pressure tapping/waterstopping installations with his own forces, a technical representative from the company providing the equipment and materials for the tapping/waterstopping installation shall be present when connections are made to existing water lines. The Representative shall have thorough knowledge and be familiar with all phases of the tapping/waterstopping procedures and installation.

4.23.5 If the tapping/waterstopping is to be Subcontracted and intends to use equipment on hand, and/or rent, lease or purchase equipment, a complete list of all equipment and the method for making tapping/waterstopping installation shall be submitted to the City of Germantown for approval.

4.23.6 All work involved for in-line valve installation shall conform to other applicable parts of this section of these specifications.

4.24 Sterilization: After backfilling and prior to acceptance of the new water system by the City of Germantown and opening to existing water systems, all pipes shall be tested for bacteriological contamination.

4.24.1 After Backfilling and before hydrostatic testing the pipe lines, sterilize all new pipework with chlorine for a period of not less than twenty-four (24) hours.

4.24.1.1 Introduce sufficient chlorine into the pipe line to provide a chlorine strength of not less than 50 ppm throughout the entire piping system.

4.24.1.2 Liquid Chlorine or chlorine bearing compounds can be used.

4.24.2 After a retention period of not less than twenty-four (24) hours, thoroughly flush the chlorinated water out of the pipe lines.

4.24.3 Do NOT open the sectionalizing valves between the new water system and the existing water system until the bacterial analysis of the new water systems involved have been approved by the City of Germantown.

4.24.3.1 Valves shall only be operated with approval from the City of Germantown and with a City of Germantown representative present.

4.24.3.2 Valves may be opened only as required to admit water into the new system for testing, sterilizing and flushing.

4.25 Bacteriological Testing. After the sterilization retention period, the chlorinated water shall be thoroughly flushed out of the system from its extremities and water samples taken from approved locations for bacteriological testing. See AWWA C651-14, Section 5.1.

4.25.1 Water samples shall be analyzed for bacterial purity by an approved laboratory.

4.25.2 Contractor shall continue the process of flushing and testing until the samples indicate that the water is free of contamination and safe for domestic use.

4.26 Hydrostatic Testing. After Sterilization & Bacteriological Testing, subject all pipework to hydrostatic pressure and leakage tests. Piping may be tested in sections (isolated between valves) as the work progresses. Hydrostatic testing shall be used to test the new system for leaks and shall be performed with a City of Germantown representative present.

4.26.1 Admit water slowly into the section being tested, expelling air through approved corporation stops installed in the high points of the pipe and through other openings as required.

4.26.2 After all air has been expelled, apply a pressure of one-hundred fifty (150) PSI, and maintain it for not less than two (2) hours.

4.26.3 Leakage shall not exceed that permitted by AWWA Standard C600 for mechanical joint and push on joint pipe as given by the following formula:

$$L = \frac{ND(P).5}{7{,}400}$$

Where L is the allowable leakage in gallons per hour.
N is the number of pipe joints in the section.
D is the nominal pipe diameter in inches.
P is the average test pressure in PSI.

4.26.4 Should the measured leakage exceed the maximum specified allowable leakage, contractor shall locate and repair the leaks complying with Sections 4.24 and 4.25, then repeat the hydrostatic testing on sections of pipe involved until all tests have been passed.

4.26.5 The contractor shall provide all approved testing equipment to include:

4.26.5.1 A suitable pump to apply and maintain test pressure.

4.26.5.2 Accurate pressure gauges.

4.26.5.3 Suitable equipment to measure volume of water pumped into system to maintain the test pressure.

4.26.5.4 A copy of AWWA Standard C600, which shall be maintained on the job and in good condition for computing the permissible leakage in each section tested.

4.26.6 Water for testing, sterilization and flushing shall be furnished by the City of Germantown from existing water facilities without cost to the contractor.

4.26.6.1 The contractor shall furnish all piping and equipment to convey the water to the new water system.

4.26.6.2 The contractor shall maintain a record of what items were opened to flush the lines and how long flushing was performed.

4.26.7 If corporation stops were installed specifically to facilitate testing and sterilization, they shall remain in place with the outlets plugged. Any copper and curb stops installed on said corporations shall be removed.

4.26.8 DO NOT, UNDER ANY CIRCUMSTANCES, OPEN THE SECTIONALIZING VALVES BETWEEN THE EXISTING MAIN AND THE NEW MAINS UNTIL THE BACTERIAL ANALYSIS OF THE MAINS INVOLVED HAS BEEN APPROVED BY THE CITY OF GERMANTOWN, EXCEPT THAT UPON THEIR APPROVAL, VALVES MAY BE OPENED ONLY AS REUIRED TO ADMIT WATER INTO THE NEW MAINS FOR STERILIZING, FLUSHING AND TESTING.

4.27 Cleanup of Distribution System: Cleanup the distribution system as the work progresses. Negligence in proper cleaning up which causes undue inconvenience to the public or private citizens or presents an unsightly or dangerous condition or causes embarrassment to civic officials, will be sufficient reason for rejection of construction estimates until the unsatisfactory conditions have been remedied.

4.27.1 After all work is complete, make a final cleanup of ALL areas where work has been done and leave them in broom clean condition

4.28 Service, Valve and Hydrant Check: After completion of all work and testing and prior to acceptance, a final check of each water service, valve and hydrant installed as part of the project and each existing valve that has been operated in connection with this project shall be checked.

4.28.1 All checks shall be performed in the presence of a City of Germantown representative.

4.28.2 Each water service shall be checked for water flow in the presence of a City of Germantown representative.

4.28.3 Each valve shall be operated and demonstrated to be in the fully open or closed position, consistent with its intended purpose.

4.28.4 Each fire hydrant shall be operated to fully open and then closed in the presence of a City of Germantown representative.

4.29 Pavement Repair – City Streets and Roads: Immediately after installing each water line across a City street or road, restore that street or road (to include the right of way at that location) to at least the conditions which existed prior to the water line work and to the satisfaction of the City of Germantown. Refer to section 4.18 Backfill and Cleanup. Pavement repairs shall conform to details listed in the Engineering Departments standard drawing “TYPICAL REPAIR OF UTILITY CUTS IN PAVEMENTS”.

4.30 Measurement and Payment: Payments will be made to the nearest complete unit as listed in the proposal. Quantities submitted for payment shall be rounded to the nearest foot, yard, or other applicable unit.

4.30.1 **Pipe, Ductile Iron, in open cut.** Paid for at the unit bid price per linear foot of pipe, of the size specified, in place in open cut trenches or excavations, measured along the top centerline of the pipe between intersecting centerlines or ends of pipes and through fittings and valves.

4.30.2 **Pipe, Ductile Iron, in bore (no casing required).** Paid for at the unit bid price per linear foot of pipe, of the size specified, in place within bored, jacked or tunneled holes more than five (5) feet long, without pipe casing, measured along the top centerline of the pipe for the full length of the bored, jacked or tunneled hole. The boring, jacking or tunneling shall not be paid for separately but shall be included in the cost of the pipe. No payment shall be made for any pipe in excess of the lengths indicated on the drawings or authorized. Pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as Pipe, Ductile Iron, in open cut.

4.30.3 **Pipe, Ductile Iron, in casing.** Paid for at the unit bid price per linear foot of pipe, of the specified size, in place in pipe casing, measured along the top centerline of the pipe for the full length of the casing. The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers, casing end seals and, when specified in the drawings, grout or flowable fill shall be considered incidental to the work. No payment shall be made for any pipe in casing in excess of the lengths indicated on the drawings or authorized.

4.30.4 **Ductile Iron and Cast Iron Fittings.** When specifically listed in the proposal, paid for at the unit bid price per pound of fittings in place, as established by the invoice weight of the fittings on the basis of ANSI/AWWA C110 published body of bolts, nuts, glands, gaskets or cement linings; or at the unit bid price of each of the specified fitting of the specified size in place which shall include body, nuts, bolts, washers, glands (including retaining type), gaskets and installation. Does not include tap sleeves used for pressure connections which shall be paid for as described in Pressure Connections. When not specifically listed in the proposal, these items are not paid for separately but are considered incidental to the work and the cost shall be included in the various unit bid prices for pipe and other related items.

4.30.5 **Valves and Boxes.** Paid for at the unit bid price for each valve of the specified size and its box in place. Includes concrete pad and extensions. Does not include tapping type valves and their associated box, which shall be paid for as described in Pressure Connections.

4.30.6 **Fire Hydrants.** Paid for at the unit bid price for each hydrant in place, complete with base support, anchorage, thrust-block, drainage gravel and painting, based upon standard three (3) or four (4) foot bury hydrants.

4.30.7 **Relocated Fire Hydrants.** Paid for at unit price for each relocated hydrant in place, complete with base support, anchorage, drainage gravel and painting, based upon specified bury, without hydrant extensions.

4.30.8 **Fire Hydrant Extensions.** Paid for at the unit bid price per linear foot of hydrant extensions, in place. No payment shall be made for unauthorized hydrant extensions (see section 4.17 Fire Hydrant Installation).

4.30.9 **Fire Hydrant Leads.** Paid and measured as specified for Pipe, Ductile Iron, in open cut.

4.30.10 **Connections to Existing Plugged Valves or Lines.** Unless specified otherwise in the proposal, no separate payment. Cost shall be included in the various unit bid prices. Pipe and fittings involved in the connection shall be paid for as specified hereinbefore.

4.30.11 **Non-Pressure Connections.** Unless specified otherwise in the proposal, no separate payment. Cost shall be included in the various unit bid prices. Pipe and fittings involved in the non-pressure connection shall be paid for as specified hereinbefore.

4.30.12 **Pressure Connections.** Paid for at the unit bid price for each complete pressure connection of the size specified made to existing water mains, while the main is in service and under pressure. Includes the tap sleeve, tap valve, tap valve box with concrete pad, required hardware, in place, with the appropriate size hole cut into the existing water main. For payment purposes, the size of the tap valve shall determine the size of the pressure connections as shown on the proposal. Pressure connections for water services shall not be paid under this item but shall be included under item Single Service Unit.

4.30.13 **Single Service Unit.** Paid for at the unit bid price for each complete single service unit of the size specified in place. Includes tapping, corporation stop and fittings required to attach the corporation to the water main, curb stop, meter coupling, service pipe couplings and fittings, adapters, excavation and backfill. Includes service pipe when service pipe is not listed separately on the proposal. This item will not be paid when the service is installed to facilitate testing of the water main.

4.30.14 **Service Pipe, in open cut.** Normally included in the unit bid price for Single Service Unit. When listed separately, paid for at the unit bid price per linear foot of service pipe of the size specified in place in open trenches or open cut excavations, measured from the center of the water main to the end of the pipe, and through fittings and stops. This item will not be paid when the service is installed to facilitate testing of the water main.

4.30.15 **Service Pipe, Bored (no casing required).** Paid for at the unit bid price per linear foot of service pipe of the size specified in place within bored, jacked or tunneled holes more than five (5) feet long, without pipe casing, measured for the full length of the bored, jacked or tunneled hole. The boring, jacking or tunneling shall not be paid for separately but shall be included in the cost of the pipe. No payment shall be made for any pipe in excess of the lengths indicated on the drawings or authorized. Service pipe in bored, jacked or tunneled holes that are five (5) feet or fewer in length shall be classified and paid for as Service Pipe, in open cut.

4.30.16 **Service Pipe, in casing.** Paid for at the unit bid price per linear foot of service pipe of the size specified in place in pipe casing. The bore and casing shall not be paid for separately but shall be included in the cost of the pipe. Spacers and casing end seals shall be considered incidental to the work. No payment shall be made for any service pipe in casing in excess of the lengths indicated on the drawings or authorized.

4.30.17 **Drain rock, granular embedment material and granular backfill material.** This item is not normally paid as a separate item but is included in the various unit bid prices of the items involved. When listed separately on the bid tabulation sheet, paid for at the unit bid price per ton of loose material in place, as evidenced by delivery tickets. Delivery tickets must be delivered daily or at time of pay request.

4.30.18 **Encasement concrete.** Paid for at the unit bid price per cubic yard in place. Measurement shall be actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets are to be delivered daily or included with the pay request. The cost of forms and extra excavation below the planned grade shall be included in the unit price bid for encasement concrete.

4.30.19 **Foundation concrete.** Paid for at the unit bid price per cubic yard in place. Measurement shall be the actual amount used to the limits and dimensions specified on the drawings or as directed by the City Engineer. No payment shall be made for material in excess of the dimensions specified. Copies of the delivery tickets are to be delivered daily or included with the pay request. The cost of forms and extra excavation below the planned grade shall be included in the unit bid price.

4.30.20 **Road gravel in place.** Paid for at the unit bid price per cubic yard of compacted road gravel in place. Measurement shall be the actual surface area covered with a compacted layer to the indicated, specified or otherwise authorized thickness. Includes base courses under pavement and special surface repairs. No payment shall be made for any road gravel placed without the City of Germantown authorization or placed outside of the specified payment limits. Copies of the delivery tickets are to be delivered daily or included with the pay request.

4.30.21 **Cement Treated Base (CTB Pug-Mill Mix).** Paid for per square yard, to the thickness indicated, compacted and in place. Copies of the delivery tickets are to be delivered daily or included with the pay request.

4.30.22 **Replacement of pavement and special surfaces.** Paid for at the unit bid price per ton or square yard in place. Measurement shall be the actual areas repaired. No payment will be made outside the specified payment limits. Does not include gravel base courses which shall be paid separately as noted above.

4.30.23 **Meter Relocations.** Paid for at the unit price for each meter and box relocated, including couplings, gaskets, excavation and backfill.

4.30.24 **Extra depth excavation.** No payment shall be made for extra depth excavation that may be required to permit piping to pass under obstructions regardless to whether the obstructions are indicated on the drawings or not. When extra depth excavation is authorized and required to facilitate the removal of unsatisfactory subgrade, it shall not be paid for directly but shall be included in the cost of the material used to replace the unsatisfactory subgrade.

4.30.25 **Gaskets, bolts, nuts, mechanical joint glands, compounds, lubricants, cements, joint material, iron fittings, trenching, excavating, boring, tunneling, backfilling, jacking, removal of existing pavement, testing, removal and replacement of sod and fences, and other miscellaneous items.** No separate payment will be made unless specifically indicated. These items are incidental to the work and the cost shall be included in the various unit bid prices for pipe and other related items.

4.30.26 **In-Line Valve Installation.** Paid for at the unit price for each complete in-line valve installation made to existing mains while the main is in service under pressure. This includes the linestopping fitting, pressure tap, linestopping pressure plugging, temporary valve and all other appurtenances required to isolate a section of existing water main.

4.30.27 **Engineer directed backfill.** Paid for at the unit bid price per cubic yard of the type specified. Measurement shall be from twelve (12) inches above top of pipe to the ground line or to the depth directed and for the length directed and for the width based upon the maximum trench width for the size of pipe involved at the top of pipe or the width otherwise directed. Copies of the delivery tickets signed by the City representative are to be included with the pay request.

4.30.28 **Other Miscellaneous Items.** No separate payments unless otherwise indicated; include these in the various unit prices.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Sewer Construction

2023

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Sewer Construction:

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5.1 General Information:

5.1.1 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.

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

5.2 Materials and Equipment: 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.

5.2.1 **Material.** 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.

5.2.2 **Higher Strength Pipe.** The Contractor may substitute a higher strength pipe of the same type as that specified subject to the approval of the Engineer.

5.2.3 **Qualifications of Manufacturers.** 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 ten (10) years domestic experience producing the type of pipe supplied.

5.2.4 **Material Inspection and Testing.**

5.2.4.1 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 a reputable 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.

5.2.4.2 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.

5.2.5 **Storage.** 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.

5.2.6 **Prestressed Concrete Cylinder Pipe.**

5.2.6.1 All prestressed concrete cylinder pipe shall conform to the requirements of AWWA C301 and C304 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 C301, whichever is greater. The interior surface of the pipe will be a smooth, cylindrical surface. Cement will meet all the requirements ASTM C150, Type II. Steel cylinder shall be made of steel sheets not lighter than No. 16 gauge with 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 A570. 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 A570. Steel plate and special shapes for spigot joint rings shall conform to the requirements of ASTM A36 or the other ASTM specifications listed in AWWA C301. 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 A648. No lifting holes will be allowed. The pipe will be furnished complete with gaskets, grout bands and lubricant as required for proper installation.

5.2.6.2 The interior of all thirty-six (36) inch and larger diameter pipe will be fully lined with a PVC liner as part of the manufacturing process. The liner will be installed by the pipe manufacturer prior to pipe delivery.

5.2.6.3 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.

5.2.6.4 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 three-eighths (⅜) inch thick and exterior mortar coating shall be one (1) inch thick unless otherwise indicated. All materials and workmanship shall be as specified in AWWA C301.

5.2.6.4.1 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.

5.2.7 **Reinforced Concrete Pipe (RCP).**

5.2.7.1 All reinforced concrete pipe for gravity sewer applications will conform to the requirements of ASTM C76 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 C150, 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.

5.2.7.2 The interior of all thirty-six (36) inch and larger diameter pipe will be fully lined with a PVC liner as part of the manufacturing process. The liner will be installed by the pipe manufacturer prior to pipe delivery.

5.2.7.3 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.

5.2.7.4 Joints in reinforced concrete pipe less than thirty (30) inches in diameter will have compression gaskets or trapped O-ring gaskets. Pipes thirty (30) inches in diameter or greater will have trapped O-ring gaskets meeting the requirements of ASTM C443. 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 C443 and ASTM C361. The shape, dimensions, and tolerances of the bell and spigot or tongue and groove ends of the pipe will meet the requirements of ASTM C443. 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.

5.2.8 **Ductile Iron Pipe and Fittings.** Ductile iron pipe for gravity sewer and service connections will conform to ASTM A746. Ductile iron pipe for force main applications will conform to ANSI A21.51. The pipe thickness design will conform to ANSI A21.50. 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 A21.10. Unless otherwise specified, joints will be push-on gasket type conforming to the requirements of ANSI A21.11. Mechanical joints will conform to the requirements of ANSI A21.11. Flanged joints will conform to the requirements of ANSI A21.15. Flexible joint ductile iron pipe for river crossing applications will conform to ASTM A536 and will be Grade 70-50-05. Steel retainer rings will conform to ASTM A148 for Grade 90-60.

5.2.9 **Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (8-15 inch Diameter).**

5.2.9.1 All PVC gravity pipe and fittings eight-to-fifteen (8-15) inches in diameter shall be solid wall PVC; no profile wall PVC pipe is allowed for pipes fifteen (15) inches or less in diameter. PVC solid wall pipe and fittings for gravity sewer applications will conform to the requirements of ASTM D3034. The standard dimension ratio (SDR) will be SDR 26 (Type PSM). PVC resin will conform to ASTM D1784 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.

5.2.9.2 All PVC gravity pipe joints will be gasketed bell and spigot push-on type conforming to ASTM D3212, 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.

5.2.9.3 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 D2680.

5.2.10 **Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (18-36 inch Diameter).**

5.2.10.1 All eighteen to thirty-six (18-36) inch diameter PVC sewer pipe and fittings shall be designed and manufactured in accordance with ASTM F679, F794, F949, or F1803. 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 D1784. 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 five (5%) percent deflection shall be forty-six (46) psi when tested in accordance with ASTM D2412 and as specified in ASTM F679, F794, F949, or F1803, as applicable. Samples of the type of pipe to be used shall be tested in accordance with ASTM D2412. Impact tests shall be conducted in accordance with ASTM D2444 and shall comply with ASTM F679, F794, F949, or F1803. 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.

5.2.10.2 All joints shall be the bell and spigot type and conform to ASTM D3212. Gaskets shall meet ASTM F477. 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.

5.2.10.3 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.

5.2.10.4 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.

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

5.2.11.1 Pipe shall meet the requirements of ASTM D3262 - 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.

5.2.11.2 Minimum acceptable nominal length for joints of pipe shall be twenty (20) feet except where field conditions require otherwise.

5.2.11.3 Design: The design of the pipe shall comply with all requirements of the latest revision of ASTM D3262 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 D3262, whichever gives the greater live load.

5.2.11.4 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.

5.2.11.5 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.

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

5.2.11.7 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 (0) leakage joint. The coupling shall be factory assembled to one end of the pipe. Each joint shall be pressure tested after installation.

5.2.11.8 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 D3262, 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.

5.2.11.8.1 Pipes: These shall be manufactured and tested in accordance with ASTM D3262.

5.2.11.8.2 Joints: Coupling joints shall meet the requirements of ASTM D4161 and/or produce a zero leakage joint.

5.2.11.8.3 Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D2412 shall be forty-six (46) psi.

5.2.11.9 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.

5.2.11.10 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.

5.2.11.11 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.

5.2.12 **High Density Polyethylene (HDPE) Pipe and Fittings.**

5.2.12.1 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 PE3408 or PE3608 polyethylene pipe grade resin to a minimum cell classification of PE345434C as determined by ASTM D3350. No post consumer recycled polyethylene materials shall be allowed. The minimum material classification shall conform to ASTM D1248.

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

5.2.12.3 Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of seventy-five (75) psi and temperature of four-hundred (400°) degrees Fahrenheit. All such connections shall be performed in strict accordance with the manufacturer's instructions.

5.2.13 **Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.**

5.2.13.1 PVC pipe and couplings for force main applications will conform to the requirements of ASTM D2241 and AWWA C900 Standard for Polyvinyl Chloride (PVC) Pressure pipe four (4) inches through twelve (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.

5.2.13.2 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 C900 and/or ASTM D2241.

5.2.14 **High Density Polyethylene (HDPE) Pressure Pipe and Fittings.**

5.2.14.1 HDPE shall be manufactured from virgin, extra high molecular weight, high density PE3408 polyethylene pipe grade resin to a minimum cell class as determined by ASTM D3350. No post consumer recycled polyethylene materials allowed. The minimum material classification shall conform to ASTM D1248.

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

5.2.14.3 Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of seventy-five (75) psi and temperature of four-hundred (400°) degrees Fahrenheit. All such connections shall be performed in strict accordance with the manufacturer's instructions.

5.2.15 **Air/Vacuum Valves, Automatic Air Release Valves and Combination Valves.**

5.2.15.1 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.

5.2.15.2 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 one-hundred fifty (150) psi or as specified on the plans. Combination Valves shall be A.R.I. or approved equal.

5.2.15.3 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.

5.2.15.4 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.

5.2.16 **Check Valves, Gate Valves and Ball Valves.**

5.2.16.1 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.

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

5.2.16.3 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 C504 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.

5.2.16.4 Wedge gate valves will be resilient wedge gate valves as manufactured by Mueller Co., or approved equal. Wedge gate valves must conform to AWWA C509 or AWWA C515 and will be either series 2360 or series 2361.

5.2.16.5 All ball valves for two (2) inch and three (3) inch diameter fittings shall be full port, brass ball valves, shall be rated to one-hundred twenty-five (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.

5.2.16.6 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.

5.2.17 **Steel Casing Pipe.**

5.2.17.1 Casing pipe will conform to ASTM A139. Minimum yield strength will be thirty-five thousand (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 Ø (inches)
0.188	Less than 14” Ø
0.219	14” Ø and 16” Ø
0.250	18” Ø
0.281	20” Ø
0.312	22” Ø
0.344	24” Ø
0.375	26” Ø
0.406	28” Ø and 30” Ø
0.438	32” Ø
0.469	34” Ø and 36” Ø
0.500	38” Ø, 40” Ø, and 42” Ø

5.2.17.2 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 twelve and three-quarters (12¾) inches.

5.2.18 **Lubricants for Prefabricated Pipe Gaskets.** 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 five (5°) Fahrenheit to one-hundred twenty (120°) Fahrenheit (-15°C to 50°C). Containers will be labeled with the intended, compatible pipe material and the manufacturer's name.

5.2.19 **Primers and Adhesives.** All primers and solvents used with ABS Composite Sewer pipe will conform to ASTM D2235 and will be applied as recommended by the manufacturer. For bonding PVC to PVC, solvent cement will conform to ASTM D2564. For bonding PVC to ABS, solvent cement will conform to ASTM D3138. Adhesives used to fasten flexible rubber or rubber gaskets will conform to the requirements of the gasket manufacturer.

5.2.20 **Adapters and Couplings.**

5.2.20.1 At the direction of the Engineer, a connection of sanitary sewer pipes, six (6) inches through sixteen (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 C143, C425, C564, and D3212. 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 A167. 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.

5.2.20.2 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 5.10.3. Mechanical connectors meeting the above requirements may be used at the direction of the Engineer.

5.2.21 **Concrete.** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

5.2.21.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

5.2.21.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

5.2.21.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

5.2.21.4 Concrete used for construction and installation of Sewer Manholes and Structures shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

5.2.22 **Crushed Limestone.** 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:

No. 67 Coarse Aggregate Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)					
Sieve Size	1"	¾"	⅜"	No. 4	No. 8
Passing	100%	90-100%	20-55%	0-10%	0-5%

5.2.23 **Sand.** Sand for pipe bedding will consist of natural sand, all of which passing a three-eighths (⅜) inch sieve and not more than ten (10%) percent passing a No. 200 sieve.

5.2.24 **Mortar.**

5.2.24.1 Mortar will be composed of one part Portland cement, two parts masonry sand, hydrated lime not to exceed ten (10%) percent of the cement used, and four (4) parts water. All mortar components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and will be proportioned by measurements and not by estimating.

5.2.24.2 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 thirty (30) minutes after mixing.

5.2.25 **Bracing Lumber.** Lumber for tunnel bracing will be a minimum of three (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.

5.2.26 **Pit Run Gravel.**

5.2.26.1 Pit Run Gravel shall consist of one of the three (3) gradations shown in the table below.

Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)							
Sieve Size	2½"	1¾"	1½"	1"	⅜"	No. 40	Clay *
Passing	100%	95-100%	-	-	35-65%	10-30%	1-12%
	-	100%	95-100%	-	40-65%	10-30%	1-12%
	-	-	100%	90-100%	45-65%	10-35%	2-12%

* Clay content will be determined by the Hydrometer Test-AASHTO T88.
Clay content up to 15 percent may be used with the approval of the Engineer.

5.2.26.2 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 twenty-five (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

5.2.27 **Brick.**

5.2.27.1 All brick will conform to ASTM C55 for Grade A. Unless otherwise approved by the Engineer, bricks will conform to the following dimensions:

	Depth (in)	Width (in)	Length (in)
Standard Size	2¼"	3¾"	8"
Allowable Variation	± ¼"	± ¼"	± ½"

5.2.27.2 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.

5.2.27.3 The Contractor may be required to furnish the Engineer with at least five (5) bricks of the character and make he proposes to use, at least one (1) week before any bricks are delivered for use. All brick will be of the same quality as the accepted samples.

5.2.28 **Non-Shrinking Grout.**

5.2.28.1 Grout will be mixed in small quantities as needed and will not be retempered 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 nonshrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

5.2.28.2 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

5.2.29 **Polyvinyl Chloride (PVC) Protective Lining for Concrete Pipe & Structures.**

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

5.2.29.2 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.

5.2.29.3 Polyvinyl chloride resin shall constitute not less than ninety-nine (99%) percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

5.2.29.4 Tensile specimens shall be prepared and tested in accordance with ASTM D412 using die B. Weight change specimens shall be one (1) inch by three (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.

5.2.29.5 Liner plate locking extensions embedded in concrete shall withstand a test pull of at least one-hundred (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 seventy (70°) degrees Fahrenheit to eighty (80°) degrees Fahrenheit inclusive.

5.2.29.6 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.

5.2.29.7 The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to one-quarter (¼) inch settling cracks, which may occur in the pipe or in the joint after installation, without damage to the lining.

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

5.2.29.9 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.

5.2.29.10 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.

5.2.29.11 These channels shall be not less than ¾" wide and not more than 1¼" 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.

5.2.29.12 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.

5.2.29.13 Weld strips shall be approximately one (1) inch wide with a minimum width of seven-eighths (⅞") inch. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal one-eighth (⅛") inch.

5.2.29.14 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.

5.2.30 **New Materials and Methods.** 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.

5.3 Construction Requirements:

5.3.1 Site Preparation and Restoration.

5.3.1.1 **Right-of-Way and Easements:** Right-of-Way and/or easements as shown on the Plans and/or right-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 right-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.

5.3.1.2 **Clearing of Right-of-Way and Easements:** The Contractor will confine his clearing of right-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 three (3) inches of existing ground. This work will be done well before excavation operations but only after erosion controls have been placed.

5.3.1.3 **Location of Existing Obstructions:** 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.

5.3.1.4 **Removal of Obstructions:** 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.

5.3.1.5 **Protection of Obstructions Outside Easement Limits:** 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 right-of-way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

5.3.1.6 **Special Protection of Obstructions inside Easement Limits:** 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.

5.3.1.7 **Disposal of Debris:** 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. 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.

5.3.1.8 **Replacement of Fences:** 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.

5.3.1.9 **Restoration of Turfed Areas:** 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 re-graded 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 Standard Specifications.

5.3.2 **Excavation.** 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.

5.3.2.1 Trench Excavation.

5.3.2.1.1 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.

5.3.2.1.2 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.

5.3.2.1.3 No more than two-hundred (200) feet of trench will be opened ahead of the completed sanitary sewer, nor will more than one-hundred (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.

5.3.2.1.4 The width of trenches below a level one (1) foot above the outside top of pipe will be at least six (6) inches but not more

than twelve (12) inches on each side of the outside of the pipe for all sizes up to and including sixteen (16) inches in diameter. A maximum trench width dimension for these pipe sizes will be thirty-six (36) inches. For eighteen (18) inch diameter pipes, the width of trenches below a level one (1) foot above the outside top of pipes will be at least six (6) inches on each side of the pipe, with a maximum trench width of forty-two (42) inches. For pipe sizes more than eighteen (18) inches, the width of trenches below a level one (1) foot above the outside top of the pipe will be at least twelve (12) inches but no more than fifteen (15) inches on each side of the outside of the pipe. If the trench width at or below one (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.

5.3.2.1.5 The sides of the trench will be as nearly vertical as possible. The bottom of the trench will be carefully graded, formed, and to the satisfaction of the Engineer before sanitary sewers are laid.

5.3.2.2 Other Excavation.

5.3.2.2.1 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.

5.3.2.2.2 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 six (6) inch maximum lifts and compacted to ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D698) or a minimum relative density of zero-point seventy-five (0.75).

5.3.2.2.3 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 5.3.2.2.2.

5.3.3 **Change in Location and Grade.**

5.3.3.1 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 ten (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 ten (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 one (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.

5.3.3.2 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.

5.3.3.3 Filling a portion of existing excavation to meet changed grades will be accomplished according to the appropriate section of STD Specifications.

5.3.3.4 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.

5.3.4 **Disposition of Excavated Material.**

5.3.4.1 Excavated material suitable for backfill will be stored no closer than two (1) 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 the City’s Storm Water Ordinances.

5.3.4.2 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.

5.3.5 **Control of Water.**

5.3.5.1 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.

5.3.5.2 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.

5.3.5.3 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.

5.3.6 **Excavation around Obstructions.**

5.3.6.1 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.

5.3.6.2 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.

5.3.7 **Excavation for Manholes and Special Structures.**

5.3.7.1 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.

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

5.3.7.3 Where structures are to be built in street rights-of-way or paved areas, the excavation will not exceed two (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 5.2.26.

5.3.8 **Special Protection.**

5.3.8.1 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.

5.3.8.2 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 this sheeting and shoring without the Engineer's instructions.

5.3.8.3 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 five (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 5.3.2.1. 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.

5.3.8.4 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 two (2) feet below the surface and will remove the cut off material from the excavation.

5.3.8.5 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.

5.3.8.6 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.

5.3.8.7 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 D2321, and no concrete cradle will be used.

5.3.8.8 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.

5.3.8.9 Sanitary sewer construction will be carefully protected from all blasts. Excavations requiring blasting will be completed thirty (30) feet (min.) ahead of the laying of the pipe. The mouth of the pipe will always be protected to the pipe to prevent earth or other substances from entering.

5.3.8.10 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.

5.3.8.11 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 responsibility for protection of the structure and its contents.

5.3.9 **Existing Utilities.**

5.3.9.1 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 the utilities.

5.3.9.2 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.

5.3.9.3 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.

5.3.9.4 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.

5.3.9.5 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.

5.3.9.6 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.

5.3.9.7 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.

5.3.9.8 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.

5.4 Sewer Pipe Installation:

5.4.1 **General.** 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.

5.4.2 **Modifications of Existing Sanitary Sewer Facilities.**

5.4.2.1 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.

5.4.2.2 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 eighteen (18) inches, or one-half (½) 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.

5.4.2.3 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.

5.4.2.4 Connection to Existing Manholes: The Contractor will cut 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.

5.4.2.5 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 insure that the earth sub-base and bedding next to the manhole will provide firm solid support to the pipe.

5.4.2.6 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.

5.5 Pipe Bedding:

5.5.1 **General.** 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, B.2, or C bedding, 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.

5.5.2 **Class A - Concrete Cradle.** 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.

5.5.3 **Class B.1 - Crushed Limestone.** Class B.1 bedding will be number 67 crushed limestone. Pipe four (4) inches to twenty-four (24) inches in diameter will be bedded on 4 inches of bedding material. Pipe twenty-seven (27) inches to forty-eight (48) inches in diameter will be bedded on six (6) inches of bedding material. Bedding for pipes larger than forty-eight (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 six (6) inches in loose thickness around the pipe to the spring line. The remainder of the installation will be as outlined in Specification Section 5.12. Unless otherwise instructed, concrete and ductile iron pipe will be bedded in Class B.1 bedding.

5.5.4 **Class B.2 - Crushed Limestone.** Class B.2 bedding will be number 67 crushed limestone. Pipe four (4) inches to twenty-four (24) inches in diameter will be bedded on four (4) inches of number 67 crushed limestone Pipe twenty-seven (27) inches to forty-eight (48) inches in diameter will be bedded on six (6) inches of bedding material. Bedding for pipes larger than forty-eight (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 six (6) inches in loose thickness around and above the pipe to a level six (6) inches above the outside top of the pipe. The remainder of the installation will be as outlined in Specification Section 5.12. Class B.2 bedding will be used for all flexible pipe including fiberglass reinforced polymer mortar pipe, PVC and HDPE.

5.5.5 **Class C - Sand.** Class C bedding will only be used when specified by the Engineer or construction plans. The remaining depth of the trench will then be backfilled and compacted as specified in Specification Section 5.12.

5.6 Pipe Laying:

5.6.1 **Inspection Before Laying.** 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.

5.6.2 **Preparations of Pipe Ends.** 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.

5.6.3 **Care During Hoisting, Placing, and Shoving Home.** 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.

5.6.4 **Direction of Work.** 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.

5.6.5 **Uniform Pipe Bearing.** 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.

5.6.6 **Alignment and Grade.** 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.

5.6.7 **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.

5.6.8 **Flotation and Water in the Trench.** 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.

5.6.9 **Open Ends.** Whenever pipe laying is stopped for any significant amount of time, such as 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.

5.6.10 **Concrete Cradle Section next to Manhole.** 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.

5.6.11 **Cutting Pipe.** 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 as required.

5.6.12 **Wyes and Special Fittings.** 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.

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

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

5.6.13.2 Air release, vacuum relief and combination air valves larger than three (3) inches in diameter will be installed on either flanged or mechanical joint ductile iron pipe. A gate valve conforming to section 5.2.16 shall be installed to isolate these air valves from the force main.

5.6.13.3 Air release, vacuum relief and combination air valves three (3) inches in diameter and smaller will be installed on a ductile iron tap 'T' fitting. A ball valve conforming to section 5.2.16 shall be installed on a six (6) inch threaded nipple between the 'T' and the air valve.

5.7 Pipe Joints:

5.7.1 **General.** 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. The following provisions will apply to insure tight and sound joints:

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

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

5.7.1.3 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.

5.7.1.4 Cement and lubricant will be used as recommended by the manufacturer and designated by the Engineer.

5.7.2 **Compression Joints.**

5.7.2.1 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.

5.7.2.2 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.

5.7.3 **Mechanical Joints.**

5.7.3.1 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 C600.

5.7.3.2 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. Torque all bolts 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.

5.7.3.3 Any joints not properly positioned will be disassembled, cleaned, and reassembled as previously indicated.

5.7.4 **Flanged Joints.** 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. Torque bolts evenly by alternating tightening of bolts opposite one another until all bolts are tightened to the recommended torque.

5.7.5 **Solvent Cement Joints.** 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.

5.7.6 **Restrained Joints.** 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.

5.8 Pipe Caps and Plugs: Wyes, stubs, or other fittings installed in the pipe for future connections will be closed at the open end. For pipes twenty-one (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 twenty-one (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.

5.9 Service Connections:

5.9.1 All service connections for pipe diameters up to and including twelve (12) inches will be six (6) inch diameter in-line wye connections unless indicated otherwise on the Plans. Service connections on pipes larger than twelve (12) inches in diameter will not be allowed. Saddles will not be used on new construction. 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. Building connections will be laid on no less than a one (1%) percent grade for six (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 two (2) feet above the manhole invert, the service will be constructed as a drop construction.

5.9.2 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.

5.10 Pipe Encasement, Collars and Thrust Blocks (Kickers):

5.10.1 **General.** 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 A as outlined in Section 5.2.21, 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 one-half 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 six (6) inches regardless of pipe size.

5.10.2 **Pipe Encasement.** 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 A as outlined in Section 5.2.21, 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 one-half 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 six (6) inches regardless of pipe size.

5.10.3 **Pipe Collars.** Concrete pipe collars are to be used to join pipe ends that cannot be joined with prefabricated joints. Concrete will be Class A as outlined in Section 5.2.21, 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 can be used for pipe connectors sixteen (16) inches and smaller.

5.10.4 **Thrust Blocks (Kickers).** 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 A as outlined in Section 5.2.21, and will be reinforced when shown on the Plans. 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. 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. 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 twelve (12) inches and larger. Thrust blocks will be included in the linear foot price for the force main.

5.11 Inverted Siphons:

5.11.1 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.

5.11.2 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.

5.11.3 Unless otherwise specified, inverted siphon pipe will be lined ductile iron Class 50 pipe and fittings as specified in Specification Section 5.2.8 fabricated for push-on type joints or HDPE conforming to Specification Section 5.2.12. The siphon pipes will be encased in concrete at the locations and to the dimensions shown on the Plans or Design Standards. The excavation, bedding, laying, jointing, pipe encasement, and backfill operations will conform to the applicable sections of this Specification.

5.11.4 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.

5.11.5 The inlet, outlet, and any intermediate manholes will be constructed according to the requirements of the City of Germantown Standard Specifications.

5.11.6 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.

5.12 Backfilling:

5.12.1 **General.**

5.12.1.1 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 (or other organics) to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.

5.12.1.2 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 twelve (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.

5.12.1.3 Property with an existing dwelling located on it or lots within a developed subdivision or planned development are considered improved property.

5.12.2 **Street Right-of-Way and Improved Property.**

5.12.2.1 **Backfill Material.** 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.

5.12.2.2 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 one (1) inch of the surface in areas to be sodded, or to the surface in all other areas.

5.12.2.3 Select material will be free from debris, organic matter, perishable compressible material, and will contain no stones or lumps larger than six (6) inches. Rocks and lumps smaller than six (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 three (3) feet of backfill in sodded or planted areas will be free of rocks or lumps larger than one (1) inch in diameter.

5.12.2.4 **Placement and Compaction.**

5.12.2.4.1 Sanitary Sewer Trenches: Backfill material will be placed by hand in six (6) inch loose layers and tamped to a point two (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 thirty-six (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 forty-eight (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 nine (9) inch, maximum, loose layers. All backfill material will be compacted to ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D698).

5.12.2.4.2 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 six (6) inch loose layers and compacted with heavy tampers or pneumatic tampers to ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D698). 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.

5.12.3 **Open Areas and Un-Improved Property.**

5.12.3.1 **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 or lumps or rock fragments larger than six (6) inches. Rocks or lumps smaller than six (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, well distributed, and all voids will be completely filled with fine material.

5.12.3.2 **Placement of Backfill.** Backfill procedures specified in Specification Section 5.12.2.4 will apply from the trench bottom to a point two (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.

5.12.4 **Sanitary Sewer Facilities Placed on Fill.**

5.12.4.1 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.

5.12.4.2 The fill material will be placed in six (6) inch loose layers and compacted to ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D698) up to a point at least two (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 ten (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 five (5) feet outside the structure base slab.

5.12.5 **Removal of Excess Material.**

5.12.5.1 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 areas with turf may be replaced and properties cleaned.

5.12.5.2 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.

5.13 Tunneling, Boring and Jacking:

5.13.1 **General.**

5.13.1.1 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.

5.13.1.2 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 bentonite slurry may be allowed at the discretion of the Engineer and the owner of the right-of-way.

5.13.1.3 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.

5.13.1.4 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 two (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.

5.13.1.5 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.

5.13.2 **Tunneling.**

5.13.2.1 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.

5.13.2.2 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.

5.13.2.3 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.

5.13.2.4 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.

5.13.2.5 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.

5.13.2.6 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.

5.13.2.7 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.

5.13.2.8 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.

5.13.2.9 A ladder meeting OSHA requirements will be provided in each shaft and will be kept in safe, good repair, clean and clear of debris.

5.13.2.10 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 one (1) part Portland cement and seven (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.

5.13.2.11 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.

5.13.2.12 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 one (1) part cement to seven (7) parts sand by volume and a minimum amount of water necessary for proper placement whether placed under pressure or by hand.

5.13.2.13 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.

5.13.3 **Boring.**

5.13.3.1 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.

5.13.3.2 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.

5.13.3.3 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.

5.13.3.4 The following procedures will be used for carrier pipe eighteen (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 six (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.

5.13.3.5 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.

5.13.3.6 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.

5.13.4 **Jacking.**

5.13.4.1 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.

5.13.4.2 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.

5.13.4.3 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.

5.13.4.4 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.

5.13.4.5 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 two (2) inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero (0) at the point where the excavation conforms to the contour of the pipe.

5.13.4.6 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 two (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.

5.13.4.7 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.

5.13.4.8 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.

5.13.4.9 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 5.12.

5.13.5 **Sewer Pipe in Jacketed Liner.** 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 lines 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.

5.14 Final Grading: 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.

5.15 Cleaning: 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.

5.16 Final Testing and Acceptance:

5.16.1 **Visual Inspection.** 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.

5.16.2 **Leakage Tests.** 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.

5.16.2.1 Exfiltration Leakage Test. This section will only apply to pipe larger than twenty-four (24) inches and smaller than forty-eight (48) inches in diameter. All pipe over forty-eight (48) inches in diameter will have individual joint testing according to Specification Section 5.16.2.4. 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 four-foot head will be standing at the end of the test. The maximum hydrostatic head is limited to fifteen (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.

5.16.2.1.1 In areas where groundwater is known to exist, a one-half inch diameter capped pipe nipple approximately ten (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 two-point-three (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 zero (0) gallons per inch of internal diameter per mile of pipe per day for each reach tested.

5.16.2.1.2 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 two (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 one-hundred (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.

5.16.2.1.3 If anytime the exfiltration observed and measured by the Engineer exceeds zero (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.

5.16.2.1.4 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.

5.16.2.2 Air Leakage Test for 6-24 inch diameter pipe: Upon completion of construction, 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, will be for all types of gravity sewer pipe and will also include service lines from manholes.

5.16.2.2.1 The pressure test gauge will meet the following minimum specifications:

Size (diameter)	4½ inches Ø
Pressure Range	0-15 PSI
Figure Intervals	1.0 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 & mirror edges
Pipe Connection	Low male ½ inch NPT

5.16.2.2.2 Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer.

5.16.2.2.3 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 psi Pressure Drop for Size & Length of Pipe Indicated [1]

Pipe Diameter (inches)	Minimum Test Time per 100ft of pipe	Test Time Formula for Length of Sewer Tested "SC's" = Service Connections "L" = Length of pipe (Lineal Feet)
6" Ø pipe	0.7 minutes (42 seconds)	(0.7 x L /100) + (0.18 x No. of SC's) = Test Time
8" Ø pipe	1.2 minutes (1 minute, 12 seconds)	(1.2 x L /100) + (0.18 x No. of SC's) = Test Time
10" Ø pipe	1.5 minutes (1 minute, 30 seconds)	(1.5 x L /100) + (0.18 x No. of SC's) = Test Time
12" Ø pipe	1.8 minutes (1 minute, 48 seconds)	(1.8 x L /100) + (0.18 x No. of SC's) = Test Time
15" Ø pipe	2.1 minutes (2 minutes, 6 seconds)	(2.1 x L /100) + (0.18 x No. of SC's) = Test Time
18" Ø pipe	2.4 minutes (2 minutes, 24 seconds)	(2.4 x L /100) + (0.18 x No. of SC's) = Test Time
21" Ø pipe	3.0 minutes (3 minutes, 0 seconds)	(3.0 x L /100) + (0.18 x No. of SC's) = Test Time
24" Ø pipe	3.6 minutes (3 minutes, 36 seconds)	(3.6 x L /100) + (0.18 x No. of SC's) = Test Time

1. Establish the required test time for the sewer length using the Test Time formula above.

5.16.2.3 Infiltration Test: 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. Maximum allowable infiltration will be zero (0) gallons per mile per inch of diameter of sewer per twenty-four (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.

5.16.2.4 Joint Acceptance Testing: Individual joints will be tested for pipe diameters of forty-eight (48) inches and greater. Testing will be performed according to ASTM C1103.

5.16.3 **Deflection Test – Simi rigid and Flexible Pipe.**

5.16.3.1 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 thirty (30) days. All lines will be thoroughly cleaned before testing to assure accuracy.

5.16.3.2 Tests will be run using a rigid ball or nine arm mandrel having a diameter of ninety-five (95%) percent of the inside diameter of the pipe for PVC and ninety-six (96%) percent 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 five (5%) percent for PVC and four (4%) percent 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.

5.16.4 **Sewer Force Mains.**

5.16.4.1 The Contractor will perform hydrostatic pressure and leakage tests concurrently conforming to AWWA C600, AWWA C605, or ASTM D2774 procedures as applicable and as modified herein. Tests will apply to all sewage force mains after backfilling.

5.16.4.2 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.

5.16.4.3 Hydrostatic Pressure Test: Conduct tests at 1.5 times maximum operating pressure determined by following formula:

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

5.16.4.4 Hydrostatic Leakage Test: Conduct tests conforming to AWWA C600, AWWA C605, or ASTM D2774 procedures, as applicable, at maximum operating pressure determined by following formula:

P_{Lt} = 0.0.433 (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

5.16.4.5 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

5.16.5 **Final Acceptance.** 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 two (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.

5.17 Measurement:

5.17.1 **Site Preparation and Restoration**

5.17.1.1 The area to be considered for measurement will be the limit of the construction area in acres unless otherwise directed by the Engineer.

5.17.1.2 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.

5.17.2 **Undercut Backfill.** Undercut backfill will be measured by the ton of limestone in place.

5.17.3 **Sheeting and Shoring Directed to Remain in Place.** Sheeting and shoring directed to remain in place will be measured by the one-thousand (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.

5.17.4 **Pavement Backfill.** 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.

5.17.5 **Service Connection Removal and Replacement.** 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.

5.17.6 **Excavation.** 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.

5.17.7 **Sewer Pipe.** 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. Sewer pipe length measurement will include the length of wyes as measured along the primary axis for all sizes of sewer pipe.

5.17.8 **Pipe Wyes.** Pipe wyes on sewer lines will not be measured for payment, but are incidental to the cost of furnishing and installing sewer pipe.

5.17.9 **Sewage Force Main.** 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.

5.17.10 **Ductile Iron Pipe Fittings.** 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.

5.17.11 **Service Connections.**

5.17.11.1 Building 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.

5.17.11.2 Building 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 building connection depth will be made. Building connection length will include the length of fitting, reducers, and specials as measured along their centerline.

5.17.12 **Non-Shrinking Grout.** 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.

5.17.13 **Normal Weight (Plain) Concrete for General Use.** 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.

5.17.14 **Reinforced Concrete.** 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.

5.17.15 **Inverted Siphon.** Inverted siphons according to Plans and Specifications will be measured per lump sum, for each siphon complete in place.

5.17.16 **Sewer in Earth Tunnel.** Sewers constructed in earth tunnels will be measured by the centerline length for tunnels with liner plate or without liner plate. Measurements will be from the face of the pit to the face of the pit.

5.17.17 **Sewer in Bored Hole.** Sewers constructed in a bored hole will be measured by the centerline length for bored holes with or without liner pipe. If the 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.

5.17.18 **Jacked Sewer.** 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.

5.17.19 **Sewer in Jacked Liner.** 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.

5.17.20 **Abandonment of Existing Pipe.** Abandonment of existing pipe will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

5.17.21 **Removal of Existing Pipe.** 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.

5.18 Payment:

5.18.1 **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, areas with turf, and all other items will be as specified in the Plans and Contract Documents or as directed by the Engineer.

5.18.2 **Undercut Backfill.** 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.

5.18.3 **Sheeting and Shoring Directed to Remain in Place.** Accepted quantities of sheeting and shoring directed by the Engineer to remain in place will be paid for at the contract unit price per one-thousand (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.

5.18.4 **Pavement Backfill.** 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.

5.18.5 **Building (House) Connection Removal and Replacement.** Accepted quantities of building connections removed and replaced will be paid for at the contract unit price per each for various types of building 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. All pipeline material will be generically the same throughout the project except solid wall PVC pipe service connected to truss pipe mainlines.

5.18.6 **Sewer Pipe.** 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.

5.18.7 **Sewage Force Main.** 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.

5.18.8 **Service Connections.** The accepted quantities of building 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.

5.18.9 **Non-Shrinking Grout.** 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.

5.18.10 **Normal Weight (Plain) Concrete for General Use.** 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.

5.18.11 **Reinforced Concrete.** 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.

5.18.12 **Inverted Siphon.** 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.

5.18.13 **Sewer in Earth Tunnel.** 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.

5.18.14 **Sewer in Bored Hole.** 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.

5.18.15 **Jacked Sewer.** 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.

5.18.16 **Sewer in Jacked Liner.** 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.

5.18.17 **Removal of Existing Pipe.** 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.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Sewer Manholes and Special Structures

2023

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Sewer Manholes and Special Structures:

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6.1 Scope: 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.

6.2 Materials and Equipment:

6.2.1 **Construction Material.** 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.

6.2.2 **Qualifications of Manufacturers.** 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.

6.2.3 **Material and Testing.** 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 upon request three (3) copies of certified reports from a reputable 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. The Contractor will notify the Engineering Department before any deliveries of material and will make whatever provisions are necessary to aid the Engineer Department in the inspection and culling of the material before installation.

6.2.4 **Storage.** The contractor will provide storage facilities and exercise measures that will maintain the specified quality/fitness of materials to be incorporated in the work.

6.2.5 **Concrete.** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

6.2.5.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

6.2.5.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

6.2.5.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

6.2.5.4 Concrete used for construction and installation of Sewer Manholes and Structures shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

6.2.6 **Steel Reinforcement.** Deformed steel reinforcing bars and welded wire fabric will be as shown on the Plans or as directed by the Engineer. All steel reinforcement shall conform to the requirements of ASTM A615, Grade 60.

6.2.7 **Mortar.** Mortar will be as designated in Standard Specification Section 5.2.24.

6.2.8 **Brick.** All brick will be as designated in Standard Specification Section 5.2.27. No new brick manholes are to be allowed in the City of Germantown system. This specification is included for repair of existing brick manholes and incidental use of brick for leveling courses in new construction.

6.2.9 **Gray Iron Castings.** Unless otherwise noted, Castings will be as detailed on the Plans. They 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. Castings will meet the requirements of ASTM A48, Class #35, or Grade 65-45-12 ductile iron meeting the requirements of ASTM A536. 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.

6.2.10 **Manhole Steps.** To be plastic coated steel meeting the requirements in ASTM D4101, Type II, Grade 49108 (or approved equal).

6.2.11 **Precast Concrete Manhole Sections, Bases and Other Structures.**

6.2.11.1 All precast reinforced concrete manhole risers, cones, grade rings, and flat slab tops will conform to the requirements of ASTM C478 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. The bottom of all precast base sections and cast-in-place bases four (4) feet in diameter will extend a minimum of six (6) inches beyond the outside wall of the manhole riser. The bottom of all precast base sections and cast-in-place bases five (5) feet in diameter will extend a minimum of seven (7) inches beyond the outside wall of the manhole riser. The bottom of all precast base sections and cast-in-place bases six (6) feet and larger in diameter will extend a minimum of eight (8) inches beyond the outside wall of the manhole riser.

6.2.11.2 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 eight (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 twelve (12) inches thick. All precast manhole base sections shall be reinforced with Number four (4) steel reinforcing bars placed six (6) inches on center each way and at mid depth of the slab, unless shown otherwise on the plans. Steel reinforcement shall conform to the requirements of ASTM A615, Grade 60.

6.2.11.3 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.

6.2.11.4 Gaskets between manhole sections will be a flexible material meeting the requirements of Federal Specification SS-S-00219 for Type I gaskets and AASHTO M198 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 6.4.2.

6.2.11.5 All pump station wet wells and siphon structures shall be lined or coated with a material conforming to either Section 5.2.29 or Section 6.2.17.

6.2.11.6 All manholes and structures on pipe thirty-six (36) inches in diameter and larger shall be lined or coated with a material conforming to either Section 5.2.29 or Section 6.2.17.

6.2.12 **Sand.** Sand for structure abandonment will consist of sand or a natural sandy soil, all of which passes a three-eighths (⅜) inch sieve and not more than ten (10%) percent passes a No. 200 sieve.

6.2.13 **Pit Run Gravel.** Pit run gravel will be as designated in Specification Section 5.2.26.

6.2.14 **Non-Shrinking Grout.** Non-shrinking grout will be as designated in Specification Section 5.2.28.

6.2.15 **Waterproofing.** Waterproofing for manhole exteriors will consist of two coats of asphalt or coal tar pitch. Asphalt will conform to the requirements of ASTM D449. Coal tar pitch will conform to the requirements of ASTM D450.

6.2.16 **Flexible Pipe Connectors to Manholes.** 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 twenty (20°) degrees. 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 (or approved equal). The connector will meet the requirements set forth in the latest revision of ASTM C923. A corrosion resistant, stainless steel external band will be used around the flexible connector to create the external seal around the pipe. Any void between the pipe and connector will be filled with an approved flexible gasket material. Flexible connectors will be considered an integral part of the manhole sidewall, and no separate payment will be allowed.

6.2.17 **Protective Linings and Coatings.** All polyvinylchloride (PVC) protective lining for concrete structures shall conform to Section 5.2.29. Protective coating for concrete structures will be a calcium aluminate mortar mix such as SewperCoat as manufactured by Lafarge Aluminates, Aluminaliner as manufactured by Quadex Rehabilitation Products, or as approved.

6.2.18 **Grade Adapter Rings.** Grade adapter rings shall be compatible with City of Germantown standard rings and covers. Grade adapter rings shall be gray iron castings conforming to Section 6.2.9 in these specifications.

6.2.19 **Equipment.** 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.

6.3 Construction Requirements:

6.3.1 **Site Preparation and Restoration.** Site preparation and restoration for sewer manhole and structure construction will be performed per Specification Section 5.3.1.

6.3.2 **Earthwork.** Earthwork for sewer manholes and structures will be performed per Specification Section 5.3.2.

6.3.3 **Removal or Abandonment of Existing Manholes and Structures.**

6.3.3.1 Removal:

6.3.3.1.1 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.

6.3.3.1.2 Excavation will be backfilled per Specification Section 5.12.

6.3.3.2 Abandonment:

6.3.3.2.1 Existing manholes and structures to be abandoned in place will be shown on the Plans or as identified by the Engineer.

6.3.3.2.2 After removing manhole and structure rims, covers, and similar items, all pipes will be bulkheaded. The walls will be lowered to two (2) feet below final grade if in earth or to twelve (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.

6.3.3.2.3 Sand will be placed in approximately twelve (12) inch layers and each layer compacted to seventy-five (75) percent relative density or ninety-five (95%) percent of maximum density (standard proctor) as applicable. A twelve (12) inch thick plain concrete slab will be installed over the manhole top extending twelve (12) inches beyond the outside face of the manhole.

6.3.3.2.4 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.

6.3.3.2.5 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.

6.3.4 **General Construction Requirements.**

6.3.4.1 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. 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.

6.3.4.2 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, Design Standards, 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 counter-flow is prevented. Water stops will be installed around pipes as they pass through the sanitary manhole wall.

6.3.4.3 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. Concrete shall conform to Specification Section 3.1.2.

6.3.4.4 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 one (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. The unit will not be disturbed until the mortar or concrete has hardened.

6.3.5 **Repairing of Brick Manholes and Structures:** The Contractor will repair brick manholes or structures as shown on the Plans or directed by the Engineer.

6.3.6 **Precast Concrete Construction:**

6.3.6.1 Precast concrete manholes will be neatly and accurately built according to the Plans or as directed by the Engineer. Precast manholes may be placed on a six (6) inch concrete slab constructed of Class A concrete or an eight (8) inch thick crushed stone foundation, but not required.

6.3.6.2 Precast concrete manhole base sections using crushed stone foundations shall be No. 67 crushed limestone base conforming to Section 5.2.22.

6.3.6.3 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.

6.3.6.4 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.

6.3.6.5 All precast concrete manhole cones will be of eccentric construction as shown on the Plans or Details.

6.3.6.6 All flat top manhole slabs will be steel reinforced with a minimum thickness of six (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 6.3.9.

6.3.7 **Cast-in-Place Construction:**

6.3.7.1 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. Unless otherwise specified, Concrete shall conform to Specification Section 3.1.2.

6.3.7.2 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 six (6) inches thick.

6.3.7.3 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.

6.3.7.4 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.

6.3.7.5 The inside and outside surfaces of the manhole or structure walls will receive a Class 1, Surface Finish as defined by Specification Section 3.4.21.2.1. Waterproofing will be applied per Specification Section 6.3.9.

6.3.8 **Manhole Drop Construction:**

6.3.8.1 **Drop Construction for New Manholes.** 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 Design Standards for inside 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 6.2.16. 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. Solvent cement joints may be used on PVC for drop construction. Encasement of the outside drop pipe will be constructed of Class A concrete conforming to Specification Section 3.1.2.

6.3.8.2 **Drop Construction for Existing Manholes.** 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 Design Standards for inside drop construction. The Contractor will cut a hole in the manhole wall to permit inserting the inlet pipe at the required flow line elevation, horizontal angle, and slope, and to allow two (2) inches space around the pipe for bedding and filling solidly with nonshrinking grout. Care will be used to avoid unnecessary damage to the existing masonry or concrete. 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 steel support straps will be fastened to the manhole wall with two bolts per strap set in expansion sleeves in drilled holes.

6.3.9 **Waterproofing:** 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 twelve (12) mils. Each coat will be applied at a rate not to exceed one gallon per one-hundred (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. 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 (2) coats of waterproofing reapplied as previously specified.

6.3.10 **Dewatering:** 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 Section 6.5 and 6.6.

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 6.5 and 6.6.

6.3.12 **Adjustment of Manhole Rims and Covers (see also Section 22.3):**

6.3.12.1 **Manhole Adjustment (Standard Method).** 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. If the cover requires adjustment, 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 eighteen (18) inches. If the adjustment would require a collar of greater than eighteen (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. Any changes in grade of precast or poured-in-place manholes shall be as shown on the plans or as directed by the Engineer.

6.3.12.2 **Manhole Ring Adjustment (with Grade Adapter Rings).** For manhole covers to be raised less than or equal to five (5) inches and where the total collar height would not exceed eighteen (18) inches, manhole adapter rings may be used if approved by the Engineer. Adapter rings may be up to a maximum of five (5) inches utilizing no more than one ring. Adapter rings shall be tack welded to the existing rim at a minimum of four (4) locations.

6.3.12.3 **Manhole Ring Adjustment (Alternative Method).** For manhole covers requiring adjustment where Cement Stabilized Aggregate Base (Specification Section 10) or Cement Stabilized Soil Cement Base (Specification Section 11) 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 twenty-four (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 Cement Stabilized Aggregate Base or Cement Stabilized Soil Cement Base a minimum three (3) feet square directly over each manhole. The manhole rims and covers shall then be replaced with Class A concrete conforming to Specification Section 3.1.2 to the subgrade. If, in the process of adjusting the manhole rims, the Contractor removed a larger section than specified, the Contractor shall replace the entire area so removed with Class A concrete at his own expense.

6.3.13 **Pumping Stations:** 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."

6.4 Acceptance Testing for Sewer Manholes and Structures:

6.4.1 **Visual Inspection.** 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.

6.4.2 **Manhole Leakage Test (Vacuum Test).** All manholes and special structures will be subjected to a Negative Pressure (vacuum) test as outlined in ASTM C1244 or as specified. The manhole, including the frame, will be placed under a vacuum of ten (10) inches Hg (4.9 psig). The manhole will be considered acceptable if the time measured for the vacuum to drop to nine (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. 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.

Minimum Test Times for Various Manhole Diameters and Depths

Depth (ft.)	4'Ø (48")	5'Ø (60")	6'Ø (72")	7'Ø (84")	8'Ø (96")
8'	20 sec.	26 sec.	33 sec.	42 sec.	55 sec.
10'	25 sec.	33 sec.	41 sec.	51 sec.	64 sec.
12'	30 sec.	39 sec.	49 sec.	66 sec.	86 sec.
14'	35 sec.	46 sec.	57 sec.	74 sec.	96 sec.
16'	40 sec.	52 sec.	67 sec.	87 sec.	113 sec.
18'	45 sec.	59 sec.	73 sec.	95 sec.	123 sec.
20'	50 sec.	65 sec.	81 sec.	105 sec.	137 sec.
22'	55 sec.	72 sec.	89 sec.	116 sec.	150 sec.
24'	59 sec.	78 sec.	97 sec.	126 sec.	164 sec.
26'	64 sec.	85 sec.	105 sec.	137 sec.	177 sec.
28'	69 sec.	91 sec.	113 sec.	147 sec.	191 sec.
30'	74 sec.	98 sec.	121 sec.	157 sec.	205 sec.

6.4.3 **Protective Linings.**

6.4.3.1 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 twenty-thousand (20,000) volts minimum. All welds shall be physically tested by a nondestructive probing method. All patches over holes, or repairs to the liner wherever damage has occurred, shall be accomplished in accordance with manufacturer's recommendation.

6.4.3.2 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 two (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.

6.5 Measurement:

6.5.1 **Standard Depth Sewer Manhole.** 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 six (6) feet as measured vertically from the top of the manhole rim 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 four (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.

6.5.2 **Extra Depth Sewer Manhole.** Extra depth manholes will be measured per vertical foot along the vertical centerline of the manhole from a point six (6) feet above the invert of the manhole to the top of the manhole for the various diameters and types. Only manholes deeper than six (6) 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.

6.5.3 **Sewer Manhole Drop Construction.** Drop construction in new or existing manholes will be measured per vertical foot as measured from the upper inlet pipe flow-line to the flow-line 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).

6.5.4 **Repair Brick Sewer Manhole and Structure.** Repair of brick manholes and structures will be measured per each.

6.5.5 **Special Sewer Structure.** 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.

6.5.6 **Sewer Manhole Rim and Cover.** Manhole rims and covers will be measured per each set consisting of one rim and one cover for the various types.

6.5.7 **Sewer Manhole and Structure Removal.** 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 sewer facility.

6.5.8 **Sewer Manhole and Structure Abandonment.** Manholes and other sewer structures to be abandoned will be measured for payment per each. Material for backfilling abandoned structures will not be measured.

6.5.9 **Dewatering**. 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 that the 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.

6.5.10 **Bypass Pumping**. 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.

6.5.11 **Adjustment of Manhole Rims and Covers**.

6.5.11.1 Manhole Adjustment (Standard Method): Standard manhole adjustments will be measured per each manhole rim adjusted to grade.

6.5.11.2 Manhole Ring Adjustment (with Adapter Rings): Manhole adjustment with adapter rings will be measured per each manhole rim adjusted to grade.

6.5.12 **Pumping Station.** 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 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.

6.6 Payment:

6.6.1 **Standard Depth Sewer Manhole.** 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.

6.6.2 **Extra Depth Sewer Manhole.** 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 of base slab, transition slabs, flat tops, 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 excavation, and backfilling outside of pavement areas.

6.6.3 **Sewer Manhole Drop Construction.** 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).

6.6.4 **Repair Brick Sewer Manhole and Structure.** 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.

6.6.5 **Special Sewer Structure.** 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.

6.6.6 **Sewer Manhole Rim and Cover.** The accepted quantities of sewer manhole rim and cover set will be paid for at the contract unit price per each 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, and cleaning and inspection.

6.6.7 **Sewer Manhole and Structure Removal.** 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.

6.6.8 **Sewer Manhole and Structure Abandonment.** 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, and handling of salvageable material.

6.6.9 **Dewatering.** 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 from the construction site and to satisfactorily complete the work.

6.6.10 **Bypass Pumping.** 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.

6.6.11 **Adjustment of Manhole Rims and Covers**.

6.6.11.1 Manhole Adjustment (Standard Method): 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.

6.6.11.2 Manhole Ring Adjustment (with Adapter Rings): 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.

6.6.12 **Pumping Station.** 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 water main 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.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Clearing, Grubbing, Removal of Structures

2023

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Clearing, Grubbing, Removal of Structures:

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7.1 Scope: This work shall consist of clearing, grubbing, removal, and disposal of all vegetation and debris within the limits of the right-of-way and easement areas, and 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.

7.2 Equipment: All equipment for the satisfactory performance of the work shall be on the project and approved before the work will be permitted to begin.

7.3 Construction Requirements:

7.3.1 **Clearing and Grubbing.**

7.3.1.1 The right-of-way lines and construction limits shall be clearly established before work begins. All trees, shrubs, hedges, fences, and other items to remain shall be as indicated on the Plans or as directed by the Engineer.

7.3.1.2 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. 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.

7.3.1.3 Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed by the Engineer. 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 workers 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.

7.3.1.4 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 Section 8, Excavation, Embankments, & Subgrade Prep.

7.3.2 **Removal of Structures and Obstructions.**

7.3.2.1 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 Section 7.3.1 except those for which other provisions have been made. Demolition of buildings shall be done in accordance with all applicable sections of the Shelby County Building Code.

7.3.2.2 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 with the provisions of Section 8, Excavation, Embankments, & Subgrade Prep. With the approval of the Engineer, 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.

7.3.2.3 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.

7.3.2.4 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.

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

7.3.2.6 When so designated on the plans or in the Contract Documents, all salvageable pipe, frames and grates, manhole rims and covers, pre-cast manhole sections, shall become the property of the City. Salvageable items shall be carefully removed and every precaution taken to avoid damage. These salvaged items shall be taken to the Public Services Complex at 7700 southern Avenue or other designated storage locations as directed by the City of Germantown. When no designation regarding ownership of salvageable items is made, then the items shall become the property of the Contractor and he shall have full responsibility for protecting and removing the items from the site.

7.3.3 **Disposal of Debris.** All material from clearing and grubbing or removal of structures and obstructions except salvaged items shall be disposed of off the Project site and it shall be the Contractor's responsibility to secure any permits necessary for the disposal.

7.4 Measurement.

7.4.1 **Clearing, Grubbing and Removal of Structures and Obstructions:** This item will be paid for on a lump sum basis and no measurement will be made.

7.4.2 **Removal of Concrete Sidewalk:** This item will be measured by the square yard in place at time of removal.

7.4.3 **Removal of Asphalt Pavement**: This item will be measured by the square yard in place at time of removal.

7.4.4 **Removal of Concrete Pavement:** This item will be measured by the square yard in place at time of removal.

7.4.5 **Removal of Concrete Curb and Gutter:** This item will be measured by linear foot measured along the face of curb at time of removal.

7.4.6 **Removal of Guardrail:** This item will be paid for by linear foot at time of removal.

7.5 Payment.

7.5.1 **Clearing, Grubbing and Removal of Structures and Obstructions:** Payment will be made for the work, completed and accepted by the Engineer, at the contract lump sum price, which price shall be full compensation for clearing and grubbing vegetation; removal and disposal of vegetation, debris, 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.

7.5.2 **Removal of Concrete Sidewalk:** Payment will be for the work, completed and accepted, by the Engineer at the contract unit price per square yard, which price shall be full compensation for sidewalk removal and disposal; removal of reinforcement, minor structures such as pull boxes, meter boxes, sign posts, 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 of salvageable materials to designated storage locations.

7.5.3 **Removal of Asphalt Pavement:** Payment will be made for the work, completed and accepted, by the Engineer at the contract unit price per square yard, which price shall be full compensation for asphalt pavement removal and disposal; removal of minor structures or frames, pavement base material and backfilling of depressions below subgrade elevation; protection of manholes, inlets, meters, pull boxes to remain; and moving of salvageable material to designated storage locations.

7.5.4 **Removal of Concrete Pavement:** Payment will be for the work, completed and accepted, by the Engineer at the contract unit price per square yard, which price shall be full compensation for concrete pavement removal and disposal; removal of reinforcement, minor structures such as pull boxes, meter boxes, sign posts, 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 of salvageable materials to designated storage locations.

7.5.5 **Removal of Concrete Curb and Gutter:** Payment will be for the work, completed and accepted, by the Engineer at the contract unit price per linear foot, which price shall be full compensation for concrete curb and gutter removal and disposal.

7.5.6 **Removal of Guardrail:** Payment will be for the work, completed and accepted, by the Engineer at the contract unit price per linear foot, which price shall be full compensation for guardrail removal and disposal.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Excavation, Embankments & Subgrade Prep

2023

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Excavation, Embankments & Subgrade Prep:

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8.1 Scope: This work consists of excavating; building controlled embankments; disposal of unsuitable material from roadbed excavations and beneath embankment areas; construction and removal of temporary detours ordered by the Engineer; sloping, shaping and dressing of all slopes; and the construction and preparation of the graded roadbed to receive the construction of a base or pavement. Excavation shall consist of the removal of all material shown on the Plans in cut sections or necessary undercutting as ordered by the Engineer. Embankment work shall consist of constructing roadway or street embankments including preparation of the areas upon which they are to be constructed by the placing and compacting of material in holes, pits, and other depressions within the embankment area, all in conformity with the lines, grades, and typical cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments. Subgrade preparation shall consist of the final grading of the roadbed in both cuts and fills to the density specified, including gravel backfill, gravel stabilization, or cement stabilization when ordered by the Engineer.

8.2 Equipment: All equipment necessary for the satisfactory performance of excavation, hauling, and embankment construction shall be on the project and approved by the Engineer before the work will be permitted to begin. Compaction shall be accomplished by any type of compacting equipment that will produce the required result, except equipment for final subgrade compaction shall include pneumatic tire rollers with a minimum contact pressure of eighty-five (85) pounds per square inch and a minimum single wheel load of four-thousand five-hundred (4,500) pounds. Each roller shall be a wobble-wheel type in which the rear set of wheels will not track the forward set and will be centered between the wheels of the forward set. The roller shall be capable of forward and backward propulsion on any grade encountered, and the Contractor shall furnish to the Engineer charts or tabulations of the contact areas and pressures for the full range of tire loadings for each type of compactor tire to be used.

8.3 Construction Requirements:

8.3.1 **General.** Prior to beginning excavation, embankment, and subgrade operations, all necessary clearing and grubbing and removal of structures and obstructions shall have been completed in the area in accordance with Specification Section 7, Clearing Grubbing and Removal of Structures. The removal of unsuitable material and/or undercutting ordered by the Engineer will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively. If there is insufficient suitable material from excavation on the project, it shall be the Contractor's responsibility to obtain the additional material off the project to complete embankments according to the lines, grades, and cross-sections on the Plans. Unsuitable material above subgrade or from undercutting in cuts shall be disposed of as directed by the Engineer at no additional cost to the City. Any imbalance of material quantities caused by these operations or change in actual shrinkage factor shall be the Contractor's responsibility. The Engineer's decision on the suitability of material or the need for undercutting shall be final. If approved by the Engineer, gravel for undercut backfill or stabilization and Portland cement for stabilization will be used and paid for as separate items in the contract. The Contractor shall provide for proper drainage of the project area to protect from ponding and erosion.

8.3.2 **Excavation.**

8.3.2.1 Excavation (unclassified) shall consist of the removal of all suitable or unsuitable material in cut sections to the lines, grades, and cross-sections shown on the Plans. All slopes, ditches and berms shall be neatly trimmed to the lines given. Excavation beyond given lines or to correct slides, regardless of the location, will be at the Contractor's expense, and the suitability of the material from slides for embankment construction will be determined by the Engineer. In the event the Contractor does have to obtain

material from off the project, he shall notify the Engineer sufficiently in advance so that the material to be used can be tested for suitability as embankment material.

8.3.2.2 Surplus excavated material, if determined to be suitable by the Engineer, may be used to widen embankments or to flatten slopes or may be deposited in such other places and for such other purposes on the right-of-way as the Engineer may approve. No payment to the Contractor shall be made for the placement of surplus excavated material. Materials unsuitable for construction of embankment or use as backfill shall be removed to off-site waste disposal areas. The Contractor shall secure waste disposal areas and dispose of surplus and unsuitable materials in such areas. It is the Contractor's responsibility to obtain written permission from the owners of all property(s) to be used for waste disposal areas prior to removal of material to disposal sites. The Contractor shall dispose of all materials on the sites to the satisfaction of the property owner(s).

8.3.3 **Undercutting.** This work shall consist of the removal and disposal of unsatisfactory materials below grade in cut sections or in areas upon which embankments are to be constructed. Areas to be undercut may be designated on the Plans if sufficient information is available. However, the Engineer may increase, decrease, or change such areas to be undercut if conditions dictate as construction progresses. Undercut areas shall be backfilled with suitable material from excavation quantities, gravel backfill, or material stabilized with gravel or Portland cement as ordered by the Engineer.

8.3.4 **Embankments.**

8.3.4.1 This work shall consist of constructing roadway or street embankments including the preparation of the area upon which they are to be constructed, the placing and compacting of approved materials where unsuitable material has been removed, and the placing and compacting of embankment material in holes, pits, and other depressions not filled in accordance with Section 7, Clearing Grubbing and Removal of Structures. All work shall be in accordance with these Specifications and in conformity with the lines, grades, and cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments, which material shall come from excavation on the project or from approved sources furnished by the Contractor.

8.3.4.2 Any area upon which an embankment is to be constructed shall be plowed or scarified, all cleavage planes destroyed, and the area rolled thoroughly with a sheep's-foot roller before embankment construction is begun in the area. An area upon which an embankment is to be constructed having a slope steeper than three-to-one (3:1) shall be benched with steps of not less than eight (8) inches rise before any embankment materials are placed thereon. Benching shall be of sufficient width to permit the operation of placing and compacting equipment. Each successive benching cut shall begin at the intersection of the original ground line and the vertical side of the previous cut. Material thus cut out shall be re-compacted along with new material at the Contractor's expense.

8.3.4.3 Embankment construction will not be permitted within fifty (50) feet of any structure or proposed structure until such structure is cured sufficiently to permit embankment formation against it. This requirement will be waived when an embankment or portion thereof is to form the foundation of a structure or part thereof. Embankment to be placed on both sides of a concrete wall, manhole, or box type structure shall be so constructed that the embankment is always approximately the same elevation on both sides of the structure. Embankments on only one side of abutments, wing-walls, or piers shall not be constructed until the superstructure is in place or final concrete design strength has been obtained.

8.3.4.4 Where embankment is to be constructed across ground that will not support earth moving equipment, the fill shall be started with a uniformly distributed layer of thickness not greater than necessary to support the hauling equipment while placing subsequent layers. In the construction of such a lift the density requirement will be waived but the moisture content of the material used shall not exceed the optimum moisture content for that material. Maximum thickness and minimum density requirements will apply to all succeeding layers of embankment construction. Each succeeding layer of embankment is to be constructed with a compacted thickness not to exceed six (6) inches and shall be approved before material for the next succeeding layer is placed.

8.3.4.5 Embankments shall be so constructed that adequate surface drainage will be provided at all times. Roadway embankment materials shall be placed in horizontal layers not to exceed a depth which will produce a six (6) inch compacted layer. Each layer shall be compacted for the entire embankment width to a density not less than ninety-five (95%) percent of maximum density as determined in accordance with the standard specification of compaction and density of soils, AASHTO T99. The moisture content of the embankment material shall be controlled in such a way that the material will be compacted with a moisture content ranging from two (2%) percent below to two (2%) percent above the optimum moisture content as determined from the above mentioned test and approved by the Engineer. If the moisture content of the material in the embankment prior to compaction is greater than two (2%) percent above the optimum moisture content, the material shall be aerated by disking, harrowing, plowing, or other means approved by the Engineer, who shall be the sole judge as to when the required density has been obtained. For each layer of embankment material, the Contractor shall disk sufficiently to break down oversize clods, thoroughly mix any different materials, secure correct moisture content, ensure uniform density, and obtain proper compaction. Rolling with compacting equipment shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the tamping roller. Tamping equipment shall be operated at a speed of no more than three (3) miles per hour.

8.3.4.6 The Contractor shall be responsible until final acceptance for the stability of all embankments and shall replace at his own expense any portion which, in the opinion of the Engineer, has become displaced or damaged due to carelessness, negligence, or by rainfall and weathering.

8.3.4.7 The slopes of all embankments, ditches, channels, and such other appurtenances as may be indicated on the Plans shall be shaped and trimmed to the lines, grades, and cross-sections shown or as directed by the Engineer. This work shall also include the satisfactory shaping of spoil banks, waste deposits, and any other areas deemed necessary by the Engineer to prepare the project for final inspection and acceptance.

8.3.4.8 Water for dust control when ordered by the Engineer, whether to comply with local Air Pollution Ordinances, safety, or good construction practices, shall be readily available along with adequate distribution equipment.

8.3.5 **Subgrade Preparation.**

8.3.5.1 Work shall consist of the preparation of the roadbed to receive the construction of a base or pavement, curb and gutter, driveways, or sidewalks thereon.

8.3.5.2 Subgrade preparation in fill sections shall consist of the compaction of the top six (6) inches below subgrade elevation in paved areas only to a density of ninety-eight (98%) percent as determined in accordance with the standard specification of compaction and density of soils as defined in Section 8.3.4.

8.3.5.3 Areas in cut sections where required density cannot be obtained may be undercut and backfilled with suitable excavation material, stabilized with gravel or Portland cement, or undercut and backfilled with gravel as directed by the Engineer, who shall be the sole judge as to the method to be used. Special attention shall be given to areas such as utility trenches and manhole backfill areas. Payment will be made only for the gravel or Portland cement used, and no additional compensation will be paid the Contractor for the work.

8.3.5.4 The Contractor shall be held responsible for the stability and proper maintenance of subgrade acceptable to the Engineer, and no additional compensation shall be paid to the Contractor to restore any subgrade after preliminary acceptance. The Contractor shall also take all precautions necessary to protect the acceptable subgrade from damage, and hauling over the finished subgrade shall be limited to that which is essential for construction purposes.

8.3.5.5 Just prior to the installation of cement stabilized soil base and also prior to the installation of asphaltic base material on the finished subgrade, the Contractor shall conduct a proof-rolling of the subgrade. The proof-rolling shall be conducted in the presence of a certified soil-test technician. A three (3) axle straight dump truck with a single front axle and two (2) tandem rear axles capable of carrying a minimum cargo weight of forty-four thousand (44,000) pounds (22 tons) shall be used. The truck shall be fully loaded (min. 22 tons). Any area of the subgrade observed to yield under the wheels of the proof-roll vehicle shall be repaired and re-stabilized before any base material is placed upon it. The repairs and re-stabilization of the subgrade shall be at the Contractor's expense.

8.4 Measurement:

8.4.1 **General:** It is the intent of these Specifications to pay only for quantities of Excavation and Embankment as shown on the Plans or Proposal, and it shall be the Contractors responsibility to ensure that excavation materials are suitable for embankment construction.

8.4.2 **Excavation:** Excavation will be computed by the cubic yard and only in cut sections of the project. No measurement will be made for material from off the project required for the satisfactory completion of the project. Measurements will be made for excavation material in its original position by cross-sections and the average-end-area method. Original cross-sections and final cross-sections will be taken from the sections shown on the Plans. Excavation volumes so measured will not include an allowance for removal of material from the Contractor's stripping operation. No measurement will be made for excavation outside the project construction limits shown on the Plans; the removal of slides; nor for undercutting which may be required. Undercut excavation will not be measured. The cost of undercutting will be included in the price of gravel backfill, Portland cement for stabilization of backfill material, or of earth backfill material.

8.4.3 **Embankment:** Embankment construction will be computed by the cubic yard in place, compacted and ready for acceptance. Measurements for computations will be made by cross-sections and the average-end-area method. Original cross-sections and final cross-sections will be taken from sections shown on the Plans. Earth embankment required to backfill undercut areas will be measured by the cubic yard in place compacted and shaped to original ground line in fill sections or to subgrade elevation in cut sections.

8.4.4 **Gravel for Undercut or Subgrade Stabilization:** Gravel for undercut backfill or subgrade stabilization in cut sections will be measured by the ton.

8.4.5 **Portland Cement for Undercut Backfill or Subgrade Stabilization:** Portland cement for stabilization of subgrade or backfill materials will be measured by the pound.

8.5 Payment:

8.5.1 **General:** Subgrade preparation is not considered a pay item, and no work involved shall be paid for directly except gravel and/or Portland cement as defined in Sections 8.5.4 and 8.5.5 below. It is the Contractor's responsibility to ensure that adequate acceptable material is available to complete the project, and variations in shrinkage factors, undercut quantities, or unsuitable material quantities will not relieve him from that responsibility.

8.5.2 **Excavation:** Payment will be made at the contract unit price per cubic yard in its original position in cut sections which price will be full compensation for the excavation and hauling of acceptable materials to designated embankment areas and the disposal of excess or unacceptable materials off the project or as directed by the Engineer. No payment will be made for material excavated off-site and hauled to the project to complete the work, which material will be paid for under embankment.

8.5.3 **Embankment:** Payment will be made at the contract unit price per cubic yard in its final position, in place, compacted, and accepted by the Engineer, which price shall be full compensation for the preparation of the area, furnishing, depositing and compacting the material, and the shaping and trimming of the embankments to the lines, grades, and cross-sections shown on the Plans.

8.5.4 **Gravel for Undercut or Subgrade Stabilization:** Gravel for undercut backfill or subgrade stabilization in cut sections will be paid for at the contract unit price per ton, which price shall be full compensation for the excavation, placing and/or mixing gravel with in-place material, compaction, and dressing to plan elevation as directed by the Engineer, complete in place.

8.5.5 **Portland Cement for Undercut Backfill or Subgrade Stabilization:** Portland cement for subgrade stabilization in cut sections or as backfill stabilization for undercut areas will be paid for at the contract unit price per pound in place, which price shall be full compensation for furnishing and placing cement, processing, compaction, and dressing to plan elevation as directed by the Engineer, complete in place.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Graded Aggregate Base Course

2023

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Graded Aggregate Base Course:

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9.1 **Scope:** This work shall consist of furnishing and placing one or more courses of graded aggregate on a prepared subgrade in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-sections shown on the Plans or as directed by the Engineer.

9.2 **Materials and Equipment:** Aggregates for Graded Aggregate Base Course shall be crushed stone or crushed or uncrushed gravel together with such material as manufactured sand or other fine materials naturally contained or added thereto as needed to conform with one of the three gradations shown in the table below, as specified.

Grading Table for Graded Aggregate Base Course
Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)

Sieve Size	2½"	2"	1½"	1"	⅜"	No. 40	Clay *
Passing	100%	95-100%	-	-	35-65%	10-30%	1-12%
	-	100%	95-100%	-	40-65%	10-30%	1-12%
	-	-	100%	90-100%	45-65%	10-35%	2-12%

* Clay content will be determined by the Hydrometer Test - AASHTO T88.
Clay content up to 15 percent may be used with the approval of the Engineer.

9.2.1 **Materials:** Mineral aggregate for graded aggregate base course shall consist of hard durable particles or fragments of crushed stone or gravel and other finely divided mineral matter. Individual materials shall meet the requirements specified hereinafter.

9.2.1.1 Crushed stone shall be free of silt and clay. The coarse aggregate portion of the stone shall have a percentage of wear of not more than fifty (50), and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15).

9.2.1.2 Gravel shall be screened and all oversize material may be crushed and fed uniformly back over the screen. The coarse aggregate portion (retained on the No. 4 sieve) shall have a percentage of wear of not more than fifty (50), and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15). The portion of the material passing the No. 40 sieve shall be non-plastic or shall have a liquid limit of not more than thirty (30) and a plasticity index of not more than eight (8).

9.2.1.3 If fine aggregate, coarse aggregate, or binder, in addition to that present in the base material, is needed in order to meet the gradation or density requirements or for satisfactory bonding of the material, it shall be uniformly blended with the base course material at the mixing plant by a mechanical feeder to maintain a uniform flow on the belt to the mixer. Blending of materials on the stockpiles or in the pits by bulldozer, clamshell, dragline, or similar equipment will not be permitted. The composite gradation of aggregate shall be the grading specified.

9.2.2 **Equipment**: All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved before work will be permitted to begin. If mixing is required, an approved stationary twin shaft pugmill or a mechanical mixer (for road mixing) shall be included. Pneumatic-tire rollers as described in Standard Specification Section 8.2, Excavation, Embankments & Subgrade Prep.

9.3 Construction Requirements:

9.3.1 **General.** After the subgrade has been completed as specified in Specification Section 8, aggregate shall be spread in one or more layers for one or more lane widths as directed by the Engineer. It shall not be laid on a subgrade that is frozen or contains frost. Hauling over material already placed will not be permitted until it has been spread, mixed, shaped, and compacted.

9.3.2 **Mixing.** If mixing of two or more materials is required, one of the following types of mixing operations may be used. If the required compacted depth of the base course exceeds six (6) inches, the base shall be constructed in two or more layers of approximate equal thickness, unless vibrating or other methods are approved. Types of special compacting equipment MUST be used. In such cases, the compacted depth of a single layer of base course may be increased to eight (8) inches upon approval by the Engineer.

9.3.2.1 **Stationary Plant Method.** The base course material shall be mixed in an approved stationary mixing plant. Water shall be added during the mixing operation in the amount necessary to provide a moisture content satisfactory for compaction.

9.3.2.2 **Road Mix Method (Mechanical Mixer).** After the material for the base course has been placed by an aggregate spreader or windrow-sizing device, the material shall be mixed by means of an approved mechanical mixer (for road mixing). Water shall be added during mixing in the amount necessary to provide a moisture content satisfactory for compaction.

9.3.2.3 **Road Mix Method (Motor-Grader).** After the material has been thoroughly mixed, it shall be spread while at the required optimum moisture content by means of approved motor graders.

9.3.3 **Manhole and Water Valve Adjustments.** Drainage and sanitary sewer manholes and water valves owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as described in Standard Specification Section 22, Manhole Adjustment. Manholes, valve boxes, and other utility structures not owned by the City, but within the right-of-way of the Project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

9.3.4 **Shaping and Compaction.**

9.3.4.1 Except where mechanical aggregate spreading equipment is used to place the base material, final shaping of each layer prior to compaction shall be accomplished by motor grader. In the event that mechanical spreading equipment fails to shape the base material properly, final shaping shall be done by motor grader or other approved means.

9.3.4.2 Immediately following spreading and final shaping, each successive layer shall be compacted with pneumatic-tire rollers described under Specification Section 8.2, Excavation, Embankments & Subgrade Prep. Equipment and any other types of compacting equipment provided the required density and the required degree of uniformity and smoothness are attained. Compaction shall progress gradually from the edges of the base to the center, parallel with the centerline of the road, and shall continue until the base layer has been compacted to its full width. Where lifts of shoulder materials are placed to confine the base material, the initial pass of the compacting equipment shall overlap the shoulder to a

width of not less than twelve (12) inches. Along curbs, headers, and walls, and at all places not accessible to the roller, the material shall be compacted with hand operated vibrating equipment to the required density.

9.3.4.3 Compaction of each layer shall continue until an average dry density of not less than one-hundred (100%) percent of theoretical density based upon eighty-three (83%) percent of a solid volume has been achieved. Further, no individual test shall be less than ninety-seven (97%) of theoretical density. The density determination will be based on the bulk specific gravity, AASHTO T84 and T85 and the dry weight of the aggregate. The compaction of each layer shall be approved before material for the next successive layer is placed. Placing and compacting areas shall be kept separate.

9.3.4.4 The surface of each layer shall be so constructed that the aggregates become firmly keyed and a uniform texture produced and shall be maintained in that condition until covered by the following stage of construction or until final acceptance of the project. Any irregularities that develop shall be corrected by loosening the material at those places and adding or removing material, as required.

9.3.4.5 Approved distributors shall be used to apply water uniformly over the base materials during compaction in sufficient quantity for proper compaction. Softening of the underlying subgrade resulting from use of excess water is to be avoided.

9.3.5 **Maintenance.** After construction of the base has been completed satisfactorily, it shall be maintained, under traffic if required, smooth and uniform until covered by the following stage of construction or until the project has been completed and accepted.

9.3.6 **Thickness Requirements.** The thickness of the completed base shall be in conformity with the thickness shown on the Plans. The thickness shall be measured at such frequency as established by the Engineer by means of test holes or other approved methods.

9.3.7 **Surface Requirements.** The surface of the finished base shall conform to the lines, grades and cross-sections shown on the Plans or established by the Engineer and shall have a satisfactorily smooth riding quality.

9.4 Measurement:

9.4.1 **General.** Subgrade preparation for the for the placing of base courses will be considered a part of the work for providing Graded Aggregate Base course except where gravel for backfill or subgrade stabilization or cement for backfill or subgrade stabilization is required. In such cases, payment will be made in accordance with payment Specification Section 8.5.4 or 8.5.5.

9.4.2 **Graded Aggregate Base Course.** Measurement will be by the square yard, compacted in palace at specified thickness.

9.5 Payment: The accepted quantities for Graded Aggregate Base Course will be paid for at the contract unit price per square yard for the specified thickness, which price will be full compensation for furnishing, mixing, spreading, and compacting the aggregate, complete in place.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Cement Stabilized Aggregate Base

2023

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Cement Stabilized Aggregate Base:

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10.1 Scope: This work shall consist of constructing a base composed of graded aggregate base course and Portland cement in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-section shown on the Plans or as directed by the Engineer.

10.2 Materials and Equipment:

10.2.1 **Aggregate.** Aggregate for Cement Stabilized Aggregate Base construction shall conform to the requirements of Specification Section 9.2, Graded Aggregate Base Course. Except that the use of pit run gravel will be allowed, provided that the gravel shall meet the general requirements of Section 9.2.1.1 of said Section.

10.2.2 **Portland Cement.** Portland cement shall comply with the latest specifications for Portland cement, AASHTO M85 or AASHTO M240 for the type specified.

10.2.3 **Water.** Water shall be free of injurious quantities of oil, salt, acid, alkali, sugar, vegetable matter, or other substances detrimental to hardening of the treated base.

10.2.4 **Bituminous Material.** Bituminous material for curing shall be Emulsified Asphalt Type SS-1, RS-2, or Cut-Back Asphalt, Grade RC-250.

10.2.5 **Equipment.** All equipment necessary for the satisfactory performance of this construction shall be on the Project site and approved for use by the City of Germantown Engineering Department before work will be permitted to begin.

10.3 Construction Requirements:

10.3.1 **Limitations.** No cement shall be applied when the aggregate base is frozen or contains frost. Before beginning construction operations for the day, the ambient temperature shall be at least forty (40°) degrees Fahrenheit in the shade and rising. Application of cement, mixing, application of water and moist mixing, compaction, and finishing shall be continuous, and surface finishing shall be completed in daylight hours. Mixing, application of water and moist mixing, and compaction inclusively shall be completed within six (6) hours.

10.3.2 **Preparation.** Before other construction operations are begun, the area to be paved shall be graded and shaped in accordance with Section 8, of the Standard Specifications in order to construct the base in conformance with grades, lines, thickness, and typical cross-section shown on the Plans. Unsuitable materials shall be removed and replaced with acceptable aggregate. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

10.3.3 **Spreading.** After subgrade preparation is complete, aggregate base material shall be spread over the moistened subgrade. The placement shall be uniform in thickness and surface contour and in such quantity that the completed base will conform to the required grade and cross-section. Aggregate shall be placed and initially compacted to specified thickness before proceeding with pulverization and application of cement. Initial compaction of the aggregate shall be considered achieved when the surface of the aggregate is tightly formed and does not show evidence of pumping and/or rutting under the operation of a motor grader, roller or other construction equipment normally employed in the stabilization of a gravel base.

10.3.4 **Moisture Content.** Prior to proceeding with the application and mixing of the cement, the Contractor shall retain the services of a qualified Geotechnical Engineer to take representative samples of the gravel placed upon the roadway to be cement stabilized. The Geotechnical Engineer shall use these samples to perform the tests necessary to determine the required cement application rate, the optimum moisture, and the optimum density of the cement stabilized aggregate

base. The maximum percentage of moisture in the aggregate at the time the cement is added shall not exceed the optimum moisture content of the aggregate cement mixture. When water application and mixing have been completed, the percentage of moisture in the mixture shall be at, but no more than, three (3) percentage points above the specified optimum moisture content. During the finishing operations, the moisture content of the surface material shall be maintained at not less than the optimum moisture content. The Contractor shall assure that a field technician is present in the field to properly monitor and record the moisture content of the aggregate and cement aggregate mix as the work progresses.

10.3.5 **Application of Cement.** Prior to the application of cement, the aggregate base shall be scarified and pulverized. The quantity of cement to be used shall be between three (3%) percent and six (6%) percent by weight of the dry material. The exact percentage of cement to be placed will be determined by the Geotechnical Engineer retained by the Contractor by performing the appropriate laboratory analysis upon representative samples taken of the gravel material placed upon the roadway. The required rate of cement shall be defined in terms of pounds of cement per square yard to be placed upon the aggregate base with an approved cement spreader. The rate of application shall be checked behind the spreader at a regular basis. When the application rate is found to be deficient, the Contractor shall take steps to correct the rate of application and to apply additional cement in those areas that are found to be deficient.

10.3.6 **Mixing.** After the cement has been applied, it shall be mixed with the aggregate so that the base material shall be a homogeneous aggregate cement mixture. Water shall be added and mixing shall continue until the mixture is sufficiently blended to prevent the formation of cement balls when additional water is added. Aggregate cement mixture shall not remain undisturbed for more than thirty (30) minutes.

10.3.7 **Application of Water and Moist-Mixing.** Immediately after the initial mixing operation, required water shall be applied uniformly and incorporated into the mixture, and excessive concentrations of water on or near the surface shall be avoided. A water supply shall be provided that will assure the application within three (3) hours of all water required. After all water has been applied, mixing shall continue until a uniform mixture of aggregate, cement, and water has been obtained.

10.3.8 **Compaction.** Prior to the beginning of compaction, the mixture shall be in a loose condition for sufficient depth to produce the specified finished thickness. Compaction will be obtained by use of a sheep's-foot roller which will be followed by rolling with pneumatic-tire rollers or other types of rollers as required to thoroughly compact the base for its full thickness. Shaping may be required to obtain uniform compaction. The aggregate cement mixture shall be compacted to ninety-five (95%) percent of maximum density as determined by the applicable method of AASHTO T134 with the moisture content being at, but not more than, two (2%) percent above optimum. The Contractor shall assure that a field technician is present in the field to properly monitor and record the field densities and moisture content. Test should be taken in a timely manner so that should areas be discovered where additional compactive effort is required to meet the density requirements, this can be accomplished within six (6) hours of the first application of cement.

10.3.9 **Finishing.** After compaction is completed, the surface of the base shall be shaped to the lines, grades, and typical cross-sections shown on the Plans. During shaping operations, the surface shall be scarified as necessary to loosen any imprints left by the compacting or shaping equipment. The resulting surface shall then be compacted to the specified density with steel wheel or pneumatic tire

rollers or both. Rolling may be supplemented by broom dragging, if required. Surface compaction and finishing shall be done in such a manner as to produce, within two (2) hours, a smooth, dense surface free of surface compaction planes, cracks, ridges, or loose material. The grades shall be ± one-half (±½) inch of planned grade. Any approved surface finishing method may be used provided the above final results are produced.

10.3.10 **Curing.** After finishing is completed, the aggregate cement shall be protected against drying for seven (7) days by the application of bituminous material as specified or allowed by the Engineer. The bituminous material shall be applied as soon as possible, but no later than two (2) hours after finishing is completed. The finished aggregate cement shall be kept moist until the bituminous material is placed. The bituminous material shall be uniformly applied at the rate of approximately 0.2 gallons per square yard with approved heating and distributing equipment. During application, the surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. If necessary, water shall be applied in sufficient quantity to fill any surface voids immediately before the bituminous material is applied. The curing material shall be maintained by the Contractor during the seven (7) day protection period so that all of the aggregate cement will be covered effectively, and should it be necessary for construction equipment or any other traffic to use the bituminous covered surface before it has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use. Finished portions of aggregate cement that are traveled on by equipment or other traffic for any reason shall be protected in such a manner as to prevent marring or damaging the completed work. When the ambient temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the aggregate cement for seven (7) days after finishing is completed.

10.3.11 **Construction Joints.** At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material. Aggregate cement for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer. Straight longitudinal joints shall be formed at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

10.3.12 **Manhole and Water Valve Adjustments.** Drainage manholes, sanitary sewer manholes and water valves owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Standard Specification Section 22, as instructed by the Engineer, or as detailed in the Plans. Manholes, valve boxes, and other utility structures not owned by the City, but within the right-of-way of the Project, shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying the owners of other such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

10.3.13 **Traffic and Maintenance.** Completed portions of the base may be immediately opened to construction equipment or local traffic and to all traffic after the seven (7) day curing period, provided the base has hardened sufficiently to prevent damage and provided curing is not impaired. The Contractor shall be required to maintain the base in good condition and in a manner satisfactory to the engineer from the time work first starts until all work has been completed and accepted. This work shall include immediate repairs to any defects that may occur in a manner that will ensure restoration of a smooth, uniform surface and durability of the area repaired. Any faulty work shall be replaced to the full depth of the base treatment rather than adding a thin layer of material to the completed work.

10.4 Measurement:

10.4.1 **General.** No water used in processing the base, bituminous curing material, or processing operations will be measured for payment, as these items are considered incidental to the work.

10.4.2 **Aggregate Base for Cement Stabilization.** Measurement will be by the square yard of aggregate base in place and initially compacted to the specified thickness.

10.4.3 **Portland Cement for Cement Stabilized Aggregate Base.** Measurement will be made by the pounds of Portland cement furnished and incorporated into the work, complete in place.

10.4.4 **Manhole Adjustments.** This item will be measured and paid for in accordance with Standard Specification Section 22, Manhole Adjustment.

10.5 Payment:

10.5.1 **Aggregate Base for Cement Stabilization.** The accepted quantities will be paid for at the contract unit price per square yard, which price will be full compensation for furnishing, spreading, and initially compacting the aggregate base in condition to receive Portland cement.

10.5.2 **Portland Cement for Cement Stabilized Aggregate Base.** The accepted quantities of Portland cement for cement stabilized aggregate base will be paid for at the contract unit price per pound, which price will be full compensation for furnishing and spreading Portland cement, mixing the material, compacting, finishing, shaping, curing, and maintaining the base until final acceptance, complete in place.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Cement Stabilized Soil Base

2023

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Cement Stabilized Soil Base:

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11.1 Scope: This work shall consist of constructing a base composed of in-place soil material and Portland cement uniformly mixed, moistened, compacted, finished and cured in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-section shown on the Plans or as directed by the Engineer.

11.2 Materials and Equipment:

11.2.1 **Soil.** Soil for soil-cement base shall be of such general character as to be classified as Group A-1or A-2, AASHTO M145. The material shall be of such size that all will pass the standard two (2) inch sieve. Samples shall be tested by the Geotechnical Engineer before work is started for determination of cement application rates and optimum moisture content.

11.2.2 **Portland Cement.** Portland cement shall comply with the latest specifications for Portland cement, AASHTO M85 or AASHTO M240 for the type specified.

11.2.3 **Water.** Water shall be free of injurious quantities of oil, salt, acid, alkali, sugar, vegetable matter, or other substances detrimental to hardening of the treated base.

11.2.4 **Bituminous Material.** Bituminous material for curing shall be Emulsified Asphalt Type SS-1, RS-2, or Cut-Back Asphalt, Grade RC-250.

11.2.5 **Equipment.** All equipment necessary for the satisfactory performance of this construction shall be on the Project site and approved for use by the City of Germantown Engineering Department before work will be permitted to begin.

11.3 Construction Requirements:

11.3.1 **Limitations.** No soil-cement shall be processed that will not be covered with the succeeding stage of base or pavement during the same construction season. No cement shall be applied when the soil is frozen or contains frost. Before beginning construction operations for the day, the ambient temperature shall be at least forty (40°) degrees Fahrenheit in the shade and rising. All operations shall be continuous, and all operations but final surface finish shall be completed within four (4) hours from the time cement is applied. No un-compacted soil-cement mixture shall be left undisturbed for more than thirty (30) minutes.

11.3.2 **Preparation.** Before other construction operations are begun, the area to be paved shall be graded and shaped in accordance with Section 8 of the Standard Specifications. After grading operations are complete and approved, any work and material required to re-grade the roadbed to finished grade shall be at the Contractor's expense. The area to receive treatment shall be thoroughly scarified and pulverized for sufficient depth and width to give, after treatment and compaction, the cross-sections shown on the Plans.

11.3.3 **Moisture Content.** Prior to proceeding with the application and mixing of the cement, the Contractor shall retain the services of a qualified Geotechnical Engineer to take representative samples of the Soil upon the roadway to be cement stabilized. The Geotechnical Engineer shall use these samples to perform the tests necessary to determine the required cement application rate, the optimum moisture, and the optimum density of the cement stabilized soil base. The optimum moisture content should be established by soil tests or as designated by the Engineer on the Plans. The maximum percentage of moisture in the soil at the time cement is added shall not exceed the specified moisture content of the soil-cement mixture by more than three (3%) percentage points. When water application and mixing have been completed, the percentage of moisture in the mixture, based on oven dried weights, shall not be more than one (1%) percentage point below or more than three (3%) percentage points above the specified optimum moisture content and shall be such that the mixture will not become unstable during compacting and finishing. During finishing operations, the moisture

content of the surface material shall be maintained at not less than the specified optimum moisture content. The Contractor shall assure that a field technician is present in the field to properly monitor and record the moisture content of the Soil-Cement mix as the work progresses.

11.3.4 **Application of Cement.** After subgrade preparation is complete, Portland cement material shall be spread over the moistened subgrade. Approved Portland cement shall be applied uniformly on the in-place soil at the rate shown on the Plans or established by the Engineer, based on tests of the soil performed before work is begun. The Engineer reserves the right to increase the rate of cement where in his judgment additional cement is desired. When bulk cement is used, adequate equipment for handling, weighing, and spreading the cement shall be provided. Prior to the application of cement, the soil base shall be scarified and pulverized. The quantity of cement to be used shall be between three (3%) percent and six (6%) percent by weight of the dry material. The exact percentage of cement to be placed will be determined by the Geotechnical Engineer retained by the Contractor by performing the appropriate laboratory analysis upon representative samples taken of the soil material upon the roadway. The required rate of cement shall be defined in terms of pounds of cement per square yard to be placed upon the soil base with an approved cement spreader. The rate of application shall be checked behind the spreader at a regular basis. When the application rate is found to be deficient, the Contractor shall take steps to correct the rate of application and to apply additional cement in those areas that are found to be deficient.

11.3.5 **Mixing.** After the cement has been applied, it shall be mixed with the aggregate so that the base material shall be a homogeneous soil-cement mixture. Water shall be added and mixing shall continue until the mixture is sufficiently blended to prevent the formation of cement balls when additional water is added. Soil-cement mixture shall not remain undisturbed for more than thirty (30) minutes.

11.3.6 **Application of Water and Moist-Mixing.** Immediately after the initial mixing operation, required water shall be applied uniformly and incorporated into the mixture, and excessive concentrations of water on or near the surface shall be avoided. A water supply shall be provided that will assure the application within three (3) hours of all water required. After all water has been applied, mixing shall continue until a uniform mixture of soil-cement, and water has been obtained.

11.3.7 **Compaction.** Prior to the beginning of compaction, the mixture shall be in a loose condition for sufficient depth to produce the specified finished thickness. Compaction will be obtained by use of a sheep's-foot roller which will be followed by rolling with pneumatic-tire rollers or other types of rollers as required to thoroughly compact the base for its full thickness. Shaping may be required to obtain uniform compaction. The soil-cement mixture shall be compacted to ninety-five (95%) percent of maximum density as determined by the applicable method of AASHTO T134 with the moisture content being at, but not more than, two (2%) percent above optimum. The Contractor shall assure that a field technician is present in the field to properly monitor and record the field densities and moisture content. Test should be taken in a timely manner so that should areas be discovered where additional compactive effort is required to meet the density requirements, this can be accomplished within six (6) hours of the first application of cement.

11.3.8 **Finishing.** After compaction is completed, the surface of the soil-cement shall be shaped to the lines, grades, and typical cross-sections shown on the Plans. During shaping operations, the surface shall be scarified as necessary to loosen any imprints left by the compacting or shaping equipment. The resulting surface shall then be compacted to the specified density with steel wheel or

pneumatic tire rollers or both. Rolling may be supplemented by broom dragging, if required. Surface compaction and finishing shall be done in such a manner as to produce, within two (2) hours, a smooth, dense surface free of surface compaction planes, cracks, ridges, or loose material. The grades shall be ± one-half (±½) inch of planned grade. Any approved surface finishing method may be used provided the above final results are produced.

11.3.9 **Curing.** After finishing is completed, the soil-cement shall be protected against drying for seven (7) days by the application of bituminous material as specified or allowed by the Engineer. The bituminous material shall be applied as soon as possible, but no later than two (2) hours after finishing is completed. The finished soil-cement shall be kept moist until the bituminous material is placed. The bituminous material shall be uniformly applied at the rate of approximately 0.2 gallons per square yard with approved heating and distributing equipment. During application, the surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. If necessary, water shall be applied in sufficient quantity to fill any surface voids immediately before the bituminous material is applied. The curing material shall be maintained by the Contractor during the seven (7) day protection period so that all of the soil-cement will be covered effectively, and should it be necessary for construction equipment or any other traffic to use the bituminous covered surface before it has dried sufficiently to prevent pickup, sufficient granular cover shall be applied before such use. Finished portions of soil-cement that are traveled on by equipment or other traffic for any reason shall be protected in such a manner as to prevent marring or damaging the completed work. When the ambient temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil-cement for seven (7) days after finishing is completed.

11.3.10 **Construction Joints.** At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material. Soil-cement for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer. Straight longitudinal joints shall be formed at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

11.3.11 **Manhole and Water Valve Adjustments.** Drainage manholes, sanitary sewer manholes and water valves owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Section 22 of the Standard Specifications, as instructed by the Engineer, or as detailed in the Plans. Manholes, valve boxes, and other utility structures not owned by the City, but within the right-of-way of the Project, shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying the owners of other such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

11.3.12 **Traffic and Maintenance.** Completed portions of the soil-cement base may be immediately opened to construction equipment or local traffic and to all traffic after the seven (7) day curing period, provided the base has hardened sufficiently to prevent damage and provided curing is not impaired. The Contractor shall be required to maintain the base in good condition and in a manner satisfactory to the engineer from the time work first starts until all work has been completed and accepted. This work shall include immediate repairs to any defects that may occur in a manner that will ensure restoration of a smooth, uniform surface and durability of the area repaired. Any faulty work shall be replaced to the full depth of the base treatment rather than adding a thin layer of material to the completed work.

11.4 Measurement:

11.4.1 **General.** No water used in processing the base, bituminous curing material, or processing operations will be measured for payment, as these items are considered incidental to the work.

11.4.2 **Portland Cement for Cement Stabilized Soil Base.** Measurement will be made by the pounds of Portland cement furnished and incorporated into the work, complete in place.

11.4.3 **Manhole Adjustments.** This item will be measured and paid for in accordance with Standard Specification Section 22, Manhole Adjustment.

11.5 Payment:

11.5.1 **Portland Cement for Cement Stabilized Soil Base.** The accepted quantities of Portland cement for cement stabilized aggregate base will be paid for at the contract unit price per pound, which price will be full compensation for furnishing and spreading Portland cement, mixing the material, compacting, finishing, shaping, curing, and maintaining the base until final acceptance, complete in place.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Concrete Sidewalks and Driveways

2023

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Concrete Sidewalks and Driveways:

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12.1 Scope: This work shall consist of constructing sidewalks, wheelchair ramps and driveways of Portland cement concrete on a prepared subgrade, in accordance with these Specifications and in conformity with the lines, grades and typical cross-sections shown on the Plans or directed by the Engineer. Wheelchair ramps and commercial and residential driveways shall be constructed in accordance with the Design Standards.

12.2 Materials and Equipment:

12.2.1 **Concrete:** Concrete shall be Class A, ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications.

12.2.1.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

12.2.1.2 Concrete shall be 3500 psi (min.) for Sidewalks, Driveways and Aprons.

12.2.1.3 Concrete shall be 4000 psi (min.) for Commercial Driveway Aprons within the City's Right-of-Way.

12.2.1.4 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

12.2.2 **Concrete Materials.** Concrete materials shall meet the requirements of Standard Specifications Section 23, Portland Cement Concrete for Class A concrete.

12.2.3 **Curing Materials.** Curing materials shall be liquid membrane forming compounds. These compounds shall conform to AASHTO M 148, Type 2.

12.2.4 **Preformed Joint Fillers.** Preformed joint fillers shall be of the bituminous type and shall conform to the requirements of AASHTO M213 and shall not be more than one (1) inch in thickness or less than one-half (½) inch in thickness. Their width shall be at least equal to the full thickness of the slab, and their length shall be sufficient to eliminate any splicing.

12.2.5 **Equipment.** Forms shall be of wood, metal or other suitable material and shall be true to line, free from warp, and of sufficient strength to resist springing out of shape during placing, consolidating and finishing the concrete. Curved forms of proper radius or flexible forms acceptable to the Engineer shall be used on all radial sections. Satisfactory floats, templates, straightedges, finish-edgers, spades, tamps and all other equipment necessary for the satisfactory performance of this construction shall be on the project and approved before work will be permitted to begin.

12.3 Construction Requirements:

12.3.1 **Subgrade Preparation.** Subgrade preparation for sidewalks and driveways shall be made to the required configuration to conform to the slab thicknesses shown on the Plans. The subgrade shall be shaped and compacted to a width that will permit satisfactory installation and bracing of forms. In cut sections, additional compaction will be required only if the soil is loose and yielding in the opinion of the Engineer. In such situations, the Contractor may remove the soft material and replace it with fill sand or approved gravel base at his own expense.

12.3.2 **Forms.** Forms shall be well staked or otherwise held to the established lines and grades, and their grade shall be such that finished sidewalks shall have one-quarter of an inch per foot fall toward the curb for drainage unless shown otherwise on the Plans or directed by the Engineer. Driveway forms shall be of such width and slope that the finished driveway will conform to the slope of the adjacent sidewalk, grass plot, parking lot or drive.

12.3.3 **Expansion and Contraction Joints.**

12.3.3.1 Unless otherwise indicated on the Plans or directed by the Engineer, preformed expansion joint filler, one-half (½) inch in thickness, shall be placed in sidewalks at the locations of and in line with expansion joints in the adjoining pavement, curb or curb and gutter, but at intervals not to exceed twenty-eight (28) feet. When expansion joints have not been installed in the adjoining pavement or gutter, a one-half (½) inch preformed expansion joint filler shall be placed transversely at intervals not to exceed twenty-eight (28) feet. Preformed expansion joint filler shall be placed at all abutting concrete such as driveways, driveway aprons (inlets), buildings or walls. Transverse expansion joints with one-half (½) inch preformed expansion joint filler shall be placed to match existing joints in abutting facilities at intervals not to exceed twenty-eight (28) feet. Preformed expansion joint filler shall be placed at each intersection of sidewalk and street curb, and at such other points as may be shown on the Plans or directed by the Engineer. Preformed expansion joint filler, one (1) inch in thickness, shall be placed around all appurtenances such as manholes, valves, utility poles, fire hydrants and signs extending into or through the sidewalk or driveway area, forming an isolated square or rectangular slab around the appurtenance with a minimum of four (4) inches clearance of the appurtenance.

12.3.3.2 The surface of sidewalks shall be divided into blocks by use of a grooving tool. The grooves shall be spaced approximately five (5) feet apart and the blocks shall be rectangular unless otherwise ordered by the Engineer. The grooves shall be cut to a depth of one-half (½) inch. The edges of the grooves shall be edged with a finish-edging tool having a radius of one-quarter (¼) inch.

12.3.3.3 Expansion joint filler material shall not be placed at sidewalk drains.

12.3.3.4 Driveway Expansion and Contraction joints shall be placed as shown in the City of Germantown's Design Standard Drawings.

12.3.4 **Placing and Finishing Concrete.** Concrete shall be placed only on a moist subgrade and shall not be placed unless the ambient temperature is thirty-five (35°) degrees Fahrenheit and rising. In no case shall concrete be placed on a frozen or frosty subgrade. After the concrete is placed in the forms, it shall be spaded along the forms (including cross forms for joints), tamped and struck off in an approved manner to the required section and grade and shall be finished with floats and straightedges until the surface requirements have been obtained. When the surface of the concrete is free from water and just before the concrete obtains its initial set, it shall be finished with a float and swept lightly at right angles to the street centerline to produce a sandy texture (Broom-finish). The longitudinal surface variations shall not be more than one-quarter (¼) inch under a twelve (12) foot straightedge nor more than one-eighth (⅛) inch on a five (5) foot transverse section, or as approved by the Engineer. The edges of sidewalks and driveways shall be carefully finished and rounded with a finish-edging tool having a one-half (½) inch radius. An edge having a one-quarter (¼) inch radius shall be placed adjacent to and on both sides of all intermediate transverse expansion joints in sidewalks, and all marks caused by the edging tool shall be removed with a wetted brush or float. The top of all expansion joint material shall be cleaned of all concrete, and the expansion joint material shall be trimmed if necessary as to be left slightly below the surface of the concrete.

12.3.5 **Concrete Testing.** Concrete for sidewalks and driveways shall be tested as shown on the Plans or directed by the Engineer. For all City owned facilities, Concrete for sidewalks and driveways shall be tested by test specimens made

and cured in accordance with AASHTO Designation T233. A minimum of three (3) test cylinders shall be made for each one-thousand (1,000) lineal feet of sidewalk poured. For each day's pour, no less than three (3) test cylinders shall be made. The Contractor shall be responsible for obtaining the services of a testing laboratory to make, handle, cure and break the test cylinders. To ensure that the cylinders are representative of the concrete being placed, fresh concrete shall be sampled in accordance to ASTM C172 (from middle of batch). Each group of test specimens shall have one cylinder subjected to seven (7) day compressive strength tests and a second cylinder twenty-eight (28) day test. Should the value of either of the first two test breaks be below the expected values, the third cylinder shall be tested for compressive strength. Low cylinder breaks may be cause to have the concrete represented by the test specimens removed and replaced. At the time the test cylinder specimens are made, the testing laboratory will check the concrete slump and the air entrained.

12.3.6 **Concrete Curing and Protection.**

12.3.6.1 **Curing:** If curing compound is to be used, the curing compound shall not be applied during rainfall. Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but in no case shall the rate be less than one (1) gallon to each one-hundred fifty (150) square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within a seventy-two (72) hour curing period, the damaged portions shall be repaired immediately with additional compound.

12.3.6.2 **Cold Weather Protection:** Concrete that is placed in cold weather when the air temperature in the shade, away from artificial heat, is or may be expected to drop below thirty-five (35°) degrees Fahrenheit, shall be protected by suitable blanket material placed over the surface and sides of the slab to sufficient depth to prevent freezing of the concrete. Care shall be taken during application of the blanket material not to mar the surface of the concrete. The period of time such protection shall be maintained shall not be less than five (5) days. The Contractor shall be responsible for the quality and strength of concrete placed during cold weather, and any concrete injured by freezing action shall be removed and replaced at his expense.

12.3.6.3 **Removing Forms:** Forms may be removed and the slab backfilled at any time that removal will not damage the concrete. Pedestrians will not be allowed upon sidewalks or driveways until seventy-two (72) hours after finishing the concrete, and no vehicles or loads shall be permitted on any sidewalk or driveway until the Engineer has determined that the concrete has attained sufficient strength for such loads. The Contractor shall construct and place such barricades and protection devices as are necessary to protect the concrete. Any sidewalk or driveway damaged prior to final acceptance of the work shall be removed within joint or groove limits and replaced with concrete of the type and finish of the original construction.

12.3.7 **Wheelchair Ramps.** Wheelchair ramps shall be installed at each intersection at locations as reflected in the plans, design standards or as directed by the Engineer. For purposes of payment, wheelchair ramps shall be considered as sidewalk area in new construction areas. Where wheelchair ramps are to be installed at locations where curb and gutter is in place, wheelchair ramps will be paid as a unit in place, including removal of curb and gutter. The curb and gutter to be removed will be marked by the Contractor and the location approved by the Engineer or his representative. A minimum one (1) inch deep saw cut is to be cut across the entire face of the curb and gutter at the limits. Any over-breakage that occurs will be removed to neat sound lines.

12.3.8 **Thickness.** Thickness of sidewalks and driveways shall be as shown on the Plans and Design Standards.

12.4 Measurement:

12.4.1 **Concrete Sidewalk.** Concrete sidewalks will be measured for payment by the square foot at specified thickness, complete in place. Payment for wheelchair ramps shall be included as concrete sidewalk in new construction areas.

12.4.2 **Concrete Driveway.** Concrete driveways will be measured for payment by the square foot at specified thickness, complete in place.

12.4.3 **Wheelchair Ramp (Existing Conditions).** Wheelchair ramps placed in areas where curb and gutters exist will be measured by the unit, per each, complete in place, including the removal and replacement of existing curb and gutter.

12.5 Payment.

12.5.1 **Concrete Sidewalk.** The accepted quantities of concrete sidewalk, including area of wheelchair ramps in new construction areas, will be paid for at the contract unit price per square foot of each specified thickness, which price will be full compensation for excavating and preparing the subgrade; forming; furnishing, placing, finishing and curing the concrete; providing all joints; and protecting the concrete until final acceptance, complete in place.

12.5.2 **Concrete Driveway.** The accepted quantities of concrete driveway will be paid for at the contract unit price per square foot of each specified thickness, which price will be full compensation for excavating and preparing the subgrade; forming; furnishing, placing, finishing and curing the concrete; providing all joints; and protection of concrete until final acceptance, complete in place.

12.5.3 **Wheelchair Ramp (Existing Conditions).** The accepted quantities of wheelchair ramps placed in areas where curb and gutter exist will be paid for at the contract unit price per each, which price will be full compensation for removing existing curb and gutter and, if required, sidewalk; excavating and preparing the subgrade; furnishing, placing and finishing the concrete; and protecting the concrete until final acceptance, complete in place.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Curb, Curb & Gutter, Water Table

2023

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Curb, Curb & Gutter, Water Table:

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13.1 Scope: This work shall consist of constructing concrete curb, concrete curb and gutter, asphalt curb, and concrete water table in conformity with the lines, grades, and dimensions shown on the Plans or as directed by the Engineer.

13.2 Materials and Equipment:

13.2.1 **Concrete:** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications.

13.2.1.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

13.2.2 **Concrete Materials.** Concrete materials shall meet the requirements of Standard Specifications Section 23, Portland Cement Concrete for Class A concrete. Exception will be given for special mix for use with approved curb machines as approved by the Engineer.

13.2.3 **Curb Dowel Bars.** Unless specified on the plans, curb dowels bars shall be deformed billet steel bars conforming to the requirements of ASTM A615.

13.2.4 **Asphaltic Concrete for Curbs.** Asphaltic concrete for curbs shall be in accordance with TDOT Standard Specifications Section 411.03, Grading D. Other gradations which have a history of satisfactory performance may be used when approved by the Engineer.

13.2.5 **Curing and Protection.** Protect the newly laid curb from traffic by barricades or other suitable methods until the asphaltic mixture has cooled to air temperature. Remove and replace curb or sections of curb that are displaced, destroyed, or otherwise damaged before final acceptance.

13.2.6 **Preformed Joint Fillers.** Preformed joint fillers shall be of the bituminous type and shall conform to the requirements of AASHTO M213 and shall not be more than one (1) inch in thickness or less than one-half (½) inch in thickness. For water table slab, their width shall be at least equal to the full thickness of the water table slab, and their length shall be sufficient to eliminate any splicing. For curbs and curb & gutter, they shall be precut to the full cross section of the concrete.

13.2.7 **Equipment.** Equipment for this work shall conform to the requirements of Standard Specifications Section 12.2.4. When concrete or asphalt curb machines are used, the necessary special tools required for satisfactory curb machine work shall also be included. All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved before work will be permitted to begin.

13.3 Construction Requirements:

13.3.1 **Excavation and Subgrade Preparation.** All major excavation for curb and gutter or water table construction shall be performed under other sections of these Specifications. Only the final grade preparation for this work shall be included in this Section, will be considered incidental to the work, and shall be performed in accordance with the applicable provisions of Standard Specifications Section 12.3.1 or to the satisfaction of the Engineer.

13.3.2 **Curbs.** Portland cement concrete curbs shall be constructed to the dimensions shown on the Plans and Design Standards. Dowels, if specified, shall be one-half (½) inch deformed steel bars conforming to the length and spacing shown on the Plans and will be considered incidental to the work. Asphaltic concrete curbs, when specified, shall conform to the lines, grades, and typical cross section shown on the Plans and the work shall be in accordance with Section 715 of the Tennessee Department of Transportation's Standard Specifications for Roads and Bridges.

13.3.3 **Forms.** Forms for Portland cement concrete curbs shall conform to the requirements of Standard Specifications Section 12.2.4. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. Forms for curb and gutter and water table shall conform to the applicable provisions of Standard Specifications Section 12.2.4 and 12.3.2. The forms for combination curb and gutter and back forms for water table shall have readily detachable face forms held in place by one-eighth (⅛) inch thick templates. The templates shall be lugs or other devices to hold them in position during placing of concrete and be of such design to permit removal without causing damage to the concrete. The templates, unless otherwise specified on the Plans, shall be spaced so as to form sections having uniform lengths of ten (10) feet except where reduced to a minimum of six (6) feet when necessary for closures.

13.3.4 **Expansion and Contraction Joints.** Expansion Joints shall be three-fourths (¾) inch thick in curb and curb and gutter shall be placed at intervals shown on the Plans, but shall not exceed forty (40) foot maximum spacing. Contraction (Dummy) joints shall be installed at ten (10) feet on center.

13.3.5 **Placing and Finishing Concrete.** Placing and finishing work shall be performed in accordance with the applicable provisions of Standard Specifications Section 12.3.4, or as directed by the Engineer.

13.3.6 **Concrete Testing.** Concrete for curbs, curb and gutter, and water table shall be tested in accordance with the provisions of Standard Specifications Section 12.3.5.

13.3.7 **Concrete Curing and Protection.** Curing and protection shall be performed in accordance with the applicable provisions of Standard Specifications Section 12.3.6.

13.3.8 **Use of Curb Machines.** Extruding type curb machines for asphaltic concrete curbs or Portland cement concrete curbs or curbs and gutters may be used, if approved, by the engineer. The molds shall be so constructed as to produce the desired cross section and so that the thrust against the extruded material will eliminate objectionable surface voids as the material passes through the mold. When Portland Cement concrete curb or curb and gutter is placed by curb machines, finishing shall be performed as specified above except that dummy or construction joints may be sawed at specified intervals in lieu of constructing the curb or curb and gutter in sections as stipulated in Section 13.3.4.

13.3.9 **Water Table.** Water tables, unless otherwise shown on the Plans, shall be constructed in accordance with the Plans and Design standards for concrete water table. The concrete curb, gutter, and eight (8) inch concrete slab shall be monolithic for each unit. A unit consists of the construction at the turning radius at any one corner of two interceding streets and within the limits as shown on the plans. The eight (8) foot wide x eight (8) inch deep invert between the radius slabs shall be a monolithic pour. Measurement for payment of the water table will begin outside of the front edge of the gutter on the approaches to the intersection. For example, the curb and two (2) feet of standard 6-30 curb and gutter will be paid for as Curb and Gutter for the distance around the turning radius with the balance of the concrete slab being measured and paid for as concrete water table. One inch expansion joints shall be placed between the invert section and the radii unit. The flow lines of the gutters shall be maintained across the intersection. No formed or sawed dummy or contraction joints shall be placed in the radius curb. The Portland cement concrete inverts across the traveled portion of approaching streets shall be constructed to the grade and invert depth shown on the Plans or as directed by the Engineer. Portland cement concrete inverts shall have a one (1) inch expansion joint at each end where they abut the monolithic radius slab.

13.4 Measurement:

13.4.1 **Concrete Curb.** Concrete curb of the dimensions specified will be measured for payment by the lineal foot along the face of the curb, complete in place.

13.4.2 **6-18 Curb & Gutter.** Measured for payment by the linear foot along the face of the curb, complete in place.

13.4.3 **6-30 Curb & Gutter.** Measured for payment by the linear foot along the face of the curb, complete in place.

13.4.4 **Mountable Curb & Gutter.** Measured for payment by the linear foot along the face of the curb, complete in place.

13.4.5 **Valley Curb & Gutter.** Measured for payment by the linear foot along the face of the curb, complete in place.

13.4.6 **Concrete Water Table.** Eight (8) inch thickness Concrete Water Table will be measured for payment by the square foot, complete in place within the limits described in Section 13.3.9.

13.4.7 **Asphaltic Concrete Curb.** Measured for payment by the linear foot along the face of the curb, complete in place.

13.4.8 **General.** No payment will be made for performed joint filler material or curb dowel bars as they are considered incidental to the work.

13.5 Payment.

13.5.1 **Concrete Curb.** The accepted quantities of Concrete Curb will be paid for at the contract unit price per linear foot for the size specified, which price will be full compensation for preparing the base; forming; furnishing, placing, finishing and curing the concrete; furnishing and setting all dowels; backfilling; and protection until final acceptance, complete in place.

13.5.2 **6-18 Curb & Gutter.** Paid for at the contract unit price per linear foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; and protection until final acceptance, complete in place.

13.5.3 **6-30 Curb & Gutter.** Paid for at the contract unit price per linear foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; and protection until final acceptance, complete in place.

13.5.4 **Mountable Curb & Gutter.** Paid for at the contract unit price per linear foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; and protection until final acceptance, complete in place.

13.5.5 **Valley Curb & Gutter.** Paid for at the contract unit price per linear foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; and protection until final acceptance, complete in place.

13.5.6 **Concrete Water Table.** Paid for at the contract unit price per square foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing the concrete; and protection until final acceptance, complete in place.

13.5.7 **Asphaltic Concrete Curb.** Paid for at the contract unit price per linear foot, which price will be full compensation for preparing the subgrade; forming; furnishing, placing, finishing, and curing; and protection until final acceptance, complete in place.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Earthwork Drainage Facilities

2023

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Earthwork Drainage Facilities:

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14.1 Scope: 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 Engineer.

14.2 Materials and Equipment:

14.2.1 **Lumber.** Lumber to be used for bracing trenches may be any species suitable for such purposes or as specified in the Contract Documents.

14.2.2 **Pit Run gravel.** Pit run gravel shall consist of one of the three (3) gradations shown in the table below:

Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)							
Sieve Size	2½"	1¾"	1½"	1"	⅜"	No. 40	Clay *
Passing	100%	95-100%	-	-	35-65%	10-30%	1-12%
	-	100%	95-100%	-	40-65%	10-30%	1-12%
	-	-	100%	90-100%	45-65%	10-35%	2-12%

* Clay content will be determined by the Hydrometer Test-AASHTO T88.
Clay content up to 15 percent may be used with the approval of the Engineer.

14.2.2.1 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 twenty-five (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

14.2.3 **Backfill Material.** Material for backfill shall be fine compactable soil selected from site excavation if approved by the Engineer as being suitable. Additional material needed shall be obtained from borrow excavation. Select backfill materials will be specified on plans as necessary.

14.2.4 **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.

14.3 Construction Requirements:

14.3.1 **General.** All excavation performed under this Section including trench excavation, structure excavation, and channel excavation but excluding undercut excavation 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 Standard Details for Typical Repair of Utility Cuts in Pavement.

14.3.2 **Undercut Excavation.** Undercut excavation shall consist of removing and disposing of soft, spongy earth, mulch, 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 Engineer. No undercut excavation shall be performed without prior authorization of the Engineer in writing. The limits of undercut excavation will be determined by the Engineer, who will be present during the undercut operations. Undercut areas shall be backfilled with suitable materials as specified on the plans to the grade established on the Plans. The backfill shall be placed in six (6) inch maximum lifts and compacted by use of appropriate mechanical compaction equipment.

14.3.3 **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 digging or unauthorized excavation, shall be at the Contractors 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 Section 14.3.2 unless otherwise directed by the Engineer. 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 Section 14.3.2. The unauthorized excavation outside of side excavation limits shall be backfilled with select material unless otherwise directed by the Engineer. The backfill shall be compacted in accordance with Section 14.3.2 of these Specifications.

14.3.4 **Change in Excavation Location or Grade.** If the Engineer 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.

14.3.4.1 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 center line. If the changed location or grade introduces a new depth classification not included in the Proposal Sheet(s), a Change Order will be prepared in accordance with these Specifications. 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 ten (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 ten (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 one (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 one (1) foot wide strip along both conditions and then divided by the proper lengths.

14.3.4.2 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 or a portion of an existing excavation is required due to a change by the Engineer, 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.

14.3.4.3 Filling a portion of existing excavation to meet changed grades will be accomplished in accordance with Section 14.3.2 of these Specifications.

14.3.4.4 If a change in location and/or grade is authorized in writing by the Engineer at the written request of the Contractor; whether before or after excavation work has begun; the Contractor will not receive any 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 as appropriate will be used to develop payment.

14.3.5 **Disposition of Excavated Material.** Excavated materials suitable for backfill shall be stored no closer than two (2) feet from the edge of the excavation to allow free passage of the Engineer and permit the Engineer 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. 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 Engineer 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 Engineer. 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 Engineer.

14.3.6 **Control of Storm-water.** 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 Engineer, 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. 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 Engineer.

14.3.7 **Excavation Around Obstructions.** 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. 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.

14.3.8 **Trench Excavation.** All trenches shall be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking will be allowed only on permission of the Engineer, unless otherwise shown on the Plans, and complete record thereof shall be kept in the Contractor's project diary.

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 Engineer. 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.

No more than two-hundred (200) feet of trench shall be opened at any time in advance of the completed storm drain, nor shall more than one-hundred (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.

The width of trenches below a level one (1) foot above the outside top of pipe shall be such as to leave not less than six (6) inches on each side of the outside of the pipe for all sizes up to and including fifteen (15) inch diameter pipe. Maximum trench width dimension for these pipe sizes shall be thirty-six (36) inches. For eighteen (18) inch diameter pipe, the width of trenches below a level one (1) foot above the outside top of pipes shall be such as to allow not less than six (6) inches on each side of the pipe, with a maximum trench width of forty-two (42) inches. For pipe sizes over eighteen (18) inches, the width of trenches below a level one (1) foot above the outside top of the pipe shall be such as to allow not less than twelve (12) nor more than fifteen (15) inches on each side of the outside top of the pipe. If the trench width at or below that level one (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 Contractors expense. For pipes other than circular, trench widths shall be adjusted to provide for the additional pipe width along the horizontal axis.

The sides of the trench below a level one (1) foot above the outside top of pipe 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 Engineer before storm drains are laid thereon. 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.

14.3.9 **Excavation for Drainage Structures.** 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 Engineer. 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.

The outside dimensions of all manholes, inlets, box culverts, channel lining, and other drainage structure excavations shall be at least twelve (12) inches greater than the outside of the masonry or concrete work to permit backfilling around the structure.

Where structures are to be built in street right-of-way or paved areas, the excavation shall not exceed two (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 Section 14.3.17 of these Specifications.

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.

14.3.10 **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 Engineer. 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 Engineer.

14.3.11 **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 Engineer so direct.

14.3.12 **Sheeting and Shoring.** 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 Engineer's instructions.

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 Section 14.3.8 below an elevation one (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.

Sheeting, bracing, and shoring shall be withdrawn and removed as the backfilling is being done, except where and to such extent as the Engineer shall order that sheeting, bracing, and shoring be left in place, or where the Engineer will permit the same to be left in place at the Contractor's request The Contractor shall cut off any such sheeting at least two (2) feet below the surface and shall remove the cutoff material from the excavation.

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 the structures, utilities, sewers, or property whether public or private. The Contractor shall exercise care to prevent the opening of voids during the extraction process.

Steel drag shields or trench boxes may be used in lieu of sheeting, shoring, and bracing unless the Engineer directs otherwise.

14.3.13 **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 Engineer, and no extra compensation will be allowed for the additional material or work.

14.3.14 **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 Engineer and receive approval of 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 shall be made to the Contractor.

14.3.15 **Underpinning.** When excavations require underpinning of existing structures, the Contractor shall submit shop drawings of underpinning details to the Engineer prior to commencement of excavation below the foundation of the structure. Review of underpinning details by the Engineer shall not relieve the Contractor of his responsibility for protection of the structure and its contents.

14.3.16 **Existing Utilities.**

14.3.16.1 **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.

14.3.16.2 **Protection:** 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.

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.

14.3.16.3 **Service Connections:** 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 (2) consecutive hours. The occupants shall be notified by the Contractor at least six (6) 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.

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 Engineer.

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 Section 14.5.4 of these Specifications.

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.

14.3.17 **Backfilling.** Bedding for drainage facilities shall be constructed. in accordance with the following specifications for the various type facilities:

Storm Drain Pipe Installation – Section 15
Drainage Manholes, Inlets & Structures – Section 16

After drainage facilities have been bedded and installed in accordance with appropriate specifications and upon permission of the Engineer, 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.

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.

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.

All backfill shall be placed in uniform horizontal layers. "Ramping," that is pushing backfill material down a ramp into excavated areas, will not be permitted unless authorized in writing by the Engineer.

14.3.18 **Backfilling in Street Right-of-Way and Improved Property.**

14.3.18.1 **Backfill Material within 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 Engineer orders, shall be installed in controlled lifts after the pipe has been bedded from the top of the pipe to finished subgrade elevation. The lifts have to be controlled so that the maximum compacted thickness is six (6) inches. Each layer shall be compacted to not less than ninety-five (95%) percent of maximum standard density as determined in accordance with AASHTO T99. The moisture content of the compacted material must be plus or minus two (±2%) percent of optimum. No layer of material shall be added to the trench until the preceding layer has been tested and found satisfactory. The Contractor shall ensure that a field technician is present at all times when trenches are being backfilled to perform and record the results of the required tests. Pea gravel, sand or similar granular materials approximately uniform in size and without bonding properties shall not be used. At the Contractor's option, he may choose to use either size No. 57 or No. 67 limestone aggregate backfill. No additional compensation will be made if the Contractor chooses to use the aggregate backfill.

14.3.18.2 **Backfill Material Outside of Pavement Areas:** Backfill in excavations outside of pavement in street right f-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 I inch of the surface in areas to be sodded, or to the surface in all other areas. 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 six (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 well distributed, and that all voids are completely filled with fine materials. The upper three (3) feet of backfill in sodded or planted areas shall be free of such rocks or lumps larger than one (1) inch in diameter.

14.3.18.3 **Placement and Compaction.**

14.3.18.3.1 **Storm Drain Trenches:** As soon as the pipe has been bedded, laid, jointed, and inspected by the Engineer, backfilling shall continue in the following manner. Backfill shall be placed by hand in six (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 two (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 twelve (12) inch loose layers and compacted to ninety-five (95%) percent of maximum density at plus or minus two (±2) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (AASHTO T99).

14.3.18.3.2 **Structure and Box Culvert Excavations:** As soon as the masonry or concrete work has set sufficiently to withstand compaction, and the Engineer has inspected it, suitable backfill shall be placed in six (6) inch loose layers

concurrently and uniformly on all sides and compacted with heavy tampers or pneumatic tampers to ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test (AASHTO T 99). 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.

14.3.18.3.3 **Concrete Channel Lining Excavations:** As soon as concrete work has set sufficiently to withstand backfilling and has been inspected by the Engineer, 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 three (3) inches above the top of the wall. Backfill will be rounded slightly adjacent to the top of wall to an elevation I 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.

14.3.19 **Backfilling in Open Areas and Unimproved Property.**

14.3.19.1 **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 Section 14.3.18 of these Specifications. 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 six (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.

14.3.19.2 **Placement of Backfill:** Backfill procedures specified for improved areas shall apply from the trench bottom to a point two (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.

14.3.20 **Drainage Facilities Placed on Fill.**

14.3.20.1 **Suitable Material:** 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.

14.3.20.2 **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 ninety-five (95%) percent of maximum density at plus or minus two (±2%) percent of optimum moisture content as determined by Laboratory Standard Proctor Test

(AASHTO T99) up to a point at least two (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 ten (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 five (5) feet outside of the facility base slab.

14.3.21 **Final Grading.** 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. Slopes should not be steeper than three-to-one (3:1) on adjoining properties unless otherwise specified on the plans.

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 Engineer. Grading shall provide adequate drainage over the top of channel walls. Side slopes shall be graded to provide a minimum slope of one-half (½) inch per foot beginning three (3) inches above the top of channel walls. Side slopes shall be rounded off near the channel wall to an elevation of one (1) inch above the top of wall. The addition of sod will provide a final side slope elevation two (2) inches above the top of wall.

14.4 Measurement:

14.4.1 **Undercut Backfill.** Undercut backfill will be measured by the cubic yard of suitable material upon prior authorization by the Engineer.

14.4.2 **Sheeting and Shoring Directed to Remain in Place.** Sheeting and shoring directed to remain in place will be measured by the one-thousand (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.

14.4.3 **Pavement Backfill.** Pit run gravel or other suitable materials used for backfill under pavements or other areas indicated on the Plans or required by these Specifications will not be measured for payment, but will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

14.4.4 **Unlined Channel.** Unlined channel will be measured per linear foot along the center line for various channel cross sections, complete in place.

14.4.5 **Sewer Service Connection Removal and Replacement.** Sewer service connection removal and replacement for construction of drainage facilities shall be measured per each, complete in place. Sewer service connections damage by the Contractor, which do not require removal and replacement for construction of drainage facilities, will not be measured for payment.

14.4.6 **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.

14.4.7 **Compaction Testing.** Compaction tests for backfill of all trenches within the right-of-way shall be required. Tests will be paid for by the Contractor and performed by a qualified testing agency.

14.5 Payment:

14.5.1 **Undercut Backfill.** Accepted quantities of undercut backfill will be paid for a the contract unit price per cubic yard 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.

14.5.2 **Sheeting and Shoring Directed to Remain in Place.** Accepted quantities of sheeting and shoring directed by the Engineer to remain in place will be paid for at the contract unit price per one-thousand (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.

14.5.3 **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.

14.5.4 **Sewer Service 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.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Storm Drain Pipe Construction

2023

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Storm Drain Pipe Construction:

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15.1 Scope: This work shall consist of the construction of storm drain pipe of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction shall be accomplished in accordance with 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 .The work shall include such labor, material, equipment, bedding, laying pipe, making joints, tunneling or jacking, encasement, foundation concrete, connection to other drainage structures, abandonment or removal of pipe, and all other items as may be necessary to complete the storm drains as shown on the Plans.

15.2 Materials and Equipment: 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.

15.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

15.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Storm drainage pipe shall be the standard product of a manufacturer of established good reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the pipe.

15.2.3 **Material Inspection and Testing.**

15.2.3.1 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 (3) copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. The performance or cost of all testing is the responsibility of the Contractor.

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

15.2.3.3 All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

15.2.4 **Storage.** 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.

15.2.5 **Reinforced Concrete Pipe (RCP).**

15.2.5.1 All reinforced concrete pipe shall conform to the requirements of ASTM Standards for the specified diameter and strength class as follows:

15.2.5.1.1 Arch Pipe – ASTM C506

15.2.5.1.2 Circular Pipe – ASTM C76 (Wall B)

15.2.5.1.3 Horizontal and Vertical Elliptical Pipe – ASTM C507

15.2.5.2 Strength class or classes shall be as required by the Plans or Contract Documents, but in no case shall pipe of less than strength Class III be used. The interior surfaces of the pipe shall be a smooth, true cylindrical surface free from undulations or corrugations. Lifting holes when provided shall be cast in the wall of the pipe to receive a precast truncated conical concrete plug of such size as will allow one-eighth (⅛) inch cementing material on the sides of the joining surfaces of the plug and will fill at least fifty (50%) percent of the lifting hole depth. Cement shall meet all the requirements of the Specifications for Portland cement, ASTM C150, Type II. Curved alignments shall be constructed with precast, beveled end concrete radius pipe which meet the same requirements as for straight pipe. Concrete radius pipe less than or equal to thirty-six (36) inch diameter shall have a minimum centerline radius of twenty (20) feet and all radius pipe greater than 36 inch diameter and less than seventy-two (72) inch diameter shall have a minimum centerline radius of thirty (30) feet.

15.2.5.3 Joints in reinforced concrete pipe shall conform to one of the following types:

15.2.5.3.1 Portland Cement Mortar Joint Type

15.2.5.3.2 Flexible Butyl Rope Gasket Type – AASHTO M198 (type B)

15.2.5.3.3 Flexible Plastic Rope Gasket Type – AASHTO M198 (type B)

15.2.5.3.4 Rubber wedge shaped, sliding seal, pre-lubricated gasket-ASTM C443, ASTM C361.

15.2.5.4 Type D, Portland cement mortar joint, may only be used on radial, elliptical, and arch pipe. The shape, dimensions and tolerance of the bell and spigot or tongue and groove ends of the pipe shall be compatible with the type joint used and shall conform to the above referenced specifications.

15.2.6 **Corrugated Steel Pipe (CSP).**

15.2.6.1 All corrugated steel pipe shall be zinc coated (galvanized) corrugated steel pipe conforming to AASHTO M36 Type I and Type II pipe. All special sections such as radii and flared end sections shall be the same sheet thickness and corrugation dimensions as adjoining pipe and shall conform to AASHTO M36 unless specified otherwise on the Plans or Contract Documents. Sheet thickness and corrugation dimensions of pipe and specials shall be as indicated on the Plans or Contract Documents. Type IA pipe will not be permitted. When elongated pipe is called for by the contract, the pipe shall be shop formed to provide for a five (5%) percent vertical elongation. The zinc coated sheets used to manufacture the pipe and specials shall conform to AASHTO M218. Corrugated steel pipe shall have one of the following protective coating systems:

15.2.6.1.1 Pipe and specials described above shall be asbestos bonded fully bituminous coated and fully paved. The zinc coated steel sheets shall have a layer of long asbestos fibers firmly pressed into the molten zinc coating. Seams for annularly corrugated shall be riveted with the rivets inside of the corrugation valleys. Seams for helically corrugated pipe shall be lock seam. The metal to be coated shall be free of grease, dirt, and other contaminants. Bituminous coating and paving shall conform to the requirements of AASHTO M190 for Type D pipe. The coating shall be applied in accordance with recommended procedures and as directed by the Engineer.

15.2.6.1.2 Pipe and specials described above shall be aluminized steel Type II CSP Grade conforming to AASHTO M274 and be fully bituminous coated and fully paved. The metal to be coated shall be free of grease, dirt, and other contaminants. Bituminous coating and paving shall conform to the requirements of AASHTO M190 for Type D pipe. The coating shall be applied in accordance with recommended procedures and as directed by the Engineer.

15.2.6.2 All corrugated steel pipe shall be furnished with lifting straps for handling. The lifting straps may be attached by welding. No burning of holes will be permitted.

15.2.6.3 All connections shall conform to AASHTO M36 with the following exceptions:

15.2.6.3.1 Coupling bands shall have the same material and corrosion protection coatings as the pipe and specials which they connect.

15.2.6.3.2 Coupling bands shall be of the circumferential locking band type with 0-ring gasket. Bands shall be of sufficient width to match with two corrugation bands on either side of the pipe ends.

15.2.6.4 Field applied bituminous coatings for filling joints between adjacent paved inverts and coating coupling bands and all touch-up work shall conform to AASHTO M243.

15.2.6.5 All corrugated steel pipe radii shall be shop fabricated to provide a smooth internal radius of not less than the following for various size pipes:

15.2.6.5.1 CSP less than or equal to thirty-six (36) inch diameter – twenty (20) foot radius.

15.2.6.5.2 CSP greater than thirty-six (36) inch diameter and less than seventy-two (72) inch diameter – thirty (30) foot radius.

15.2.6.6 Unless specified by the Plans or Design Standards, No elbows, tees, wyes, and similar specials shall be permitted.

15.2.7 **Corrugated High Density Polyethylene Pipe (HDPE):**

15.2.7.1 Corrugated high density polyethylene pipe shall have a full circular cross-section, with an outer corrugated pipe wall and an essentially smooth inner wall, or with an essentially smooth waterway braced circumferentially with circular ribs which are formed simultaneously with an essentially smooth outer wall. All sizes shall conform to the AASHTO Classification Type S or D (pipe with a smooth waterway).

15.2.7.2 The pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M294 and/or MP6-95, latest edition. Pipe and fittings shall be made from virgin PE compounds which conform with the requirements of cell classification 335420C as defined and described in ASTM 03350.

15.2.7.3 The fittings shall not reduce or impair the overall integrity or function of the pipe line. Common fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. Couplings shall be of the bell and spigot type and provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. The spigot and O-ring gaskets for the bell and spigot coupling shall be manufactured in accordance with ASTM specifications. Only fittings supplied or recommended by the pipe manufacturer shall be used and as approved by the Engineer.

15.2.7.4 The minimum parallel plate stiffness values when tested in accordance with ASTM D2412 shall be as follows:

Diameter Ø (inches)	Pipe Stiffness (psi)
12” Ø	50 psi
15” Ø	42 psi
18” Ø	40 psi
24” Ø	34 psi
30” Ø	28 psi
36” Ø	22 psi
42” Ø	19 psi
48” Ø	17 psi

15.2.8 **Ductile Iron Culvert Pipe.** All ductile iron culvert pipe shall conform to the requirements of ASTM A716 for the specified diameters and strength classes. All pipe shall be smooth and circular in cross section. All gray and ductile iron fittings shall conform to the requirements of ANSI A21.10 for the specified diameters. All joints shall be push-on type conforming to the requirements of ANSI A21.11 for the specified diameters. All pipe shall be bituminous coated inside and out.

15.2.9 **Vitrified Clay Culvert Pipe.** All vitrified clay culvert pipe shall meet the requirements of ASTM C700 for Extra Strength Clay Pipe. All joints shall be compression type meeting the requirements of ASTM C425.

15.2.10 **Portland Cement Concrete.** Unless noted on the Plans or directed by the Engineer, Portland Cement Concrete for storm drain pipe installation shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery, shall be as specified in Standard Specifications Section 23, Portland Cement Concrete.

15.2.10.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

15.2.10.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

15.2.10.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

15.2.11 **Crushed Limestone.** 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:

No. 67 Coarse Aggregate Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)					
Sieve Size	1"	¾"	⅜"	No. 4	No. 8
Passing	100%	90-100%	20-55%	0-10%	0-5%

15.2.13 **Mortar.** Mortar shall be composed of one (1) part Portland cement, two (2) parts masonry sand, hydrated lime not to exceed ten (10%) percent of the cement used, and four (4) parts water. All ingredients shall be proportioned by measurement and not by estimation. All Portland cement, sand, and water shall be as specified in Standard Specifications Section 23, Portland Cement Concrete. All hydrated lime shall be as specified by ASTM C6.

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

15.2.14 **Bracing Lumber.** Lumber for tunnel bracing shall be sound bridge oak placed to form a structurally sound timber tunnel lining properly braced. The timber tunnel lining shall remain in place after laying the pipe and backfilling. All timbers used in tunnels shall be of good quality reasonably straight grained and free from weakening knots and other defects.

15.2.15 **Equipment.** The equipment provided by the Contractor shall include hoisting equipment capable of handling and placing the pipe in final position without damage to the pipe. Mechanical tamps shall also be provided.

All of the above equipment, as well as any additional equipment necessary for the satisfactory performance of this construction, shall be on the project and inspected by the Engineer before work will be permitted to begin.

15.3 Construction Requirements:

15.3.1 Modifications to Existing Storm Drain.

15.3.1.1 **Abandonment of Drainage Pipe:** Drainage pipe to be abandoned shall be sealed by mortaring (bricking) the end of the pipe for a distance of eighteen (18) inches minimum, or one-half (½) the diameter (Ø) of the pipe, whichever is larger. The pipe shall be sealed with solid concrete block or brick and acceptable cement grout to form a solid waterproof plug completely bonded to the pipe, unless otherwise specified.

The Contractor will be allowed to remove that portion of the pipe to be abandoned in lieu of filling and blocking. If the Contractor elects the removal method, all costs for backfilling the excavation and all costs for surface restoration, in addition to removing and properly disposing of the pipe, shall be included in the unit bid price for Abandonment.

15.3.1.2 **Connection to Existing Structures:** The Contractor shall cut suitable openings as approved by the Engineer into existing structures or remove existing pipe to accommodate the drain pipe if at the proper elevation, location, and direction, as indicated on the Plans. The existing pipe shall be removed or a hole cut in the structure wall to permit inserting the drain pipe at the required flow line elevation, horizontal angle, and slope, and to allow two (2) inches space around the pipe for bedding and filling solidly with mortar. Care shall be used to avoid unnecessary damage to the existing masonry.

All loose material shall be removed from the cut surfaces, which shall be completely coated with mortar before setting the pipe. If the structure wall is reinforced concrete, a cage of steel reinforcement shall be installed and the existing bars reshaped and tied to the cage around the entire pipe before mortar is placed in accordance with the Design Standard. Before inserting the pipe, a sufficient thickness of mortar shall be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe shall be solidly filled with mortar and neatly pointed up or the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions in the existing invert shall be made to provide a smooth plastered surface for properly channeled drainage from the new connection. Particular care shall be given to ensure that the earth sub-base and bedding adjacent to the manhole will provide firm solid support to the pipe.

15.3.1.3 **Removal of Drainage Pipe:** Existing pipes to be removed and their locations are shown on the Plans. Unless otherwise indicated in the Plans or Contract Documents, all salvageable material shall become the property of the Contractor who will be responsible for properly disposing of same off-site. All pipe whose removal is required to facilitate the installation of the proposed drainage facilities shall be removed without separate measurement or payment. This work shall be included in the price of the new drainage facility.

15.3.2 **Storm Drain Pipe Installation.**

15.3.2.1 **General:** Drain pipe and bedding shall be constructed of the sizes, classes, dimensions, and materials and to the alignments and grades shown on the Plans.

15.3.2.2 **Pipe Bedding:** Bedding for concrete, ductile iron and vitrified clay drainage pipe shall conform to the requirements given below for Class A, B, or C bedding, whichever is shown on the Plans. If the class of bedding is not shown, a minimum of Class C bedding shall be provided.

15.3.2.2.1 **Class A Bedding – Concrete Cradle:**

Class A bedding for drainage pipe shall consist of a continuous concrete cradle up to spring-line constructed in conformity with the details shown on the Plans or as directed by the Engineer.

15.3.2.2.2 **Class B Bedding – Crushed Limestone:**

Class B bedding shall be constructed by bedding the drainage pipe on a six (6) inch thickness of crushed limestone and sufficient additional crushed limestone which is accurately shaped by a template to fit the lower part of the pipe exterior for at least ten (10%) percent of its overall height. After pipe installation, crushed limestone shall then be rammed under the haunches and tamped in layers not over six (6) inches in loose thickness around the pipe to the spring-line. The remaining depth of trench shall then be backfilled and compacted as specified in Standard Specifications Section 14, Earthwork Drainage Facilities. When bell and spigot pipe is to be placed, recesses shall be dug in the bedding material of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than two (2) inches.

15.3.2.2.3 **Class C Bedding – Natural Subgrade (undisturbed):**

Class C bedding shall be constructed by bedding the drainage pipe on a natural earth subgrade shaped by a template to fit the lower part of the pipe exterior for at least ten (10%) percent of its overall height. After pipe installation, select earth material shall then be rammed and tamped in layers not over six (6) inches in loose thickness around the pipe to the spring-line. The remaining depth of trench shall then be backfilled and compacted as specified in Standard Specifications Section 14, Earthwork Drainage Facilities. When bell and spigot pipe is to be placed, recesses shall be dug in the subgrade of sufficient width and depth to accommodate the bell without its resting on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than two (2) inches.

15.3.2.3 **Pipe Installation.**

15.3.2.3.1 The Contractor shall inspect all pipe upon delivery and such pipe as does not conform to the requirements of these Specifications and which are not suitable for use shall be rejected and immediately removed from the work site.

15.3.2.3.2 Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed or of the factory made jointing materials shall be clean and dry. All necessary lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturers' specifications.

15.3.2.3.3 Equipment used to handle, lay and joint pipe shall be so equipped and used as to prevent damage to the pipe and its jointing materials. All pipe and fittings shall be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be accepted and shall not be installed. All rejected material shall be removed from the job site.

15.3.2.3.4 Special care shall be taken to ensure that the pipe is solidly and uniformly bedded, cradled, or encased in accordance with the type of bedding, cradle, or encasement required by the Plans. No pipe shall be brought into position for joining until the preceding length has been bedded, joined and secured in place.

Where concrete cradle is required, the pipe shall be supported at not more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

15.3.2.3.5 The laying of pipe in finished trenches shall be commenced at the lowest point. When installed, the bell or grooved end shall be forward or upgrade. All pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered so that when laid, they will form a drain with a uniform invert.

15.3.2.3.6 Each piece of pipe shall be checked for vertical and horizontal alignment immediately after being laid.

15.3.2.3.7 The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench. Water shall not be allowed to rise in the trench until the joint materials and any concrete cradle or encasement is hardened and cannot be damaged by the water.

15.3.2.3.8 Whenever pipe laying is stopped for any significant length of time, such as the end of a workday, the unfinished end shall be protected from displacement, flotation, cave-in, in-wash of soil or debris, or other injuries. A suitable temporary tight fitting plug, stopper, or bulkhead shall be placed in the exposed ends of the pipe.

15.3.2.3.9 Curved storm drain alignments shall be constructed with manufactured, beveled end radius pipe for circular pipe sizes of twenty-one (21) inch diameter and larger. Curved

storm drain alignments for noncircular pipe and circular pipe smaller than twenty-one (21) inch diameter shall be constructed with a brick radius. Brick radius shall be constructed to the radius and dimensions shown on he Plans, but not less than twenty (20) foot radius, and in accordance with Standard Specifications Section 16.3.2.2.5. Curved storm drain alignments shall not be constructed by breaking joints of straight pipe sections. Curved alignments of corrugated metal and corrugated high density polyethylene pipe storm drain shall be constructed of shop fabricated radii constructed to the radius specified.

15.3.2.4 **Pipe Joint.**

15.3.2.4.1 **General:** Jointing operations shall continue immediately following the installation of such pipe section. In no case shall any pipe section be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.

15.3.2.4.2 **Reinforced Concrete Pipe (RCP):**

15.3.2.4.2.1 **Rubber Wedge Shaped, Sliding Seal, Pre-lubricated Gasket Joints:**

The two ends to be joined shall be thoroughly cleaned and a rubber gasket compatible· with the type of pipe ends to be joined shall be placed on the tongue or spigot end of the pipe. Care shall be taken to assure even tensioning and uniform cross-section of the gasket around the full circumference of the pipe. When required, lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the tongue or spigot may enter the groove or bell squarely. The pre-lubricated gasket shall be kept in a closed bag until ready to be used.

Suitable means shall be used to force the tongue or spigot end of the pipe into the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Any pipe or gasket damaged during jointing operations shall be removed and pipe shall be re-jointed at the Contractor's expense.

15.3.2.4.2.2 **Plastic or Butyl Gasket Joints:**

The two ends of flexible gaskets to be joined shall be thoroughly cleaned. If primers are recommended by the gasket material manufacturer, they shall be applied sufficiently in advance to allow primer to dry prior to

placement of gasket material. Protective paper shall be removed from one side of gasket and gasket laid around joint surfaces near center of final gasket position desired. Gasket material may be placed on either the bell or spigot ends of the pipe as well as the tongue or groove ends of pipe. Gasket shall be placed and pressed firmly around the entire circumference of the joint and butted end to end forming a continuous gasket without stretching the gasket material. Care shall be exercised to ensure that the proper gasket size for the associated pipe joint is used.

The upstream pipe shall be positioned and remaining protective paper removed. Suitable means shall be used to force the tongue or spigot end of the pipe into the groove or bell end without damage to the pipe and its jointing materials, and without disturbing the previously laid pipes and joints. Pipe shall be shoved home until gasket material is squeezed out of the joint. Squeeze out will be external if gasket material is placed on the tongue or spigot and internal if on the groove or bell ends of the pipe. All joints not fully filled with gasket material until "squeeze-out" occurs shall be rejoined with new gasket material at the Contractor's expense.

15.3.2.4.2.3 **Portland Cement Mortar Joints for Radius, Elliptical and Arch Pipe:**

Bell and Spigot Pipe: When the bell and spigot type of joint is used, a closely twisted hemp or oakum gasket, of such diameter as required to support the spigot of the pipe at the proper grade and make truly concentric joints and in one piece of sufficient length to pass around the pipe and meet at the top, shall be thoroughly saturated in Portland cement mortar. This gasket shall be laid in the bell for the lower third of the circumference of the joint and covered with mortar specified for pipe joining. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted, and carefully driven home, after which a small amount of mortar shall be inserted in the annular space around the entire circumference of the pipe.

The ends of the gasket shall then be wrapped around the pipe and solidly rammed into the joint with a caulking tool; the mortar previously placed being driven ahead of the gasket. The remainder of the joint shall then be completely filled with mortar and beveled off to an angle of forty-five (45°) degrees with the outside of the pipe.

The fresh mortar joint shall then be protected by wrapping with a strip of suitable tight woven cloth passed under the pipe, drawn up tight around the joint and tied at the top with a knot behind the bell. The bell hole under the pipe shall then be fully packed with cement mortar.

On pipes of twenty-four (24) inches or larger in diameter, the joints shall be pointed and smoothed from the inside and excess or wasted mortar removed from the inside of the pipe. On smaller pipes, the inside of the pipe shall be smoothed and wasted mortar removed. Excess mortar on the inside of small diameter pipe shall be struck and smoothed using the backside of a pointed shovel.

Tongue and Groove Pipe: When the tongue and groove type of joint is used, the groove end of the first pipe must be thoroughly cleaned with a wet brush and a layer of soft mortar applied to the lower half of the groove. The tongue end of the second pipe must be thoroughly cleaned with a wet brush and, while in a horizontal position, a layer of soft mortar applied to the upper half of the tongue. The tongue end of the second pipe is then inserted into the groove end of the first pipe until the mortar is squeezed out on the interior and exterior surface. The pipe is then to be partially bedded in place in the trench by tamping dirt on both sides leaving a gap or open space at the joints, special care being exercised so that no dirt gets into the joint. The annular space is then to be completely filled by calking mortar into the joint from the outside and on the inside around the entire perimeter of the pipe. A strip or band of cement mortar one (1) inch thick and three (3) inches wide shall then be built up around the entire outside perimeter of the pipe. The joint shall then be protected by wrapping with a strip of burlap, cotton cloth, or strong waterproof paper of suitable width. This strip of protective covering shall pass underneath the pipe, be drawn up tight around the joint and securely fastened at the top. The space under the pipe at the joint shall then be packed with mortar. In addition to the above outlined method of sealing pipe joints, the Contractor will be required to caulk the joints with mortar around the entire perimeter of the pipe on the inside, finally pointing up and brushing the joint to a smooth finish.

15.3.2.4.2.4 **Poured Mortar Joint:** A continuous diaper shall be placed around the outside of each joint with a twelve (12) inch gap at the top for pouring. Diapers shall consist of heavy cotton, burlap or approved synthetic fiber of such strength and texture that leakage and sagging under the weight of the grout will be prevented. Diapers shall be attached to the pipe with steel wires or bands of adequate strength to hold the loaded diaper without stretching or slipping. Diapers shall be filled with mortar. Consistency of the mortar shall be such that the diaper will be completely filled in one continuous pouring operation. The pouring space at the top of the joint shall be plastered with mortar. Diapers shall be left in place. Provision shall be made on the inside of the pipe to prevent loss of mortar through the joint. The Contractor shall then grout the joint around the entire perimeter of the pipe on the inside with stiff mortar, point and brush the joint to a smooth finish.

15.3.2.4.2.5 **Jointing Tolerances**: The maximum allowable joint width measured on the inside surface of concrete pipe shall not be more than three-quarters (¾) inch for pipe sizes fifteen (15) inches through twenty-one (21) inches in inside diameter; one (1) inch for pipe sizes twenty-four (24) inches through forty-five (45) inches in inside diameter; and one and one-quarter (1¼) inch for pipe sizes forty-eight (48) inches and larger in inside diameter. When the width of any joint exceeds the foregoing limits, the Engineer will determine the acceptability of the joint, the requirements for acceptable repair, or will reject the joint to require relaying and re-jointing.

15.3.2.4.2.6 **Lift-Holes for Reinforced Concrete Pipe:** Before backfilling of concrete pipe provided with lift-holes, the Contractor shall ensure that all pipe has been placed with the lift-holes placed in the vertical position. The lift holes shall then be sealed by inserting a truncated conical concrete plug in each lift hole. The plug shall be of such size that it can be inserted at fifty (50%) percent of the lift-hole depth. Prior to inserting the plug, the edges of the lift-hole shall be wiped with a concrete mortar in such a manner so as to ensure a minimum of one-quarter (¼) inch thickness of mortar is built up completely around the opening. The plug shall then be forced into the lift-hole so that the mortar is squeezed out around the plug. The Contractor shall then build up a mortar cap over the plug that extends a minimum of six (6) inches in all directions beyond the edge of the lift-hole and in a minimum of three (3) inches

thick over the top of the plug. The Contractor shall take care not to damage the mortar cap over the plug as backfill of the pipe continues. Any mortar that falls through inside the pipe during this process shall be promptly cleaned up.

15.3.2.4.3 **Corrugated Steel Pipe (CSP):**

15.3.2.4.3.1 **Coupling Band:** The two ends to be joined and the coupling band shall be thoroughly cleaned within the area to be covered by the coupling band and the inside of the coupling band. The coupling band and ring gasket shall be placed on the end of the pipe section to be lowered into the trench such that one-half the band width is exposed. Care shall be taken during the pipe positioning operations to prevent dirt or foreign matter from becoming lodged between the pipe ends and the coupling band. The upstream pipe shall be positioned such that the two pipe ends butt together squarely. Coupling bands shall be positioned such that the band corrugations and 0-ring gaskets are aligned with the pipe corrugations and the coupling band laps on an equal portion of each pipe section. Fastening devices shall be located to facilitate ease of tightening. Fastening bolts shall be tightened uniformly to the required torque recommended by the pipe manufacturer but shall not be over tightened creating excessive stresses in the pipe. After coupling band installation, the interior joint between asphalt pavements shall be completely filled with trowel grade mastic material as outlined in this Specification. The mastic shall be brought up flush with the asphalt pavement surfaces being joined. The entire exterior of each joint assembly, including bands, rods, lugs, bolts, and nuts shall be given one coat of mastic material of spraying or brushing consistency.

15.3.2.4.3.2 **Jointing Tolerances:** The maximum allowable separation between adjoining sections of pipe when measured on the inside surface of corrugated steel pipe shall not be more than one (1) inch. When the width of any joint exceeds the foregoing limits, the Engineer will reject the joint and require relaying and re-jointing.

15.3.2.4.4 **Ductile Iron Pipe (DIP):** The two ends to be joined shall be thoroughly cleaned and a rubber gasket compatible with the type of pipe ends to be joined shall be placed on the spigot end of the pipe. Lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and both ends of the pipe immediately before pipe ends are joined. The

upstream pipe shall be positioned such that the spigot may enter the bell squarely. Suitable means shall be used to force the spigot end of the pipe into the bell end without damage to the pipe and its jointing materials and without disturbing the previously laid pipes and joints.

15.3.2.4.5 **Vitrified Clay Culvert Pipe (VCCP):** The two ends to be joined shall be thoroughly cleaned and a compression gasket compatible with the type of pipe ends to be joined shall be placed on the spigot end of the pipe. Lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket and-both ends of the pipe immediately before pipe ends are joined. The upstream pipe shall be positioned such that the spigot may enter the bell squarely. Suitable means shall be used to force the spigot end of the pipe into the bell end without damage to the pipe and its jointing materials and without disturbing the previously laid pipes and joints.

15.3.2.4.6 **Corrugated High Density Polyethylene Pipe:**

15.3.2.4.6.1 **Bell and Spigot Joint:** Thoroughly clean the bell and spigot ends, making sure they are free of mud and grit. Be sure the gasket and gasket seat is clean. Lubricant recommended by the joint material manufacturer shall be liberally applied to the gasket, spigot and bell end of the pipe. The upstream end shall be positioned such that the spigot may enter the bell squarely and push the spigot home. Use a bar and wood block on larger diameters when necessary, making sure the block protects the pipe end from the bar. When pushing the joint home, make sure the bedding material is not pulled into the bell by the spigot.

15.3.2.4.6.2 **Jointing Tolerances:** The maximum allowable joint width measured on the inside surface of the pipe shall not be more than three-quarter (¾) inch of pipe sizes fifteen (15) inches through eighteen (18) inches in inside diameters; one (1) inch for pipe sizes twenty-four (24) inches through forty-two (42) inches in inside diameter; and one and one-quarter (1¼) inch for pipe sizes forty-eight (48) inches and larger in inside diameter.

15.3.2.5 **Cleaning and Inspection.** The interior of the pipe shall, as the work progresses, be cleared of all dirt, cement extruded joint materials, debris, and extraneous materials of every description. On small pipe where cleaning after laying may be difficult, a squeegee shall be kept in the pipe line and pulled forward past each joint immediately after its completion.

All work shall be in undamaged condition and constructed properly in accordance with the Plans and Contract Documents. All defects

and leaks disclosed by tests shall be remedied. No piping shall be buried, covered, or concealed until it has been inspected, tested, and approved. To do otherwise will be grounds for rejection of the pipe by the Engineer. All tests shall be performed by the Contractor under supervision of the Engineer.

While the pipe is being laid between adjoining structures in each straight or working section of the drain, light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of such section and shall show the true character and shape of the interior surface of the drain. The test shall be applied for each working section after the drain is complete in all respects before it is accepted.

Pipe sizes thirty-six (36) inch diameter or greater shall be entered and examined while smaller diameter or equivalent diameter pipe shall be visually inspected from each end of the pipe section. Pipe sections shall be visually inspected for debris and obstructions, structural cracks and defects, deflection, alignment, joint tolerances, joint workmanship and satisfactory connection to drainage structures. If the pipe appears to have excessive misalignment or deflection, the Engineer may require a measuring device be pulled through lines smaller than thirty (30) inches diameter to verify the pipes alignment and deflection. Deflection should not exceed seven and one-half (7.5%) percent. If excessive deflection is observed or suspected, a representative deflection test shall be performed on a run of pipe selected by the Engineer or his authorized representative. If the representative pipe run passes, then the entire installation will be considered satisfactory. If the representative run is found to have excessive deflection, then the entire project shall be tested and all pipes found to have deflection in excess of seven and one-half (7.5%) percent shall be corrected.

15.3.3 **Concrete Encasement.**

15.3.3.1 Concrete encasement is to be used at the locations shown on the Plans or as directed by the Engineer. Unless otherwise noted, concrete used for encasement shall be Class A concrete.

15.3.3.2 All pipe requiring encasement shall 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.

15.3.3.3 All concrete shall be placed, cured and protected in accordance with Standard Specifications Section 3, Concrete Structures. Concrete shall be placed on either side of the pipe in approximately equal amounts to prevent movement of the pipe. Pipe alignment shall be inspected immediately following concrete placement, and any misalignment caused by the placement of concrete shall be corrected prior to the concrete's initial set. Concrete shall be protected against water flowing over the concrete until cured.

15.3.3.4 Concrete encasement is to be rectangular in section with a minimum concrete thickness of six (6) inches between the outside edge of pipe and the outside of encasement at the closest point unless shown otherwise on the Plans. Encasement around pipe joints shall extend a minimum of two (2) feet either side of the joint as measured along the centerline of the pipe. Encasement shall be reinforced if specified on the Plans or instructed by the Engineer.

15.3.4 **Tunneling and Jacking.**

15.3.4.1 **General:** Storm drain shall be constructed by tunneling or jacking only at those locations and within limits shown on the Plans or directed by the Engineer.

Where pipe is required to be installed under railroads, highways, streets, or other facilities by tunneling or jacking, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.

If any storm drain, sewer, or utility above or adjacent to the tunnel is endangered or has been damaged because of the tunneling or jacking operations or movements of earth, the owner of same shall be notified immediately and shall be given access to the work for repair. The Contractor shall repair, at his expense, any storm drain or sewer damaged during the tunneling or jacking operation. If any public or private property is endangered, or has been damaged, it shall be repaired at the Contractor's expense. All cost and expense to the Contractor of carrying out the above requirements shall be incidental to the work.

The jacking pit shall be of sufficient size to provide ample working space for the jacking equipment, reaction blocks, bracing, liner plates, spoil removal and one (1) or two (2) sections of pipe. Provisions shall 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 shall be provided. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to prevent earth caving.

The Contractor shall furnish and operate all necessary pumping equipment of ample capacity and make all necessary provisions to keep tunnels and shafts free of water during construction and to satisfactorily dispose of such water. During placing of concrete, drainage and pumping shall be so arranged that concrete is placed in the dry and that no water will flow over the concrete until it has set and will not be damaged and not sooner than two (2) hours after initial set. The Contractor shall have on hand at all times sufficient equipment in good working order for all ordinary emergencies that are likely to arise.

15.3.4.2 **Tunneling:** The Contractor shall carry out the work of tunneling and supporting the tunnel face, roof, walls, and floor so that there will be no fall or flow or caving or heaving of earth or other materials into the tunnel excavation. If there should be any fall or movement of earth into the tunnel at any time, the Contractor shall proceed with the work with all necessary precautions and in such a manner as will ensure the safety of life and of all sewers, utilities, and public and private property above and adjacent to the tunnel. The Contractor shall comply with all applicable OSHA Regulations as stipulated in Part 11, General Conditions during Tunnel Construction Work.

The Contractor shall furnish, place, and maintain all sheeting, bracing, lining or casing required to support the tunnel floor, roof, sides, and face until the pipe and its bedding, jointing, encasement, and backfilling have been completed. All liners shall

remain in place. Care shall 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 drain 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 placed against it. No part of the lining, bracing, or flanges of steel liner plates shall 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. If timber is used for lining and bracing instead of steel liner plates, invert struts shall 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, shall be properly fitted and wedged in place. Timber sets in tunnels shall be abutting. All void spaces in back of timbers shall be filled with blocking or other suitable material.

Timbering shall be so designed and placed that there will be no space or pockets that cannot be packed and filled. All excavated material not required for backfilling abandoned shafts shall be removed from the site and disposed of by the Contractor at his expense.

Shafts shall be constructed at the location shown on the Plans. Temporary construction shafts shall be of adequate size and properly constructed and equipped to meet all requirements of safety to personnel and to the work. All shafts shall be barricaded and properly guarded from the beginning of the excavation until the shaft is completely backfilled.

Provision shall be made at all shafts so that plumb lines suspended on the centerline of the drain at each end of the shaft will hang freely from the surface.

A substantially constructed ladder shall be provided in each shaft and shall be kept in safe good repair, clean, and clear of debris.

Cavities or spaces between the actual surfaces of excavation and the tunnel liner plates or sheeting, whether from avoidable or unavoidable causes, shall be completely filled with a uniform sand cement grout, consisting of one (1) part Portland cement and maximum five (5) parts sand and the minimum amount of water necessary for proper placing, placed under pressure through grout-hole nipples in the steel liner plates or grout-holes in sheeting. The grout-holes shall be so located and the grout be placed in such sequence as to ensure the complete filling of all cavities and spaces and of carrying loads uniformly from the undisturbed material to the tunnel lining or sheeting.

All pipe used in tunnels shall be reinforced concrete pipe with rubber wedge shaped, sliding seal gasket joints and shall be the strength class or classes required by the Plans.

After the tunnel section is excavated, lined, and braced, the pipe shall be placed on and supported by steel rails or other approved supports. The supporting system shall assure line and grade and shall allow space below the pipe for concrete grout. Care shall be used to avoid damage to

the pipe or to the liner plates. Any such damage shall be replaced when so directed by the Engineer.

The space between the pipe and the sides and roof of the tunnel shall be backfilled with a mixture of sand and Portland cement, mixed in the proportions of one (1) part cement to seven (7) parts sand by volume and a minimum amount of water necessary for proper placing whether placed under pressure or by hand. The cement grout shall be uniformly placed and compacted to fill all spaces between the outside of the pipe and inside surface of the sheeting or lining.

Temporary shafts shall be completely abandoned. Unless otherwise specified in the Plans or Contract Documents, all sheeting, bracing, and similar items may be removed or left in place at the Contractor's option. No payment will be made for such items left in place at the Contractor's option. If the Plans require leaving the sheeting, bracing, and similar materials in place, payment will be made as provided in Standard Specifications Section 14.5.2.

15.3.4.3 **Jacking:** Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided by the Contractor. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head (usually of timber), suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop capable of resisting the jacking forces shall be provided. The pipe to be jacked shall be set on guides, property braced together to support the section of the pipe and to direct it in the proper line and grade. For pipes greater than fifty-four (54) inch diameter or equivalent diameter, the rails shall be set in a concrete slab. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. If the Contractor desires, he 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 inside angles or lugs to keep the cutting edge from slipping back onto pipe.

The Contractor shall furnish for the Engineer's review, a plan showing his proposed method of handling, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, and similar items complete in assembled position. The review of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

Preferably, the pipe shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one (1) inch in ten (10) feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the Plans. Manholes at the ends of a section of jacked pipe shall not be constructed until the jacked section is completed, in order to allow corrections for deviations in the line or grade of the jacked section.

All pipe used in jacking shall be tongue and groove type reinforced concrete pipe with rubber wedge shaped, sliding seal joints and shall be the strength class required by the Plans or Contract Documents. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his own expense. A cushion material shall be placed between the butt ends of each pipe section adequate to

uniformly distribute the jacking forces around the entire periphery of the pipe. Cushion material shall allow proper positioning of the wedge shaped, sliding seal gasket upon completion of the jacking operation.

Embankment material shall 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. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two (2) inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero (0) at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2) feet in any case. This distance shall be decreased on instructions from the Engineer if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

When jacking of pipe is begun, the operation shall be carried on without interruption, until completion, to prevent the pipe from becoming firmly set in the embankment.

The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed in accordance with applicable Specification Section 14.3.17, 14.3.18, or 14.3.19.

15.3.4.4 **Pipe Drains in Jacked Liner:** When permitted as an alternate method of construction by the Plans or Contract Documents, or when permitted by the Engineer upon written request of the Contractor as an alternate to jacking without a liner of tunneling, a storm drain may be installed by jacking a pipe as a liner and inserting a carrier pipe of required size, type and class. When planning to use jacking for lines, the contractor shall state, in writing, the kind, type and strength of liner, the type of joint proposed and the method of operation. Approval, in writing, by the Engineer shall be obtained in advance of starting the work. In any case, the Contractor shall retain full responsibility for the adequacy of his jacking operation, equipment, and complete work.

15.4 Measurement:

15.4.1 **Storm Drain Pipe.** Storm drain pipe length will be measured per linear foot along the centerline of the pipe from inside face to inside face of drainage structures or to plain ends of pipe for the various sizes, types, classes, wall thicknesses, coatings or linings. Beveled end (radial) pipe length will be measured per linear foot along a centerline of the required radius and deflection angle. Storm drain pipe depth will be measured as the vertical depth between pipe flow-line and natural ground surface along the pipe centerline for the various depth classifications specified in the Proposal. For depth measurement and classification purposes, the natural ground surface is defined as the subgrade template elevation for streets or other graded areas under which drains are placed or the actual natural ground surface, whichever is at the lower elevation.

15.4.2 **Plain Concrete for Pipe Bedding and Encasement.** Plain concrete for pipe bedding and encasement at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place.

15.4.3 **Reinforced Concrete for Pipe Bedding and Encasement.** Reinforced concrete for pipe bedding and encasement at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place.

15.4.4 **Storm Drain in Tunnel or Jacked Liner.** Storm drain in tunnel or jacked liner will be measured per linear foot along the centerline length unless directed otherwise by the Engineer in writing.

15.4.5 **Jacked Storm Drain.** Jacked storm drain will be measured per linear foot along the centerline length unless directed otherwise by the Engineer in writing.

15.4.6 **Removal of Existing Pipe.** Removal of existing pipe will be measured per linear foot along the centerline of the pipe to be removed for various sizes or types. No measurement of existing pipe removal within the limits of excavation for new storm drain will be made.

15.5 Payment:

15.5.1 **Plain Concrete for Pipe Bedding and Encasement.** The accepted quantities of plain concrete for pipe bedding and encasement will be paid for at the contract unit price per cubic yard, complete in place which price will be full compensation for materials and materials' testing, pipe support, formwork, removal of forms, and placement, curing and protection of concrete.

15.5.2 **Reinforced Concrete for Pipe Bedding and Encasement.** The accepted quantities of reinforced concrete for pipe bedding and encasement will be paid for at the contract unit price per cubic yard, complete in place which price will be full compensation for materials and materials' testing, pipe support, formwork, reinforcement, removal of forms, and placement, curing and protection of concrete.

15.5.3 **Storm Drain in Tunnel or Jacked Liner.** The accepted quantities of storm drain in tunnel or jacked liner will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, which price will be full compensation for materials and materials' testing, pit excavation, sheathing, timber bracing, linear, excavation, temporary shafts, pumping, grouting, pipe, laying pipe, making pipe joints, cleaning and inspection, and backfilling of pits and shafts.

15.5.4 **Jacked Storm Drain.** The accepted quantities of jacked storm drain will be paid for at the contract unit price per linear foot furnished and laid for the various sizes; which price will be full compensation for materials and materials' testing, pit excavation, jacking equipment and concrete slab foundation, jacking back stop excavation, temporary shafts, pumping, pipe, laying pipe, making pipe joint cushions, cleaning and inspection, and backfilling of pits and shafts.

15.5.5 **Removal of Existing Pipe.** The accepted quantities of existing pipe removal shall be paid for at the contract unit price per linear foot for various pipe sizes and types which price will be full compensation for excavation, special protection, protection of existing utilities, pipe removal, salvage or disposal, backfilling and site restoration.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Drainage Manholes, Inlets & Structures

2023

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Drainage Manholes, Inlets & Structures:

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16.1 Scope: This work shall consist of the construction of manholes, inlets, junction boxes, headwalls, wing-walls, and other special drainage structures of the kinds and dimensions shown on the plans, stipulated in the Contract Documents, or as directed by the engineer. The construction shall be accomplished in accordance with these Specifications and in conformity with the lines, grades, cross-sections, and details shown on the plans or established by the Engineer. The work shall include such labor, material, equipment, removal and abandonment of structures, brick masonry, cast-in-place concrete construction, precast concrete construction, rims and covers, frames and grates, miscellaneous iron castings, and all other items as may be necessary to complete the structures as shown on the plans.

16.2 Materials and Equipment: 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.

16.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

16.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Precast Manhole Section shall be the standard product of a manufacturer of established good reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the material being supplied.

16.2.3 **Material Inspection and Testing.**

16.2.3.1 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 (3) copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. The performance or cost of all testing is the responsibility of the Contractor.

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

16.2.3.3 All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

16.2.4 **Storage.** 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.

16.2.5 **Concrete.** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

16.2.5.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

16.2.5.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

16.2.5.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

16.2.5.4 Concrete used for construction and installation of Drainage Manholes, Inlets and Structures shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

16.2.6 **Steel Reinforcement.** Deformed steel reinforcing bar shall conform to ASTM A615 for Grade 40 or Grade 60 and shall be of the grades, sizes, and dimensions shown on the plans. Reinforcing bars will be installed at the designated spacings and locations shown on the plans or as directed by the Engineer. Welded wire fabric conforming to ASTM A185 shall have a minimum yield strength of sixty-five (65,000) psi and fabric conforming to ASTM A497 shall have a minimum yield strength of seventy (70,000) psi and shall be of the size, design, and weight and at the locations shown on the plans or as directed by the Engineer.

16.2.7 **Mortar.** Mortar shall be composed of the following mixture by volume: One (1) part Portland cement, two (2) parts sand, hydrated lime not to exceed ten (10) percent of the cement used, and four (4) parts water. All ingredients shall be proportioned by measurement and not by estimation. All Portland cement, sand, and water shall be as specified in Standard Specification Section 23, Portland Cement Concrete. All hydrated lime shall be as specified by ASTM C6. The mortar shall be hand mixed or machine mixed. In the preparation of hand-mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar box until the mixture is of uniform color, after which water shall be added. Machine-mixed mortar shall be prepared in an approved mixer and shall be mixed not less than one and one-half (1½) minutes. Mortar shall be used within thirty (30) minutes after mixing.

16.2.8 **Brick.**

16.2.8.1 All brick will conform to ASTM C55 for Grade A. Unless otherwise approved by the Engineer, bricks will conform to the following dimensions:

	Depth (in)	Width (in)	Length (in)
Standard Size	2¼"	3¾"	8"
Allowable Variation	± ¼"	± ¼"	± ½"

16.2.8.2 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.

16.2.8.3 The Contractor may be required to furnish the Engineer with at least five (5) bricks of the character and make he proposes to use, at least one (1) week before any bricks are delivered for use. All brick will be of the same quality as the accepted samples.

16.2.9 **Non-Shrinking Grout.**

16.2.9.1 Grout will be mixed in small quantities as needed and will not be retempered or used after it has begun to set. Unless otherwise specified, the grout will consist of one (1) part Portland cement, two (2) parts masonry sand by volume, a nonshrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

16.2.9.2 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

16.2.9.3 All Portland cement, sand, and water shall be as specified in Standard Specification Section 23, Portland Cement Concrete.

16.2.10 **Crushed Limestone.** 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:

No. 67 Coarse Aggregate Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)					
Sieve Size	1”	¾"	⅜"	No. 4	No. 8
Passing	100%	90-100%	20-55%	0-10%	0-5%

16.2.11 **Gray Iron Castings.** Castings shall be of the standard type as detailed on the Plans and Design Standards. Castings shall be made of good quality, strong, tough, even grained cast iron and shall be smooth, free from scale, lumps, blisters, sand-holes, and defects of any nature which would render them unfit for the service for which they are intended. They shall be thoroughly cleaned and subjected to a careful hammer inspection. Castings shall meet the requirements of ASTM A48, Specifications for gray Iron Castings, Class No. 30, or ASTM A536, Standard Specification for Ductile Iron castings, Grade 65-45-12. In either case, manhole rims and doves and inlet frames and grates shall be designed to withstand HS20-44 loading as defined by AASHTO Specifications. Before being shipped from the foundry, castings shall be given one coat of coal tar pitch varnish applied in a satisfactory manner so as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off. Frames and covers shall be machined or ground at touching surfaces so as to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced at no additional cost to the City. The Contractor shall provide the Engineer with invoices, bill of lading or other necessary documentation as proof of purchase of all castings. Documentation shall be submitted along with each request for payment.

16.2.12 **Manhole Steps.** Cast iron steps shall be of the standard type as detailed on the Plans and Design Standards. Cast iron shall conform to the requirements of Section 16.2.11. Rubber or plastic coated steel manhole steps shall meet the requirements of ASTM C478. The steel shall be completely encapsulated in corrosion resistant rubber or plastic. All steps shall be cast integral with manhole walls or grouted into manhole walls. No driven steps will be permitted.

16.2.13 **Equipment.** The equipment provided by the Contractor shall include hoisting equipment capable of handling and placing the pipe in final position without damage to the pipe. Mechanical tamps shall also be provided.

All of the above equipment, as well as any additional equipment necessary for the satisfactory performance of this construction, shall be on the project and inspected by the Engineer before work will be permitted to begin.

16.3 Construction Requirements:

16.3.1 **Modifications or Removal of Existing Structures.** Existing structures to be modified or removed shall be as indicated on the Plans or directed by the Engineer. The City reserves the right to retain or reject salvage of any materials encountered. Unless otherwise indicated on the Plans or in the Contract, all castings shall become the property of the Contractor. All salvage materials retained by the City shall be delivered to the appropriate City storage yard as directed by the Engineer. All remaining materials become the property of the Contractor who will be responsible for disposing of same. Removal of existing structures within the limits of excavation for new drainage facilities will not be measured or paid for separately but included in the price of the new drainage facility.

16.3.2 **Drainage Structure Construction.**

16.3.2.1 **General.** The structures will be either of concrete (plain or reinforced as required) or of brick masonry. Where the top elevation is not shown on the Plans, the structure or appurtenances shall be built to conform to the elevation ordered by the Engineer.

The various structures shall be built as the pipe laying progresses. The Engineer, at his discretion, may stop the laying of pipe or the building of other structures until the structure just passed has been completed. Completion of the structure shall include connections to pipes, placing of castings and other construction as shown on the plans or as directed by the Engineer.

Inlet and outlet pipes shall extend through the walls of structures only a sufficient distance beyond the outside surface to allow for connections and shall cut off flush with the inside surface of the wall as shown on the Plans or otherwise directed. The pipe shall intersect at the structures so that the invert between the inlet and outlet pipe can be smoothly formed such that counter-flow is prevented.

Inverts shall be of Class C concrete and shall conform to the shapes indicated on the Design Standards or otherwise directed. The inverts shall be so constructed as to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. A smooth and uniform finish will be required.

All rims and frames shall be placed in the positions shown in the Design Standards or as directed by the Engineer and shall be set true to line and to correct elevation. Rims and frames shall be set concentric with the masonry and in a full bed of mortar so that the space between the top of the masonry and the bottom flanges of the rim or frame

shall be completely filled and made watertight. A ring of mortar at least one (1) inch thick and pitched to shed water away from the rim or frame shall be placed around the outside of the bottom flange. Mortar shall extend to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange. If rims or frames are to be bolted or anchored in concrete or brick masonry, all anchors or bolts shall be set and held in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has hardened to adequate strength.

All manholes, inlets, and junction structures deeper than four (4) feet, as measured from the top of the rim or frame to the invert of the structure, shall be provided with steps unless otherwise shown on the Plans or directed by the Engineer.

Steps shall be spaced not more than sixteen (16) inches vertically and staggered at twelve (12) inches laterally and shall be so arranged so that the lowest step shall not be more than eighteen (18) inches above the bench. The top step shall not be more than eighteen (18) inches below the structure rim or frame. If precast sections are used, steps are not required to be staggered laterally.

16.3.2.2 **Brick Masonry Construction.**

16.3.2.2.1 **Construction Methods:** All bricks shall be thoroughly clean. The bed which is to receive the bricks shall be thoroughly cleaned and damp, but should be free of water before placing mortar thereon. All bricks shall be laid in courses in freshly made mortar, using the shoved-joint method so as to thoroughly bond them into the mortar and always with the joints completely filled with mortar. The bricks shall be laid in a workmanlike manner and true to the lines and grades indicated on the Plans and Design Standards. The arrangement of headers and stretchers shall be such as will thoroughly bond the masonry. Unless otherwise indicated, brick masonry for inlets shall have a header course every fifth course. In manholes, all bricks in each course shall be headers. The course shall be laid continuously with joints broken or alternating evenly with the joints in the preceding courses. Horizontal joints shall average three-eighths (⅜) inch, but shall be not less than one-quarter (¼) inch nor more than one-half (½) inch in thickness. Face joints shall be flush and neatly struck, and all joints on unexposed faces shall be solidly filled, No spells or bats shall be used except in shaping around irregular openings or connections or when unavoidable to finish out a course. In this case, a full brick shall be used at the comer with the bat in the interior of the course. If any brick is moved or a joint broken d ring laying, the brick shall be removed, the mortar thoroughly cleaned from the brick, bed, and joints and the brick re-laid in fresh mortar.

In brick manholes, inlets, or junction structures, a row lock arch shall be placed over all incoming and outgoing pipes in such a manner to provide full continuous contact between masonry and outside of pipe, to prevent leakage and to form a neat connection.

Brick manholes, inlets, junction structures, brick radius walls, and special structures shall be plastered on the outside with a coating of mortar not less than one-third (⅓) inch thick of the same composition used in laying brick to prevent excessive infiltration of water. On the inside of the manholes, the vertical portion of the walls shall be plastered and the sloping section neatly pointed with trowel.

The inside of brick inlet, junction structure, or brick radius walls shall be plastered with not less than one-half (½) inch of mortar of the same composition used in laying brick.

Brick masonry, plastering, and mortar shall be protected against damage from freezing or lack of moisture. Brick masonry shall not be constructed when the temperature is forty (40°) degrees Fahrenheit or lower without permission of the Engineer nor without adequate approval means for protection against freezing. Brick masonry shall have sufficient moisture for proper curing and be protected from drying.

A prepared concrete slab shall be placed for all brick structures after the foundation excavation is completed. This shall be of the materials and dimensions shown in the Design Standards. The slabs shall be built of Class A concrete. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Standard Specification Section 23, Portland Cement Concrete.

Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans. Concrete reinforcing in place shall be approved by the Engineer before any concrete is placed.

Steps constructed in brick walls shall be installed at the specified spacing as the brick laying progresses. Steps shall be placed in a full bed of mortar between brick courses.

16.3.2.2.2 **Brick Manholes:** Brick manholes shall be neatly and accurately built, according to design Standards or as directed by the Engineer. Manholes with brick walls shall have walls not less than nine (9) inches thick for manholes up to six (6) feet deep and not less than thirteen (13) inches thick throughout the structure for extra depth manholes.

16.3.2.2.3 **Brick Inlets:** Brick inlets shall be neatly and accurately built, according to Design Standard or as directed by the Engineer. Top slabs (when required) shall be uniform in thickness as shown on Plans and be constructed of Class A concrete. Exposed surfaces shall have a hand-troweled finish.

16.3.2.2.4 **Brick Junction Structures:** Brick junction structures shall be neatly and accurately built in accordance with details included in the Plans or as directed by the Engineer. Access to all junction structures shall be provided by an access shaft with a manhole rim and cover at the proposed finished grade as detailed on the Plans.

16.3.2.2.5 **Brick Radius:** Brick radius shall be neatly and accurately built, according to Plans and Design Standards, or as directed by the Engineer. Brick radius walls shall not be less than nine (9) inches thick, The Contractor may, at his option, construct radius walls of reinforced concrete in lieu of brick conforming to the requirements of Section 16.3.2.3.5 of these Specifications.

The radius of construction as shown on the Plans shall be as measured along the centerline of the structure and shall be constant throughout its length unless specified otherwise. The minimum radius shall be six (6) times the inside diameter of the larger pipe at either end of the radius.

The base slab and top slab of a brick radius shall be uniform in as shown on the Plans and Design standards and be constructed of Class A concrete reinforced as detailed. The Contractor shall use a metal permanent forming material for the top that will not require striping. The form material shall be able to support the full weight of the wet concrete without the use of intermediate supports until the concrete has fully set In lieu of cast-in-place top slabs, precast units may be used if approved by the Engineer. These units shall be set securely on the brick walls using steel dowels, a mortar bed and mortared around dowels and between precast units. Care shall be exercised to set precast slabs with reinforcement on bottom side of panel when in final position.

Pipe at both ends of the radius shall be laid in the final position and firmly bedded prior to commencement of brick radius construction. Longitudinal reinforcement shall extend from the normal radius section into a concrete pipe collar. The collar shall extend a minimum of one (1) foot over each pipe end. Precast top slabs shall not be allowed over the pipe collars.

Inverts shall be constructed of Class C concrete and form a smooth radius conforming with the larger of the two pipes which they adjoin.

16.3.2.3 **Cast-in-Place Concrete Construction:**

16.3.2.3.1 **Construction Method:** All cast-in-place structures shall be built as shown on the Plans and of Class A concrete. The structures shall be built on prepared foundations and conform to the dimensions and shapes shown on the Plans. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Standard Specification Section 3, Concrete Structures.

Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans and Design Standards. Concrete reinforcing in place shall be approved by the Engineer before any concrete is placed.

Connections for inlet and outlet pipes shall conform to the sizes, alignments, and elevations shown on the Plans.

Steps, when required, shall be cast into the fun depth of the wall section in accordance with Section 16.3.2.1 of these Specifications. The Contractor may, at his option, construct steps after removing concrete forms. Under this option, holes shall be drilled of sufficient size to allow one-half (½) inch to three-quarters (¾) inch of nonshrinking grout on all sides of the prongs and sufficient depth to allow full embedment of the prongs.

16.3.2.3.2 **Cast-in-Place Manholes:** Cast-in-place manholes shall be neatly and accurately built according to the Plans or as directed by the Engineer. Wall thicknesses shall be as detailed on the Plans and Design standards but not less than six (6) inches thick. All cast-in-place manholes shall be of eccentric construction as shown on the Plans and Design Standards. The access steps shall be located on the vertical wall and staggered either side of a single vertical alignment in accordance with Section 16.3.2.1 of these Specifications.

16.3.2.3.3 **Cast-in-Place Inlets:** Inlet walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be Class A having a minimum wall thickness of six (6) inches. Cast-in-place inlets shall be constructed with the same inside dimensions as shown in the Plans and Design Standards.

16.3.2.3.4 **Junction Structures:** Junction structure walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be class A having a minimum wall thickness of six (6) inches. Cast-In-place junction structures shall be constructed to the inside dimensions shown on the Plans and Design Standard or as directed by the Engineer.

16.3.2.3.5 **Cast-in-Place Radius:** Concrete walls shall be Class A having a minimum wall thickness of six (6) inches. Cast-in-place radius shall be constructed to the radius and inside dimensions as shown in the Plans and Design Standards. Cast-in-place radius may also be constructed with a precast top slab set in a mortar bed and dowels if approved by the Engineer.

16.3.2.3.6 **Headwalls, Wingwalls, and Aprons:** All headwalls, wingwalls, and aprons used with drainage pipe, box culverts, and concrete channel lining shall be constructed of Class A concrete and to the lines and dimensions shown on the Plans and Design Standards or as directed by the Engineer.

16.3.2.3.7 **Sidewalk Drains:** Sidewalk drains shall be constructed to the dimensions and of the materials shown on the Plans and Design Standard or as directed by the Engineer. Fillet welds shall be provided between the steel channels and steel plates as shown on the Design Standard for Prefabricated Sidewalk drain. Sidewalk drains shall be securely bedded on an earth subgrade at the same elevation and slope as adjacent sidewalk prior to pouring adjacent sidewalk. Concrete for sidewalk shall be placed uniformly on either side of the drain to prevent dislocation of the drain. Drains shall be held firmly in place by suitable means to prevent movement during placement of concrete. Sidewalk drains shall have positive drainage away from the drain. The drain shall be constructed through the curb and be terminated neatly and flush with the face of curb. Drains shall be placed with tread plate up and matching the sidewalk surface.

16.3.2.4 **Pre-Cast Concrete Construction:** Precast concrete manholes shall be neatly and accurately built according to the Plans or as directed by the Engineer. All precast concrete manholes shall use either a precast base with limestone bedding as shown on the Design standard or a ten (10) inch concrete slab constructed of Class A concrete shall be cast integrally with the base section and the inlet and outlet pipes as shown on the Design Standard.

Precast concrete sections shall be set so the structure will be vertical and with sections in true alignment. Joint surfaces of the base or previously installed section shall have a flexible plastic gasket as recommended by the manufacturer installed in the recess after being primed with an asphaltic cement material also recommended by the manufacturer. Each joint shall be completely filled with plastic gasket material on the inside and outside of the manhole after sections have been placed.

All holes in precast sections used for their handling and the annular space between the wall and entering pipes shall be thoroughly plugged with nonshrinking grout, applied so that there will be no leakage through openings and around pipes. The grout shall be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces.

All precast concrete manhole cones shall be of eccentric construction as shown on the Plans. The access steps shall be located on the vertical wall and shall be aligned with the riser steps.

All flat top slabs on drain manholes shall have a minimum thickness of eight (8) inches and the manhole rim and cover shall be located eccentrically in slab as shown on the Plans.

16.3.2.5 **Test Specimens:** The Contractor shall furnish the concrete, mold and labor necessary for casting test specimens in the field. The Engineer will designate the frequency of sampling the fresh concrete. The method of making and curing these specimens will be in accordance with AASHTO Designation T23. Test cores shall be drilled by the Contractor at his expense if required by the Engineer at locations selected by the Engineer.

16.3.3 **Adjustment of Manhole Rims and Covers:**

16.3.3.1 **Manhole Adjustment (Standard Method).** 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. If the cover requires adjustment, 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 eighteen (18) inches. If the adjustment would require a collar of greater than eighteen (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. 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.

16.3.3.2 **Manhole Ring Adjustment (with Grade Adapter Rings).** For manhole covers to be raised less than or equal to five (5) inches and where the total collar height would not exceed eighteen (18) inches, manhole adapter rings may be used if approved by the Engineer. Adapter rings may be up to a maximum of five (5) inches utilizing no more than one ring. Adapter rings shall be tack welded to the existing rim at a minimum of four (4) locations.

16.3.3.3 **Manhole Ring Adjustment (Alternative Method).** For manhole covers requiring adjustment where Cement Stabilized Aggregate Base (Specification Section 10) or Cement Stabilized Soil Cement Base (Specification Section 11) 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 twenty-four (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 Cement Stabilized Aggregate Base or Cement Stabilized Soil Cement Base a minimum three (3) feet square directly over each manhole. The manhole rims and covers shall then be replaced with Class A concrete conforming to Specification Section 3.1.2 to the subgrade. If, in the process of adjusting the manhole rims, the Contractor removed a larger section than specified, the Contractor shall replace the entire area so removed with Class A concrete at his own expense.

16.4 Measurement:

16.4.1 **Standard Depth Manholes.** Standard depth manholes will be measured per each, for the various diameters and types, including the required, manhole rim and cover. Standard depth is defined as a manhole depth between zero (0) and six (6) feet as measured vertically from the top of the manhole rim to the invert of the outlet drain.

16.4.2 **Extra Depth Manholes.** Extra depth manhole will be measured per vertical foot from a point six (6) feet below the top of the manhole rim to the invert of the outlet drain for the various diameters and type. Only manholes greater than six (6) feet in depth will be considered for extra depth measurement.

16.4.3 **Inlets.** Inlets will be measured per each, for the various types including the required frame and grate.

16.4.4 **Sidewalk Drains.** Drains will be measured per pound of fabricated steel.

16.4.5 **Junction Structures.** Junction structures will be measured per each, including access shaft regardless of depth including the required manhole rim and cover or inlet frame and grate.

16.4.6 **Radius Structures.** Radius structures will be measured per linear foot along the centerline of the structure from the face of the adjoining pipe sections for the various types, widths, and heights.

16.4.7 **Headwall, Wingwalls and Concrete Skirts.** Headwalls, wingwalls, and concrete skirts will be measured per each for the various types.

16.4.8 **Structure Removal.** Removal of existing structures will be measured per each.

16.4.9 **Backfill for Structure Abandonment.** Backfill for structure abandonment will be measured per ton of material placed.

16.4.10 **Adjustment of Manhole Rims and Covers**.

16.4.10.1 **Manhole Adjustment (Standard Method):** Standard manhole adjustments will be measured per each manhole rim adjusted to grade.

16.4.10.2 **Manhole Ring Adjustment (with Adapter Rings):** Manhole adjustment with adapter rings will be measured per each manhole rim adjusted to grade.

16.5 Payment:

16.5.1 **Standard Depth Manholes.** The accepted quantities of standard depth manholes will be paid for at the contract unit price per each complete in place for the various diameters and types including rim and cover which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; placing and jointing precast sections; construction of steps and inverts; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation, and backfilling.

16.5.2 **Extra Depth Manholes.** The accepted quantities of extra depth manhole will be paid for at the contract unit price per vertical foot complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; placing and jointing precast sections; construction of steps; cleaning and inspection, and backfilling.

16.5.3 **Inlets.** The accepted quantities of inlets will be paid for at the contract unit price per each complete in place for the various types including frame and grate which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; construction of steps and invert; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation, and backfilling.

16.5.4 **Sidewalk Drains.** The accepted quantities of sidewalk drains will be paid for at the contract unit price per pound of fabricated steel complete in place which price will be full compensation for materials; fabrication of channels and plates; setting of sidewalk drains; and cleaning and Inspection.

16.5.5 **Junction Structures.** The accepted quantities of junction structures will be paid for at the contract unit price per each complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection, and curing of concrete; laying, plastering, protection and curing of brick work; construction of steps and inverts; construction of access shaft; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation, and backfilling.

16.5.6 **Radius Structures.** The accepted quantities of radius structures will be paid for at the contract unit price per linear foot complete in place for the various types, widths, and heights which price will be full compensation for materials testing; excavation; special protection; placing, protection, and curing of concrete; laying, plastering, protection and curing of brick work; construction of inverts; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation, and backfilling.

16.5.7 **Headwall, Wingwalls and Concrete Skirts.** The accepted quantities of headwalls, wingwalls, and skirts will be paid for at the contract unit price per each complete in place which price will be full compensation for materials and materials' testing; excavation; special protection: placing, protection and curing of concrete; connection to pipes, channel lining or structure; cleaning and inspection, and backfilling.

16.5.8 **Structure Removal.** The accepted quantities of structure removal will be paid for at the contract unit price per each, complete which price will be full compensation for excavation, special protection, protection of existing utilities, structure removal, disposal of debris, handling and delivery of salvage material, and backfilling.

16.5.9 **Backfill for Structure Abandonment.** The accepted quantities of sand for backfilling abandoned structures will be paid for at the contract unit price per ton furnished and placed which price will be full compensation for preparing the structure for abandonment; bulkheading inlet and outlet pipes; disposal of debris; furnishing and placing backfill material; compaction; and handling and delivery of salvageable material.

16.5.10 **Adjustment of Manhole Rims and Covers**.

16.5.10.1 **Manhole Adjustment (Standard Method):** 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.

16.5.10.2 **Manhole Ring Adjustment (with Adapter Rings):** 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.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Concrete Channel Lining & Concrete Ditch Paving

2023

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Concrete Channel Lining & Concrete Ditch Paving:

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17.1 Scope: This work shall consist of the construction of reinforced concrete channel lining, plain concrete ditch paving and reinforced concrete ditch paving of the dimensions, details, and sections presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The construction shall be accomplished in accordance with these Specifications, in conformity with the lines, grades, details, and cross-sections shown on the Plans, and directions furnished by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

17.2 Materials and Equipment: 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.

17.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

17.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

17.2.3 **Material Inspection and Testing.**

17.2.3.1 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 (3) copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. The performance or cost of all testing is the responsibility of the Contractor.

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

17.2.3.3 All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

17.2.4 **Storage.** 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.

17.2.5 **Concrete.** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

17.2.5.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

17.2.5.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

17.2.5.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

17.2.5.4 Concrete used for construction and installation of concrete channel lining and ditch paving shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

17.2.6 **Steel Reinforcement.** Deformed steel reinforcing bar shall conform to ASTM A615 for Grade 40 or Grade 60 and shall be of the grades, sizes, and dimensions shown on the plans. Reinforcing bars will be installed at the designated spacings and locations shown on the plans or as directed by the Engineer. Welded wire fabric conforming to ASTM A185 shall have a minimum yield strength of sixty-five (65,000) psi and fabric conforming to ASTM A497 shall have a minimum yield strength of seventy (70,000) psi and shall be of the size, design, and weight and at the locations shown on the plans or as directed by the Engineer.

17.2.7 **Filter Cloth and Fasteners.** Unless noted otherwise on the plans, or as directed by the Engineer, the filter cloth material and fasteners for weep-hole drainage system shall conform to applicable ASTM specifications.

17.2.8 **Washed Gravel.** Washed gravel for weep hole drainage system shall be crushed stone or washed gravel meeting the quality requirements of ASTM D692 and one of the following grading requirements:

Amounts Finer than Each Sieve-Size Total Percent by Dry Weight for Square Opening Sieves (U.S. Standard)								
Sieve Size	1½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16
Passing	100%	95-100%	-	25-60%	-	0-10%	0-5%	-
	-	100%	90-100%	20-55%	0-15%	0-5%	-	-
	-	-	100%	90-100%	40-70%	0-15%	0-5%	-
	-	-	100%	90-100%	40-75%	5-25%	0-10%	0-5%
	-	-	-	100%	85-100%	10-30%	0-10%	0-5%

17.2.9 **Weep-Hole Drain Pipe.** Perforated and non-perforated tubing and fittings for weep-hole drainage system shall be of the diameter specified on the Design Standards or as directed by the Engineer and of only one pipe material for the entire job: Perforated and non-perforated polyethylene corrugated tubing and fittings shall meet the requirements of AASHTO M252 and M294.

17.3 Construction Requirements:

17.3.1 **Concrete Channel Lining.** The requirements for concrete form-work, falsework, reinforcement, placing concrete, removal of forms and falsework, removal of defective concrete, and curing and protection of concrete as defined in Standard Specification Section 3, Concrete Structures, of these Specifications shall apply to the construction of concrete channel lining except as modified in this section of the Specifications. Concrete materials, proportioning, mixing, and delivery shall conform to Standard Specification Section 23, Portland Cement Concrete. The subgrade shall be carefully shaped to the channel section shown on the Plans and compacted to provide a firm foundation in conformance with Standard Specification Section 14, Earthwork Drainage Facilities.

17.3.1.1 **Weep-Hole Drainage System:** The weep-hole drainage system shall be constructed as shown on the Design Standards, or as directed by the Engineer. Weep-holes when shown on the Plans shall be constructed along the culvert walls at the locations and intervals shown on the Design Standard or as directed by the Engineer. Weep-holes shall be constructed of four (4) inch diameter tubing. Weep-hole tubing shall be cut off smoothly and flush with the interior surface of the culvert wall.

The weep-hole drainage system when shown on the Plans or Design Standards shall consist of a four (4) inch diameter perforated drain tubing surrounded by a continuous gravel drain, and wrapped in filter cloth. A weep-hole drain shall be constructed along the entire length of both culvert walls as shown on the Design Standard or as directed by the Engineer. The perforated drain pipe shall be connected to a weep hole at no greater than thirty (30) foot intervals.

The weep-hole drain shall be at the grade shown on the Plans but shall not be less than zero-point-four (0.40%) percent. The filter cloth shall be placed with the long dimension parallel to the centerline of the culvert and shall be laid loosely without wrinkles or creases. The filter cloth shall be installed in such a manner that all splice joints perpendicular to the culvert are provided with a minimum overlap of three (3) feet. The cloth shall be placed such that the upstream strip overlaps the downstream strip.

The cloth shall be protected at all times during construction from contamination by surface runoff, and any cloth so contaminated shall be removed and replaced with uncontaminated cloth at the Contractor's expense. Any damage to the cloth during its installation shall be replaced by the Contractor at his own expense. Gravel overlaying the cloth shall not be dropped on the cloth from a height greater than three (3) feet.

After the filter cloth has been properly placed, a layer of washed gravel shall be spread on the bottom of the drain and brought to a uniform grade at the flow-line elevation of the drainpipe. Care shall be taken during the gravel placement operation as well as the pipe installation to prevent damage to the filter cloth. To repair a torn, punctured, or otherwise damaged section, a piece of filter cloth is cut large enough to cover the damaged area and overlap all around the damaged area a minimum of twelve (12) inches and sewn to the cloth.

Perforated pipe shall be laid with the flow sector and perforations at the bottom. The under-drain pipe shall be connected to the weep hole by means of a split tee of the same material as the pipe.

After the pipe has been laid and inspected, the backfilling shall be carefully done so that the pipe will not become displaced. The backfilling around the pipe shall be with the washed gravel specified. Unless otherwise designated on the Plans, the gravel backfill shall be a minimum of four (4) inches on each side of the pipe and twelve (12) inches over the pipe. The overlap of the filter cloth closure at the top of the drain system shall be at least twelve (12) inches and secured with mechanical ties.

17.3.1.2 **Expansion Joints:** Transverse expansion joints shall be provided at thirty (30) foot intervals. Expansion joints shall be constructed at right angles to the centerline of the channel, throughout channel bottom and sidewalls in conformance with Design Standards. Preformed expansion joint material shall be three-quarters (¾) inch thickness and full depth of slab and walls.

17.3.1.3 **Connecting Storm Drains:** Existing and new storm drains intercepted by the channel shall be formed into sidewalls and cut off flush and smooth with the inside face of the wall so as to not leave an obstruction along the wall. Channel sidewalls shall be poured monolithically around pipe sections. Intercepted drains shall be oriented at right angles to the wall or skewed in the direction of flow. The steel reinforcement shall be placed around each pipe end as it intersects the channel wall in accordance with Design Standards. Existing pipes twelve (12) inches in diameter or smaller intercepted by the channel shall be extended as required for proper connection at no additional compensation. Existing pipes larger than twelve (12) inches in diameter shall be extended as required for proper connection and paid for at the appropriate price per linear foot for the pipe. Pipe extensions will be of the same material as the existing pipe except for pipe larger than twelve (12) inches in diameter which shall be reinforced concrete pipe unless otherwise directed by the Engineer.

17.3.1.4 **Finish:** Sidewalls shall be given a Class I ordinary surface finish and the bottom slab shall be given a Class 3, float finish except for brushing as defined in Section 3.4.20 of the Standard Specifications. Sidewalls and slab shall be cured in accordance with Section 3.4.22.

17.3.1.5 **Invert:** The bottom slab of the channel shall be constructed with a 'V' shaped invert as shown on the Design Standard.

17.3.1.6 **Fence Sleeves:** Shall be manufactured three (3) inch diameter sleeves in accordance with Standard Specification Section 19.3.1, Chain Link Fence. Fence sleeves shall be provided in the channel walls for fence posts as shown on the Plans or directed by the Engineer.

17.3.1.7 **Concrete Testing:** Concrete for structures shall be tested as shown on the Plans or directed by the Engineer. Concrete test specimens shall be made and cured in accordance with AASHTO Designation T233. A minimum of three (3) test cylinders shall be made for each Structure concrete pour. For each day's pour, no less than three (3) test cylinders shall be made. The Contractor shall be responsible for obtaining the services of a testing laboratory to make, handle, cure and break the test cylinders. To ensure that the cylinders are representative of the concrete being placed, fresh concrete shall be sampled in accordance to ASTM C172 (from middle of batch). Each group of test specimens shall have one cylinder subjected to seven (7) day compressive strength tests and a second cylinder twenty-eight (28) day test. Should the value of either of the first two test breaks be

below the expected values, the third cylinder shall be tested for compressive strength. Low cylinder breaks may be cause to have the concrete represented by the test specimens removed and replaced. At the time the test cylinder specimens are made, the testing laboratory will check the concrete slump and the air entrained.

With prior consent of the Engineer, the Contractor may prepare field cylinders. These cylinders may be used as a gauge for early safe removal of forms where the Contractor requests earlier removal than set out in the Specifications.

17.3.1.8 **Backfilling:** Full backfill shall not be placed until representative test samples of the concrete used in the channel lining attain a compressive strength of at least three-thousand (3,000) psi. In addition, the concrete shall have been placed a minimum of five (5) days, not counting days of twenty-four (24) hours each when the temperature is below forty (40°) degrees Fahrenheit. Backfill shall be placed by means which insures proper compaction. Backfill shall be carried up simultaneously behind the sidewalls to maintain uniform loading. Backfill above filter cloth closure shall be of suitable nonporous material. Placement and compaction of the backfill and final cleanup shall be in accordance with Standard Specifications Section 14, Earthwork Drainage facilities.

17.3.1.9 **Access Ramp:** Access ramps for maintenance vehicles shall be constructed at the locations and to the details shown on the Plans. Location of contraction and expansion joints in channel lining shall be adjusted to fall outside of the ramp connection area. Longitudinal channel wall reinforcement shall be bent and tied to ramp wall reinforcement. Longitudinal ramp bottom reinforcement shall extend into the channel bottom area a minimum of thirty (30) inches.

17.3.1.10 **Channel Transitions:** Transitions in wall height and/or channel width shall be constructed within the limits shown on the Plans or as directed by the Engineer. The full height of wall or width of channel, including the transition portion, shall be poured monolithically. Continuous vertical reinforcement as required in the Plans and Design Standards for the full wall height constructed shall be placed to insure structural adequacy for the higher wall segment. The transition from one wall height to another shall be accomplished with a smooth and uniform slope on the top of wall.

17.3.2 **Concrete Ditch Paving.**

17.3.2.1 **General:** Site preparation work and grading work shall be performed in accordance with Standard Specification Section 8 (Excavation, Embankments & Subgrade Prep.) and Section 14 (Earthwork Drainage Facilities), respectively. The subgrade shall be carefully shaped to the trapezoidal section shown on the Plans and compacted to provide a firm foundation for the concrete.

17.3.2.2 **Reinforcement:** Ten (10) gauge welded wire fabric (6" x 6") shall be used in reinforced concrete ditch paving unless otherwise specified on the Plans or directed by the Engineer. Fabric shall be sufficiently supported to maintain two (*2*) inches of clearance between fabric and bottom surface of concrete ditch paving, for four (4) inch thick ditch paving, and three (3) inches of clearance for six (6) inch thick ditch paving.

17.3.2.3 **Joints:**

17.3.2.3.1 **Contraction Joints.** Formed or sawed transverse contraction joints one-quarter (¼) inch wide by one (1) inch deep will be required at ten (10) foot maximum intervals.

17.3.2.3.2 **Expansion Joints.** Transverse expansion joints three-quarters (¾) inch width preformed expansion material full depth of slab, will be required at thirty (30) foot intervals.

17.3.2.4 **Placing and Finishing Concrete:** Immediately before placing the concrete, the subgrade shall be thoroughly wetted, and the forms given a coating of light oil. The forms shall be thoroughly cleaned and oiled each time before using.

The concrete shall be placed immediately after mixing; the edges shall be spaded and the concrete thoroughly consolidated, after which the surface shall be finished smooth and even by means of a wooden float. A final finish of a rough uniform texture shall be obtained by brushing with a fiber brush.

The edges of the paved ditch shall be rounded to a radius of one-half (½) inch, and edges along expansion joints shall be finished with an edging tool with a radius of not over one-quarter (¼) inch and then all edging marks removed with a float and brush.

17.3.2.5 **Protection and Curing:** Immediately after finishing the concrete, it shall be cured as specified under Standard Specification Section 3.4.23, Concrete Curing. The Contractor shall protect the ditch paving until final acceptance of the project. Any concrete that is damaged prior to acceptance shall be repaired by removing and reconstructing the damaged sections between joints. Such reconstruction shall be at the Contractor's expense.

17.3.2.6 **Test Specimens:** The Contractor shall furnish the concrete, mold and labor necessary for casting test specimens in the field. The Engineer will designate the frequency of sampling the fresh concrete. The method of making and curing these specimens will be in accordance with AASHTO Designation T23. Test cores shall be drilled by the Contractor at his expense if required by the Engineer at locations selected by the Engineer.

17.3.2.7 **Backfilling:** Immediately after the concrete has set sufficiently and the forms have been removed, the spaces on each side of the ditch paving shall be filled with suitable material and thoroughly compacted; or when sod is specified, it shall be placed as shown on the Plans.

17.4 Measurement:

17.4.1 **Concrete Channel Lining.** Concrete channel lining will be measured for pavement per linear foot measured along the centerline of the channel for the various wall heights, invert depths, and channel width sections included in the Contract Documents. Transition sections will be measured and paid for as the larger of the sections connected. Wingwalls and Concrete Skirts when required will be measured for payment in conformance with Standard Specification Section 16.5.7. Fence for concrete channel lining when required will be measured for payment in conformance with Standard Specification Section 19.4.1.

17.4.2 **Access Ramp.** No measurement of the access ramp structure will be made. Fence gates when required will be measured for payment in conformance with Standard Specification Section 19.5.1.

17.4.3 **Concrete Ditch Paving.** Concrete ditch paving will be measured for payment per square foot for the various thicknesses specified in the Contract Documents.

17.4.4 **Reinforced Concrete Ditch Paving.** Reinforced concrete ditch paving will be measured for payment per square foot for the various thicknesses specified in the Contract Documents.

17.5 Payment:

17.5.1 **Concrete Channel Lining.** The accepted quantities of concrete channel lining will be paid for at the contract unit price per linear foot for the various sizes specified. Their unit price shall be full compensation for excavation, foundation preparation, bedding, utility protection, materials and materials' testing, formwork, steel reinforcement, fence post sleeves, drain connections twelve (12) inches in diameter and smaller, concrete placement, form removal, finishing, curing, weep hole drainage system, joints, backfilling, and all other incidental labor, material and equipment necessary to complete the work.

17.5.2 **Access Ramp.** Access ramp construction will be paid for at the lump sum price specified in the Contract Documents which price will be full compensation for excavation, foundation preparation, utility protection, materials and materials' testing, formwork, steel reinforcement, fence post sleeves, drain connections twelve (12) inches in diameter and smaller, concrete placement, form removal, finishing, curing, weep hole drainage system, backfilling, and all other incidental labor, materials, and equipment necessary to complete the work.

17.5.3 **Concrete Ditch Paving.** The accepted quantities of concrete ditch paving will be paid for at the contract unit price per square foot complete in place for the various thicknesses specified in the Contract Documents. This unit price will be full compensation for excavation, subgrade preparation, utility protection, forming, placing concrete, materials and materials' testing, form removal, finishing, curing, joints, backfilling, and all other incidental labor, material and equipment necessary to complete the work.

17.5.4 **Reinforced Concrete Ditch Paving.** The accepted quantities of reinforced concrete ditch paving will be paid for at the contract unit price per square foot complete in place for the various thicknesses specified in the Contract Documents. This unit price will be full compensation for excavation, subgrade preparation, utility protection, forming, furnishing and placing reinforcement, placing concrete, materials and materials' testing, form removal, finishing, curing, joints, backfilling and all other incidental labor, material and equipment necessary to complete the work.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Steel Sheet Piling

2023

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Steel Sheet Piling:

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18.1 Scope: This work shall consist of the construction of reinforced concrete channel lining, plain concrete ditch paving and reinforced concrete ditch paving of the dimensions, details, and sections presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The construction shall be accomplished in accordance with these Specifications, in conformity with the lines, grades, details, and cross-sections shown on the Plans, and directions furnished by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

18.2 Materials and Equipment: 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.

18.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

18.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

18.2.3 **Material Inspection and Testing.**

18.2.3.1 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 (3) copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. The performance or cost of all testing is the responsibility of the Contractor.

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

18.2.3.3 All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

18.2.4 **Steel Sheet Piles.** Steel sheet piles shall meet the requirements of ASTM A572, Grade 50 unless otherwise specified on the Plans. Size and thickness of sheets shall be as shown on the Plans.

18.2.5 **Coal Tar Epoxy Coating.** The coating system shall be composed of one (1) coat of Coal Tar Epoxy composed as follows:

Solids by Volume (Mixed)	77.0, ± 1.0%
Dry Film Thickness	14 – 20 mils per coat
Color	Black
Finish	Semi-gloss
Curing Time at 75° F	6 Hours (maximum)

18.2.6 **Equipment.** Steel sheet piles shall be driven with vibratory or gravity hammers specifically designed for pile driving. All driving equipment shall be on hand and approved by the Engineer before work can proceed.

18.3 Construction Requirements:

18.3.1 **Handling and Storage.** Steel sheet piles shall be handled and stored by methods that will not injure the pile. The pile shall be stored above ground upon platforms, blocking, or other supports. They shall be kept free from dirt, grease, and other foreign matter and shall be protected insofar as practical from corrosion.

18.3.2 **Driving Sheet Piles.** Sheet piles shall be driven with adequate hammers as necessary to drive the piles to the line, grade, and required depth shown on the Plans. In order to maintain satisfactory alignment, the sheet piles shall be driven in such increments of penetration as may be found necessary to prevent distortion, twisting out of position or pulling apart at the interlocks.

Piles shall be kept moving during driving operations by continuous operation of the hammer except when interrupted by an emergency. The piles, when in place as a completed structure, shall be practically watertight at the joints.

18.3.3 **Jetting Sheet Piles.** The use of jets will not be permitted at locations where the stability of embankments or other improvements would be endangered. The written approval of the Engineer shall be obtained prior to jetting specific sheet piling. In case it is necessary to obtain the penetration desired, the Contractor may supply and operate one or more high pressure water jetting systems to erode the material adjacent to the pile and thereby facilitate driving the sheet piles. The jetting may not be done ahead of the actual driving operation. Jetting shall take place simultaneously with the driving operation. The jets shall be withdrawn and the final penetration of the sheet pile obtained by driving with the hammer alone for at least the last foot of penetration.

18.3.4 **Pile Cut-off and Damages.** The tops of sheet piling shall be cut-off or driven down to the elevation indicated on the Plans, or as approved by the Engineer.

If the sheet piles are appreciably distorted or otherwise damaged below cut-off elevation, the damaged piles shall be removed and replaced at the Contractor's expense.

Any sheet pile damaged during driving by reason of internal defects or improper driving or which is either out of its required line and grade shall be withdrawn and replaced with a new pile at the Contractor's expense.

18.3.5 **Coating Application.** As soon as practical after driving, the entire surface of the sheet piling exposed to view in bulkheads and retaining walls from a point two (2) feet below ground surface to cut-off level or bottom of concrete cap, as the case may be, shall receive either a Near White Blast Cleaning or Pickling Cleaning to remove all rust, loose mil scale, oil, grease and other foreign substances. Immediately following cleaning, this same surface area shall receive One (1) coat of coal tar epoxy with a dry film thickness of fourteen (14) mils minimum. The Coating shall not be applied until all concrete work is finished and all splatters or drippings shall have been removed. Apply coating only on thoroughly dry surfaces and during periods of favorable weather with surface temperature greater than fifty (50°) degrees Fahrenheit and less than one-hundred twenty (120°) degrees Fahrenheit and five (5°) degrees above dew point. The coating manufacturer's current printed instructions for mixing, application rates and methods, thinning and pot life shall be submitted to the Engineer for review prior to the coating being applied and such instructions shall be adhered to by the Contractor.

18.4 Measurement: Steel sheet piling will be measured for payment by the square foot of sheet piling measured horizontally and vertically along the piling face for the various vertical piling lengths, metal thicknesses and sections specified, complete in place.

18.5 Payment: The accepted quantities of steel sheet piling will be paid for at the contract unit price per linear foot, which unit price shall be full compensation for finishing and driving the piling, painting as required, jetting if required, and permitted by the Engineer, and all other labor, material, equipment and incidentals needed to complete the work.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Chain Link Fence

2023

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Chain Link Fence:

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19.1 Scope: This work shall consist of the construction of chain link fences and gates of the dimensions, details, and sections presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. Chain link fence may be located atop concrete channel lining walls, retaining wall or similar structure, or may be located independently of structures. The construction shall be accomplished in accordance with these Specifications, in conformity with the lines, grades, details, and cross-sections shown on the Plans, and directions furnished by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

19.2 Materials and Equipment: 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. Materials used throughout the project shall be of constant design and manufacture in respect to individual items or ports, excepting where the proposed fence will be an extension of an existing fence, in which case the new fence shall be constructed of materials similar in appearance to those in the existing fence and continued until broken by a cross street, railroad, fence, ditch, or other physical feature. Unless otherwise directed, new materials shall be as described hereinafter.

19.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

19.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

19.2.3 **Storage.** 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.

19.2.4 **Concrete.** Concrete for post footings shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

19.2.4.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

19.2.4.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

19.2.4.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

19.2.4.4 Concrete used for construction and installation of concrete channel lining and ditch paving shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

19.2.5 **Fabric.** The fabric shall be zinc coated steel chain link type meeting the requirements of AASHTO M181 for Type 1I, Class B fabric (zinc coating = 2 oz/ft²). All chain link fabric shall be manufactured of No. nine (9) gauge wire pickets, forming a uniform two (2) inch mesh, and shall be of the height shown on the Plans or specified in the Contract Documents. Fabric up to and including sixty (60) inches high shall be knuckled at the top and bottom selvage and fabric over sixty (60) inches high shall be twisted on the top selvage and knuckled on the bottom selvage.

19.2.6 **Line Posts.** Line posts shall be zinc coated steel pipe of the following dimensions and of the lengths shown on the Plans or specified herein:

Fence Height	Nominal Size (in)	Steel Pipe Outside Diameter (in)	Weight per Foot (lbs)
6 Feet or Less	1.5" Ø	1.9" Ø	2.72
6 Feet to 8 Feet	2.0" Ø	2.375" Ø	3.65

Steel pipe shall conform to ASTM A120 or MSHTO M181-85I Grade 2. The weight of zinc coating shall be minimum of 1.8 oz/ft². The weight of zinc coating and weight per foot for steel post meeting the requirements of MSHTO M181-85I Grade 2 may vary from the above noted valves.

19.2.7 **End Posts, Corner/Pull Posts, and Braces.** End posts, corner posts, and pull posts shall be zinc coated steel pipe of the following dimensions and of the lengths shown on the Plans or specified herein:

Fence Height	Nominal Size (in)	Steel Pipe Outside Diameter (in)	Weight per Foot (lbs)
6 Feet or Less	2.0" Ø	2.375" Ø	3.65
6 Feet to 8 Feet	2.5" Ø	2.875" Ø	5.79

Diagonal braces shall be one and one-quarter (1¼) inch (1.660 inch O.D.) galvanized steel pipe, weighing 2.27 pounds per foot. Steel pipe and square sections shall conform to ASTM A120 or MSHTO M181-851 Grade 2. The weight of zinc coating shall be a minimum of 1.8 oz/ft². The weight of zinc coating and weight of pipe per foot for steel post meeting the requirements of MSHTO M181-851 Grade 2 may vary from the above noted valves.

19.2.8 **Miscellaneous Fittings and Hardware.** Zinc coated miscellaneous fittings and hardware shall be commercial grade steel or better quality, pressed, wrought, or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric, posts, and wires of the quality specified herein. All steel fittings and hardware shall be galvanized in accordance with MSHTO M111.

19.2.9 **Wire Ties.** Wire ties shall be No. nine (9) gauge and shall be either zinc coated steel, aluminum coated steel or aluminum alloy and sufficient in strength and other properties to provide a balanced design when used in conjunction with fabric, posts, and wire of the qualities specified herein. When tension wire is used, wire ties and clips for fastening fabric to tension wire shall be No. eleven (11) gauge.

19.2.10 **Tension Wire.** Tension wire shall be used at the bottom of fencing fabric when not otherwise secured and used at the top unless a top rail is specified. Tension wire shall be No. six (6) gauge, spring rolled, aluminized steel wire.

19.2.11 **Truss Rods and Turnbuckle.** Unless noted on the plans or directed by the Engineer, truss rods shall be three-eighths (⅜) inch diameter steel rods and shall be equipped with a turnbuckle having a take-up of not less than four inches and shall be galvanized in accordance with AASHTO M111.

19.2.12 **General.** Fabrication of all materials shall be in conformity to the sizes, shapes, and other factors set out in these Specifications or shown on the Plans, and shall show careful, finished craftsmanship in all respects. The weights specified for steel posts, braces, and rails are nominal weights, and a tolerance of plus or minus five (± 5%) percent will be permitted. All posts located on the top of concrete channel lining walls or similar structure shall be of sufficient length to be set fully twelve (12) inches into the wall or structure.

19.3 Construction Requirements:

19.3.1 **Fencing on Concrete Structures.** Fencing shall be placed atop concrete structures, such as concrete channel linings, in accordance with Plans and Design Standards. Fence post inserts will normally have been set into the concrete walls prior to fence construction activities. Inserts shall be twelve (12) inch long solid wall PVC pipe conforming to ASTM 02241, thin wall metal conduit conforming to ANSI C 80.3 and sealed at one end or other material approved by the Engineer. Cans, bottles and the like shall not be used as inserts. Alternatively, posts may be set directly into the structure concrete as the concrete is poured, making sure that all posts are plumbed and held securely in the proper position until the concrete has set.

The inside diameter of the inserts shall be sufficient to provide a minimum of one-quarter (¼) inch clear space between the outside surface of the post and the inside surface of the insert. Inside of inserts shall be cleaned of debris and other foreign matter, insert space filled full of nonshrinking grout, the posts set into place in the insert and plumbed, and the post held plumb until the grout has set. All excess grout shall be removed before it sets. Where inserts have not been provided in the concrete structure, post holes of the same diameter and depth as required for inserts shall be cored in the concrete. Posts shall be set in cored holes in the same manner as posts set in inserts.

19.3.2 **Erecting Fence.** For fence heights less than six (6) feet a top and bottom tension wire shall be installed, unless specified otherwise. For fence heights six (6) feet or greater a top rail and bottom tension wire shall be installed.

Bracing assemblies consisting of the specified bracing pipe as the compression member and specified truss rod as the tension member shall be installed and securely tightened prior to installation of fabric. One brace assembly shall be provided for end post and two brace assemblies for corner and pull posts. When fence alignment changes abruptly by more than thirty (30°) degrees, a comer brace assembly shall be installed. When the internal angle of a curved fence alignment exceeds thirty (30°) degrees, one (1) brace assembly shall be installed at each point of curvature. Pull post shall be installed at abrupt changes in grade or at the midpoint of a straight fence alignment exceeding five-hundred (500) feet in length.

The fabric shall be placed on the side of the post as directed by the Engineer and two (2) inches above ground or concrete structure. Fabric shall be secured at one end and sufficient tension applied to remove all slack before making attachment elsewhere. The fabric shall be fastened to the posts with wire ties at intervals not exceeding fourteen (14) inches. Fabric shall be fastened to the

tension wire or rail with wire ties at intervals not exceeding twenty-four (24) inches. When specified, barbed wire shall be installed and pulled taut before being permanently attached to a post or arm.

19.3.3 **Testing.** Before any fencing is accepted, manufacturer's certificates stating that the fabric, post, rails, braces, barbed wire, tension wire, ties and hardware are made in accordance with applicable standards as specified herein shall be submitted to the Engineer upon request. At the option of the Engineer, test samples of any materials to be furnished shall be furnished at the job site before work commences.

19.4 Measurement:

19.4.1 **Chain Link Fence.** Fences will be measured for payment by the linear foot along the bottom of the fabric and from end to end of fence, complete and in place, deducting the width of gates and openings, for each type and height of fence provided.

19.5 Payment:

19.5.1 **Chain Link Fence.** The accepted quantities of chain link fence will be paid for at the Contract unit price per linear foot, complete and in place, for each type and height of fence, which price will be full compensation for fabric, posts, rails, tension wire, miscellaneous hardware, post-hole excavation, concrete footings, concrete coring and grouting.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Seeding

2023

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Seeding:

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20.1 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 as presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. This work includes all newly graded earthen areas that are not to be paved, stabilized, or sodded, unless otherwise indicated on the Plans or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

20.2 Materials and Equipment: 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.

20.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

20.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

20.2.3 **Storage.** 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.

20.2.4 **Grass Seed.** 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.

The Contractor shall furnish the Engineer 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 Engineer, 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.

When a seed group is used, the percentages forming the group shall be as set out below, unless otherwise specified.

Seed Group 'A'	Quantity, Percent (%) by Weight
Lespedeza (Common or Korean)	20 %
Sericea Lespedeza	15 %
Kentucky 31 Fescue	40 %
English Rye	15 %
White Dutch Clover	05 %
Weeping Love Grass	05 %

Seed Group 'B'	Quantity, Percent (%) by Weight
Kentucky 31 Fescue	55 %
Redtop	15 %
English Rye	20 %
White Dutch Clover	05 %
Weeping Love Grass	05 %

Seed Group 'C'	Quantity, Percent (%) by Weight
Sericea Lespedeza	50 %
Kentucky 31 Fescue	35 %
English Rye	15 %
White Dutch Clover	05 %

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.

20.2.5 **Fertilizer.** Manufactured fertilizer shall be a standard commercial fertilizer containing the specified percentages by weight of nitrogen (N), phosphoric acid and potash. 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.

20.2.6 **Agricultural Limestone.** Agricultural limestone shall contain not less than eighty-five (85%) percent of calcium carbonate and magnesium carbonate combined and shall be crushed so that at least eighty-five (85%) percent will pass the No. ten (10) mesh sieve and one-hundred (100%) percent will pass the three-eighths (⅜) inch sieve.

20.2.7 **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.

20.2.8 **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.

20.2.9 **Mulch Binder.** Cut back asphalt, Grade RC-70 or RC-250 conforming to AASHTO Specifications shall be used.

20.2.10 **Water.** Water shall be free of oil, acid, alkali inorganic matter, any harmful or objectionable qualities or organisms.

20.2.11 **Biodegradable Fabric.** Biodegradable fabric shall be as presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The fabric shall be furnished in rolls and shall conform to the following requirements:

1. Roll Widths: Five (5) feet minimum and ten (10) feet Maximum.
2. Roll Length: Approximately three-hundred sixty (360) feet.
3. Weight: Approximately 0.2 pounds per square yard of fabric.

Fabric shall be secured in a place with wood pegs or other biodegradable materials.

The manufacturer shall provide moisture proof bags comparable to four (4) to six (6) mil opaque polyethylene bags for protection of the fabric prior to installation.

20.2.12 **Erosion Control Matting.** Erosion Control blankets shall be S150 type as manufactured by North American Green, or equivalent. S150 Erosion control blanket shall be a machine-produced mat of 100% agricultural straw or approved equal. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a polypropylene netting having an approximate one-half (½) inch x one-half (½) inch mesh. The S150 shall meet Type 2.D specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17.

20.3 Construction Requirements:

20.3.1 **General.** The Contractor shall notify the Engineer at least forty-eight (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 Engineer. 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.

20.3.2 **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 twenty-three (23) pounds of Grade 6-12-12 or equivalent, per one-thousand (1,000) square feet, and agricultural limestone, at the rate of not less than one-hundred (100) pounds per one-thousand (1,000) square feet, shall be distributed evenly over the seedbed, unless others 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 for a depth of approximately one-half (½) inch. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment.

20.3.3 **Time of Seeding.**

20.3.3.1 **Group 'A':** Seed shall be used for seeding from February 1st to August 1st.

20.3.3.2 **Group 'B':** Seed shall be used from August 1st to December 1st, except that either Group "A" or "B" may be used during the month of August.

20.3.3.3 **Group 'C':** Seed shall be used from February 1st to December 1st and only when specified on the Plans or in the Contract Documents.

20.3.3.4 **General:** Seeding shall be performed only when the soil is in a tillable and workable condition, and no seeding shall be performed between December 1st and February 1st, unless otherwise permitted.

20.3.4 **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 one and one-half (1½) pounds per one-thousand (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 manufacturers of the inoculant and as directed by the Engineer. No seeding shall be done during windy weather, or when the ground surface is frozen, wet, or otherwise non-tillable.

20.3.5 **Biodegradable Fabric.** 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 to installation of the fabric. If the slope is greater than three-to-one (3:1), fabric shall be applied vertically with paper strips oriented parallel to the slope.

The Contractor shall dig a four (4) inch deep check-ditch one (1) foot back from the slope crown, then fold, place and peg fabric every nine (9) inches in the check ditch, and cover with soil. An identical check ditch shall be provided one (1) foot away from the bottom of the slope. When two (2) or more lengths of fabric are required to be installed side by side to cover an area, they shall overlap four (4) inches minimum. Fabric installed end to end shall overlap four (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 five (5) feet. Each length of fabric shall be pegged in three (3) rows, each edge and the center, with pegs placed on three (3) foot centers maximum. Overlapped ends shall be pegged on nine (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.

The Contractor shall maintain and protect the biodegradable fabric until Final Acceptance or until the Engineer 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.

20.3.6 **Erosion Control Blanket.** When erosion control blanket is specified on the Plans, the specific type and the staple pattern required shall be noted. After the soil has been prepared and the seed applied, the Contractor shall begin at the top of the slope by anchoring the blanket in a six (6) inch by six (6) inch wide trench. After the upper edge of the blanket is tucked into the trench and stapled, the trench shall be backfilled and compacted. Roll the blankets down the slope in the direction of the water flow. The edges of parallel blankets must be overlapped approximately two (2) inches. When blankets must be spliced down the slope, place blankets end over end (shingle style) with approximately six (6) inch overlap. The matting should be stapled with eight (8) inch staples in accordance with the staple pattern recommended by the manufacturer.

20.3.7 **Maintenance and Repair.** All seeded areas shall be cared for and maintained properly to the Engineer'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 Engineer. 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 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 Engineer. All material and labor required to maintain and repair seeded area shall be furnished by the Contractor at no cost to the City. If the Engineer directs the Contractor to place additional fertilizer on the area to be reseeded, an additional four (4) pounds of agricultural limestone will be required for each additional one (1) pound of fertilizer.

20.4 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.

20.4.1 **Seeding (with Mulch).** The area of seeding (with mulch) to be measured for payment will be the number of seeding units, with mulch, in accordance with these Specifications. Each unit will consist of one-thousand (1,000) square feet measured along the surface.

20.4.2 **Seeding (without Mulch).** The area of seeding (without mulch) to be measured by square yard of surface covered in accordance with these Specifications.

20.4.3 **Biodegradable Fabric.** Biodegradable fabric to be measured for payment by square yard of surface covered. Measurement will be along the surface.

20.4.4 **Erosion Control Matting.** Erosion control matting shall be measured for payment by the square yard of surface covered. Measurement will be along the surface.

20.4.5 **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.

20.5 Payment:

20.5.1 **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.

20.5.2 **Seeding (without Mulch).** Seeding (without mulch) will be paid for at the Contract unit price per square yard of surface covered 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.

20.5.3 **Biodegradable Fabric.** Biodegradable fabric will be paid for at the Contract unit price per square yard of surface covered for furnishing, installing, maintaining, and protecting the fabric, which price will be full payment for accomplishing the above.

20.5.4 **Erosion Control Matting.** Erosion control matting will be paid for at the contract unit price per square yard of surface covered for furnishing, installing, and maintaining the matting. The price shall be full compensation for all labor and materials necessary to provide a complete installation.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Sodding

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Sodding:

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21.1 Scope: This work shall consist of furnishing and placing sod at all locations as presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. 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 designed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

21.2 Materials and Equipment: 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.

21.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

21.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

21.2.3 **Storage.** 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.

21.2.4 **Sod.** New sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, nut-grass, 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 two (2) inches and cut in ten (10) to twelve (12) inch squares. 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.

21.2.5 **Fertilizer.** Manufactured fertilizer shall be a standard commercial fertilizer containing the specified percentages by weight of nitrogen (N), phosphoric acid and potash. 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. Fertilizer shall be Grade 15-15-15 unless otherwise specified on the plans or in the Contract Documents.

21.2.6 **Ammonium Nitrate.** Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified in Section 20.2.5, and shall have a minimum of thirty-three and one-half (33½%) percent nitrogen.

21.2.7 **Agricultural Limestone.** Agricultural limestone shall contain not less than eighty-five (85%) percent of calcium carbonate and magnesium carbonate combined and shall be crushed so that at least eighty-five (85%) percent will pass the No. ten (10) mesh sieve and one-hundred (100%) percent will pass the three-eighths (⅜) inch sieve.

21.3 Construction Requirements:

21.3.1 **Weather Limitations.** Sod shall be set or reset only when the soil is moist and favorable to growth. No setting or resetting shall be done between December 1st and February 1st, unless weather and soil conditions are considered favorable and permission is granted by the Engineer.

21.3.2 **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 Engineer. Unless reset immediately after cutting, sod shall be stacked in piles and kept moist until reset. Sod shall be reset within seven (7) days after removal, unless otherwise specifically permitted by the Engineer. Reset sod shall show vitality and growth at the time of acceptance by the City and for the duration of the warranty period.

21.3.3 **Sodding.** The area to be sodded shall be brought to the grades shown on the Plans or as directed by the Engineer. The surface of the ground to be sodded shall be loosened to a depth of not less than one (1) inch with a rake or other device. Area shall be moistened 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 eight (8) pounds of Quality Grade 15-15-15, or equivalent per one-thousand (1,000) square feet. Agricultural limestone shall be applied at the rate of one-hundred (100) pounds per one-thousand (1,000) square feet.

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 Engineer. Pinning or pegging shall be required on slopes greater than two-to-one (2:1) to hold the sod in place or in other instances at the direction of the Engineer.

21.3.4 **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 three and one-half (3.5) pounds per one-thousand (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 Engineer. 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.

21.3.5 **Disposal of Surplus Material.** All surplus material shall be disposed of off-site.

21.4 Measurement:

21.4.1 **Sodding.** Sod will be measured for payment by the square yard of surface upon which the sod has been set.

21.5 Payment:

21.5.1 Sodding will be paid for 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.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Manhole Adjustment

2023

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Manhole Adjustment:

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22.1 Scope: This work shall consist of the adjustment of existing drainage and sanitary sewer manholes as necessary to conform to the adjusted elevations, grades, details, and sections presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The construction shall be accomplished in accordance with these Specifications, in conformity with the lines, grades, details, and cross-sections shown on the Plans, and/or directions furnished by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

22.2 Materials and Equipment: 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.

22.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

22.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the requirements of the material being supplied.

22.2.3 **Material Inspection and Testing.**

22.2.3.1 Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested.

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

22.2.3.3 All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

22.2.4 **Storage.** 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.

22.2.5 **Concrete.** Concrete shall be Class A, 3500 psi ready mix type conforming to ASTM Specification C94 and composed of Portland cement, sand and washed course limestone aggregate all conforming to applicable ASTM specifications, Unless noted otherwise on the plans, or as directed by the Engineer.

22.2.5.1 Concrete components shall be mixed with clean water, free of oil, acid, alkali inorganic matter and supplied by an approved ready mix plant.

22.2.5.2 The design mix shall be a ready mix plant's standard for the specified strength, as established and tested by an approved laboratory in accordance with applicable ASTM standard specifications.

22.2.5.3 If so requested, submit a copy of the laboratory test reports of the proposed concrete mix and material to the City Engineer for approval prior to using the proposed concrete.

22.2.5.4 Concrete used for construction and installation of concrete channel lining and ditch paving shall be Class A. All Portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 23, Portland Cement Concrete.

22.2.6 **Mortar.** Mortar shall be composed of the following mixtures by volume: one (1) part Portland cement, two (2) parts sand, hydrated lime not to exceed ten (10%) percent of the cement used, and four (4) parts water. All ingredients shall be proportioned by measurement and not by estimation. All Portland cement, sand, and water shall be as specified in Standard Specifications Section 23, Portland concrete Cement. All hydrated lime shall be as specified by ASTM C6.

The mortar shall be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight mortar box until the mixture is of uniform color, after which water shall be added. Machine mixed mortar shall be prepared in an approved mixer and shall be mixed not less than one and one-half (½) minutes. Mortar shall be used within thirty (30) minutes after mixing.

22.2.7 **Brick.**

22.2.7.1 All brick will conform to ASTM C55 for Grade A. Unless otherwise approved by the Engineer, bricks will conform to the following dimensions:

	Depth (in)	Width (in)	Length (in)
Standard Size	2¼"	3¾"	8"
Allowable Variation	± ¼"	± ¼"	± ½"

22.2.7.2 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.

22.2.7.3 The Contractor may be required to furnish the Engineer with at least five (5) bricks of the character and make he proposes to use, at least one (1) week before any bricks are delivered for use. All brick will be of the same quality as the accepted samples.

22.2.8 **Non-Shrinking Grout.**

22.2.8.1 Grout will be mixed in small quantities as needed and will not be retempered 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 nonshrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

22.2.8.2 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

22.2.9 **Steel Reinforcement.** Deformed steel reinforcing bar shall conform to ASTM A615 for Grade 40 or Grade 60 and shall be of the grades, sizes, and dimensions shown on the plans. Reinforcing bars will be installed at the designated spacings and locations shown on the plans or as directed by the Engineer. Welded wire fabric conforming to ASTM A185 shall have a minimum yield strength of sixty-five (65,000) psi and fabric conforming to ASTM A497 shall have a minimum yield strength of seventy (70,000) psi and shall be of the size, design, and weight and at the locations shown on the plans or as directed by the Engineer.

22.2.10 **Manhole Steps.** Manhole steps shall be as specified in Standard Specification Section 16.2.12, Manhole Steps.

22.2.11 **Manhole Grade Adapter Rings.** Grade adapter rings shall be of the standard type as manufactured by Memphis Machine Works, or equal.

22.3 Construction Requirements:

22.3.1 Adjustment of Manhole Rims and Covers:

22.3.1.1 **Manhole Adjustment (Standard Method).** 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.

If the cover requires adjustment, 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 eighteen (18) inches. If the adjustment would require a collar of greater than eighteen (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. A manhole step shall be installed where required to provide a step eighteen (18) inches below the top of rim. Such additional steps shall be installed between the highest step and existing manhole steps, spaced vertically at sixteen (16) inches staggered horizontally at twelve (12) inches and in alignment with existing steps.

Any changes in grade of precast or poured-in-place manholes shall be as shown on the plans or as directed by the Engineer.

22.3.1.2 **Manhole Ring Adjustment (with Grade Adapter Rings).** For manhole covers to be raised less than or equal to five (5) inches and where the total collar height would not exceed eighteen (18) inches, manhole adapter rings may be used if approved by the Engineer. Adapter rings may be up to a maximum of five (5) inches utilizing no more than one ring. Adapter rings shall be tack welded to the existing rim at a minimum of four (4) locations.

22.3.1.3 **Manhole Ring Adjustment (Alternative Method).** For manhole covers requiring adjustment where Cement Stabilized Aggregate Base (Specification Section 10) or Cement Stabilized Soil Cement Base (Specification Section 11) 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 twenty-four (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 Cement Stabilized Aggregate Base or Cement Stabilized Soil Cement Base a minimum three (3) feet square directly over each manhole. The manhole rims and covers shall then be replaced with Class A concrete conforming to Specification Section 3.1.2 to the subgrade. If, in the process of adjusting the manhole rims, the Contractor removed a larger section than specified, the Contractor shall replace the entire area so removed with Class A concrete at his own expense.

22.4 Measurement:

22.4.1 **Manhole Adjustment (Standard Method).** Standard manhole adjustments will be measured per each manhole rim adjusted to grade.

22.4.2 **Manhole Ring Adjustment (with Grade Adapter Rings).** Manhole adjustment with adapter rings will be measured per each manhole rim adjusted to grade.

22.5 Payment:

22.5.1 **Manhole Adjustment (Standard Method).** 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.

22.5.2 **Manhole Ring Adjustment (with Grade Adapter Rings).** 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.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Portland Cement Concrete

2023

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Portland Cement Concrete:

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23.1 Scope: This specification covers the classification, materials, proportioning of materials, equipment, mixing requirements, and testing for Portland cement concrete to be used for construction of streets, and miscellaneous structures and facilities as defined in the dimensions, details, and sections presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The construction shall be accomplished in accordance with these Specifications, in conformity with the lines, grades, details, and cross-sections shown on the Plans, and directions furnished by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

23.2 Concrete Classification: Unless noted otherwise on the plans, or as directed by the Engineer, Portland cement concrete used for construction of the various items covered in the Standard Specifications shall be classified by usage as follows:

23.2.1 **Class 'A' Concrete.** Class A concrete shall be used as specified for such items as concrete curb, curb and gutter, sidewalks, drainage and sewer structures (other than box culverts), ditch paving, channel lining of ditches, concrete cradles, encasements, embankment slope paving, roadway base, pavement and similar uses.

23.2.2 **Class 'P' Concrete.** Class P concrete shall be used for cast-in-place box culverts, precast structures, precast-prestressed structures, or structural members unless noted otherwise on the plans, or as directed by the Engineer.

23.2.3 **High-Early-Strength Concrete.** High-early-strength concrete shall be as specified in Section 23.6.5.

23.3 Materials:

23.3.1 **Portland Cement.** Portland cement shall be Type I cement or Type I / II Cement conforming to the requirements of AASHTO M85. Type III (high-early-strength) cement conforming to the requirements of AASHTO M85 may also be used.

23.3.2 **Fine Aggregate.** Fine aggregate shall consist of natural sand, clean and free from any surface film or coating and graded from fine to coarse. Fine aggregate shall conform to the requirements of ASTM C33 with the following exceptions and stipulations:

Deleterious Substances: (Shall **NOT** exceed the following limits)	Max. % (by weight)
Removed by Decantation	3 %
Coal or Lignite	1 %
Clay Lumps	1 %
Other local deleterious Substances (such as shale, alkali, mica, coated grains, soft & flaky particles)	1 %
Total coal, clay lumps, shale, soft fragments and other local deleterious substances	5 %

All fine aggregate shall be free from amounts of organic impurities that would be detrimental to concrete strength and durability. Aggregate shall be subjected to the colorimetric test made in the field as follows:

Fill a twelve (12) oz. graduated bottle to the four and on-half (4½) oz. mark with the sand to be tested. Add a three (3%) percent solution of sodium hydroxide until the volume, after shaking, amounts to seven (7) ounces. Shake thoroughly and let stand for twenty-four (24) hours. The sample shall then show a practically colorless solution, or at least, a solution not darker than straw color.

Fine aggregate shall be well graded from coarse to fine and, when tested by means of laboratory sieves, shall conform to the following requirements:

Fine Aggregate Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)						
Sieve Size	⅜"	No. 4	No. 16	No. 50	No. 100	No. 200
Passing	100%	90-100%	50-90%	10-30%	0-10%	0-3%

Note: Not more than forty-five (45%) percent should be retained between any two consecutive sieves.

Fine aggregate shall be of such quality that mortar composed one {I) part Portland cement and three (3) parts fine aggregate, by weight when made into briquettes or cylinders, shall show a tensile or compressive strength at seven (7) and twenty-eight {28) days at least equal to the strength of briquettes or cylinders composed of one {I) part of the same cement and three (3) parts standard Ottawa sand by weight. The percentage of water used in making the test specimens of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand test specimens of standard consistency.

23.3.3 **Coarse Aggregate.** Coarse aggregate for any class of Portland cement concrete shall consist of crushed stone or crushed or uncrushed gravel unless otherwise specified. Coarse aggregate for Class A concrete shall be furnished in two sizes: Size No. 4 and Size No. 67 as shown hereinafter in Table 23-1, Coarse Aggregate Gradation Table. The two sizes shall be manufactured, within the specified limits, to produce Size No. 467 when combined in the proper proportions at the batching plant. If the supplier provides a proper stockpile to prevent segregation, then a combined Size No. 467 can be used in lieu of blending Size No. 4 and Size No. 67. Coarse aggregate for Class P concrete shall be Size No. 57 or Size No. 67 as may be specified or directed. Only limestone coarse aggregate shall be used for Class P concrete; gravel coarse aggregate will not be permitted. Coarse aggregate for concrete curbing placed by machine extrusion methods shall be Limestone size No. 57 or size No. 67. The coarse aggregates shall otherwise conform to the requirements of AASHTO M80 and ASTM C33 with the following exceptions and stipulations:

Deleterious Substances: (Shall **NOT** exceed the following limits)	Max. % (by weight)
1.) Coal or Lignite	1.0 %
2.) Clay Lumps	0.25 %
3.) Material passing the No. 200 sieve	1.0 %
4.) Thin or elongated pieces (length greater than 5 times average thickness)	10.0 %
5.) Soft or nondurable Fragments (Fragments which are structurally weak such as shale, soft-sand limestone, limonite concretions, gypsum, weathered schist, or cemented gravel)	3.0 %
6.) Other local deleterious substances	1.0 %

In the case of crushed aggregate, if all the material finer than the 200 mesh sieve consists of the dust of fracture essentially free of clay or shale, Item 3 (above), may be increased to one and one-half (1.5%) percent (Max.).

The sum of the percentages of Items No. l, 2, 3, 5 and 6 shall not exceed 5.0%.

When the coarse aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than nine.

The percentage of wear as determined by ASSHTO T96 shall not exceed 40%.

Table 23-1: Coarse Aggregate Gradation Table
Total Percent by Dry Weight for Square Opening Sieves (U.S. Standard)

Sieve Size	2”	1½”	1"	¾"	½”	⅜”	No. 4	No. 8
No. 4 Rock	100%	90-100%	20-55%	0-15%	-	0-5%	-	-
No. 467 Rock	100%	95-100%	-	35-70%	-	10-30%	0-5%	-
No. 57 Rock	-	100%	95-100%	-	25-60%	-	0-10%	0-5%
No. 67 Rock	-	-	100%	90-100%	-	20-55%	0-10%	0-5%

23.3.4 **Water.** The water used in mixing concrete shall be clean, free from oil, acid, strong alkalis, organic or vegetable matter.

23.3.5 **Air-Entraining Admixtures.** Air-Entraining Admixtures shall conform to the requirements of AASHTO M154, except that the tests for bleeding, bond strength and volume change will not be required. The Contractor shall furnish test data from a recognized laboratory showing that the air-entraining admixture proposed for use conforms to the requirements of these Specifications. A recognized laboratory is defined as one of the following: A State Transportation Department Laboratory; a Federal Highway Administration Laboratory; or other laboratories which are approved by the City.

23.3.6 **Chemical Additives.** For Portland cement concrete mixtures, these additives shall conform to the requirements of AASHTO M194 covering the following five types:

Type A	Water Reducing Admixtures
Type B	Retarding Admixtures
Type C	Accelerating Admixtures
Type D	Water Reducing and Retarding Admixtures
Type E	Water Reducing and Accelerating Admixtures

Additionally, admixtures for increasing the flowable characteristics of concrete (super plasticizers – high range water reducing) may be used, subject to the approval of the Engineer for each class and intended use of the concrete. Such admixtures shall meet the applicable requirements of AASTM C494. The use of a plasticizer shall not change the maximum water requirements for the approved design mix. When approved for use, the admixture shall be introduced into the mix in the manner and quantities recommended by the manufacturer.

Additives listed in Items A through E above and super plasticizers may only be used with the written approval of the Engineer. Before any admixture is approved, the manufacturer of the admixture or the Contractor shall furnish the City documentary evidence that the material proposed for use has been tested in accordance with the methods of test specified in AASHTO M194 (or ASTM C494 for super plasticizers) and meets the requirements of that Specification. Documentary evidence for all additives shall be the results of tests conducted by a testing laboratory inspected at regular intervals by the National Bureau of Standards. The City may require a notarized certification from the manufacturer of any additives used stating that the material is identical with that originally approved and has in no way been changed or altered. Even though additives have been approved by the City, the Contractor shall be responsible for the successful use of the additives. No reduction in the cement content of the concrete as designed without chemical additives will be made when additives are permitted.

Calcium chloride additives will NOT be permitted.

23.3.7 **Curing Materials.** Curing materials shall be as specified in the various Sections of the Standard Specifications, Contract Documents and as specified below:

23.3.7.1 **Water:** Water used in curing Portland cement concrete shall be free from any substance which may be injurious to concrete when applied on the surface as a curing agent.

23.3.7.2 **Burlap:** Burlap shall conform to AASHTO M182, Class 3 or Class 4. If Class 1 or Class 2 burlap is permitted, at least two layers shall be used.

23.3.7.3 **Liquid Membrane-Forming Compounds:** These compounds shall conform to AASHTO M148. Where applied texture finish is specified, a Type 1-D, Class 8, membrane which is compatible with the texture finish shall be used. Type 2 (white pigmented) membrane shall be used in all other applications, unless otherwise specified.

23.3.7.4 **White Polyethylene Sheeting:** Unless noted on the plans or directed by the Engineer, This material shall conform to AASHTO M171.

23.3.8 **Fly Ash.** Class C or Class F Fly Ash conforming to the requirements of AASHTO M295 may be used as a replacement for Portland cement if approved in writing by the Engineer. The maximum amount of cement being replaced by fly ash shall not exceed twenty (20%) percent.

23.4 Equipment: Equipment and tools necessary for handling materials and performing all parts of the Work shall be subject to the approval of the Engineer. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans and Design Standards or as directed by the Engineer.

23.4.1 **Batching Plant and Equipment.** The batching plant shall include bins, weighing hoppers, and scales. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The Contractor shall provide adequate means for cement cutoff checks. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The bulk cement storage bin or hopper shall be provided with adequate means for sampling the cement in storage.

23.4.1.1 **Bins and Hoppers:** Bins with adequate separate compartments for fine aggregates, each size of coarse aggregate, and cement shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision. A port or other opening shall be provided for removing an overload of any one of the several materials from the hopper. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent spilling under any working conditions.

23.4.1.2 **Scales:** The scales for weighing aggregates and cement shall be of either the beam type or the spring-less-dial type. They shall be accurate within one-half (0.5%) percent throughout the range of use. The value of the minimum graduation on the scale for weighing cement shall not be greater than five (5) pounds. The value of the minimum graduation on the scale for weighing amounts of aggregates up to ten-thousand (10,000) pounds or more shall be not greater than zero-point-one (0.1%) percent of the nominal capacity of the scales but shall not exceed fifty (50) pounds.

Scales shall be tested no less than once monthly by a certified scale testing company. Testing shall meet the requirements of applicable County Ordinances and State law. The Contractor shall have available not less than ten (10) standard fifty (50) pound weights meeting the requirements of the U.S. Bureau of Standards for calibrating and testing weighing equipment. The person dispensing weighed material shall certify that the amounts of materials used is in accordance with quantities shown on the delivery ticket.

23.4.1.3 **Equipment for Structural Concrete:** The requirements for batching plants shall be as prescribed above, except that when approved by the Engineer, the requirement for storage compartments in addition to weigh bins, for fine and coarse aggregates may be waived, provided the batching tolerances specified in Section 23.5.2.1 are maintained. Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than five (5) feet. Where steep slopes are required, the chutes shall be equipped with baffle boards or shall be in short lengths that will enable the direction of movement to be reversed. Tremie pipes for placing seal concrete under water shall consist of a water tight tube ten (10) inches to fourteen (14) inches in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

23.4.2 **Concrete Mixers.** Concrete may be mixed at a central point or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum, in terms of mixing and agitating capacity, and the speed of rotation of the mixing drum or blades for both mixing and agitation.

Concrete mixers shall be capable of combining the aggregates, cement, additives when specified, and water into a thoroughly mixed and uniform mass within the specified mixing period. They shall have a minimum capacity sufficient to comply with minimum production requirements.

Concrete mixers shall be equipped with an approved device for accurately measuring water within a range of error of not more than one percent. The amount of water used in each batch shall be shown by an indicator which is accurately calibrated and easily read.

Central plant mixers shall be equipped with an approved batch meter and timing device which will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. This device shall be equipped with a bell or other suitable warning device that will give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing the Contractor furnishes a satisfactory means of determining the mixing time.

23.4.2.1 **Concrete Mixers at Site of Construction:** Unless noted on the plans or directed by the Engineer, concrete mixers will not be permitted at the site of construction.

23.4.2.2 **Truck Mixers and Truck Agitators:** Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall meet all the applicable requirements under Section 23.4.2 above, and in addition, the manufacturer's plate shall indicate the various uses for which the equipment is designed, the gross volume of the drum, and the minimum and maximum speed of rotation of the drum or blades for charging, mixing and agitating. Trucks equipped for mixing shall be equipped with an approved device for recording the number of revolutions of the drum or blades. Mixers or agitators used to mix and transport paving concrete shall be of the hydraulic drum lift type or other especially designed types which will discharge low slump concrete (1" to 2½" Slump) at a satisfactory rate without segregation.

23.4.2.3 **Non-Agitator Trucks:** Bodies of non-agitator hauling equipment for concrete shall be smooth, mortar tight, metal containers, and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Covers shall be provided when needed for protection of the concrete. Non-agitator trucks may be used only with approval of the Engineer.

23.4.2.4 **Admixture Induction:** A satisfactory method and equipment for setting the dosage for admixtures must be furnished and if admixtures other than air entraining agents are used, they shall be added in the manner and in the dosage recommended by the manufacturer.

23.4.2.5 **Concrete Vibrators:** Vibrators shall be of an approved type and design, and shall operate under load at the rate as recommended by the manufacturer and approved by the Engineer. For concrete structures, all concrete to be vibrated shall be compacted by means of approved high frequency internal vibrators or other approved types of vibrators immediately after being deposited in the forms. At least two (2) vibrators in good operating condition and two (2) sources of power shall be available at the site where more than twenty-five (25) cubic yards of concrete are to be poured. The use of external vibrators for compacting concrete will be permitted where the concrete is inaccessible for adequate compaction, provided the forms are sufficiently rigid to prevent displacement or damage from external vibration and approved by the Engineer. For concrete pavement, the frequency of surface vibrators shall not be less than three-thousand five-hundred (3,500) impulses per minute and the frequency of the

internal type shall not be less than five-thousand (5,000) impulses per minute for tube vibrators and not less than seven-thousand (7,000) impulses per minute for spud vibrators. When spud type internal vibrators, either hand operated or attached to spreader or finishing machines, are used adjacent to forms, they shall have a frequency not less than seven-thousand (7,000) impulses per minute. For prestressed concrete, all concrete shall be thoroughly compacted with approved high frequency vibrators operating at a minimum of seven-thousand (7,000) vibrations per minute.

23.5 Handling, Batching and Mixing:

23.5.1 **Stockpiling Aggregates.** Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground shall be firm and smooth and well drained. A cover of at least three (3) inches of aggregate shall be maintained in order to avoid the inclusion of soil or foreign material. The stockpiles shall be built in layers not exceeding four feet in height, and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of aggregate composed essentially of material finer than the No. 4 sieve and base material.

Dumping, casting or pushing over sides of stockpiles will be prohibited, except in the case of aggregate for base material and fine aggregate materials.

Unless otherwise authorized, aggregates from different sources, different gradings or differing in specific gravity by more than zero-point-three (0.03) shall not be stockpiled together. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.

When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpiles, it shall be done in a manner approved by the Engineer. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated, and failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such stockpiling procedure.

Stockpiles shall be maintained in a saturated surface dry condition to the extent possible.

23.5.2 **Handling, Measuring and Batching Material.**

23.5.2.1 **General:** The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the Work.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to maintain a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least eleven (11) hours before being batched. Rail shipment requiring more than one-hundred two (102) hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of twelve (12)

hours may be required by the Engineer. The Engineer may require sprinkling of aggregate that has dried to the extent that it absorbs mixing water.

The fine aggregate and each size of coarse aggregate shall be separately weighed into the hopper or hoppers in the respective amounts set by the Contractor and approved by the Engineer. Cement shall be measured by the sack or weight. Separate scales and hoppers shall be used for weighing the cement. The scales shall be equipped with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks will not be allowed except when bulk cement is used.

Batching plants equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type may be used.

Batching shall be so conducted as to result in the required weights of each material being within a tolerance of one (1%) percent for cement and one and one-half (1.5%) percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one percent. Unless otherwise permitted, calibrated tanks for measuring water shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

The use of chemical additives shall be as prescribed under Section 23.3.5, and they shall be added to the mix using the methods and at the time and in the manner recommended by the manufacturer of the additive, subject to approval by the Engineer.

Unless specifically provided in the contract, the furnishing and use of approved additives or admixtures and the other precautions necessary to provide satisfactory concrete and concrete products shall be considered subsidiary to the furnishing and placement of the concrete and any and all additional costs related thereto and risks resulting therefrom shall be borne by the Contractor.

Different types of cement shall not be mixed, nor shall they be used alternately. Where it is necessary for the color of the concrete to be uniform, only those cements which will produce similar color in concrete may be used alternately. The Engineer shall designate which cements may be used alternately.

Air entraining agents shall be added to the mix by an approved procedure and by the use of an approved dispenser to assure an accurate proportioning of the agent. All admixtures shall be measured with an accuracy of plus or minus three (3%) percent.

23.5.2.2 **Limitations on Concrete Operations:** Mixing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours, unless an adequate and approved artificial lighting system is provided and operated.

When concrete is being placed during hot weather, appropriate measures shall be taken to reduce the hazards of increased rate of cement hydration and high concrete temperatures. The temperature of the concrete at point of discharge shall not exceed ninety (90°) degrees Fahrenheit. The Engineer may require any or all, but not limited to, the following precautions to reduce the temperature of the concrete:

1. Sprinkle coarse aggregate stockpiles in a manner so as to distribute the water evenly and to prevent a variation of moisture within the stockpile.
2. Use crushed or chipped ice as a portion of the mixing water, or use water cooled by refrigeration of other means. If ice is used, it shall be substituted on a pound for pound basis for water and completely melted before the concrete is discharged from the mixer.
3. The Contractor may employ other means which he may have at his disposal if approved by the Engineer. In order to minimize the number and extent of precautions as indicated during the production and use of concrete during hot weather, the Contractor may use approved chemical admixtures for set-retarding purposes, with the Engineer's approval. However, the use of such approved set-retarding admixtures shall not relieve the Contractor of the necessity for other precautions deemed necessary to minimize variability of the physical characteristics, strength, and other requirements of the green concrete.

Unless authorized in writing by the Engineer, mixing and temperature in the shade and away from artificial heat reaches forty (40°) degrees Fahrenheit (if the temperature is expected to reach thirty-five (35°) degrees Fahrenheit or below), and not resumed until an ascending air temperature in the shade and away from artificial heat reaches thirty-five (35°) degrees Fahrenheit.

When concreting at temperatures above thirty-five (35°) degrees Fahrenheit, the aggregates or water shall be heated or cooled if necessary prior to being placed in the mixer so that the temperature of the resultant mixture will be not less than fifty (50°) degrees Fahrenheit nor more than ninety-five (95°) degrees Fahrenheit at the time of placement. If heating is required, the apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the concrete.

When concreting is authorized at temperatures thirty-five (35°) degrees Fahrenheit or less, the Engineer will require the water or the aggregates or both to be heated to not less than seventy (70°) degrees Fahrenheit nor more than one-hundred fifty (150°) degrees Fahrenheit. The temperature of the mixed, heated concrete shall be not less than fifty (50°) degrees Fahrenheit nor more than one-hundred (100°) degrees Fahrenheit at the time of placement. No concrete shall be placed on frozen grade nor shall frozen aggregates be used in the concrete.

When it is expected that the ambient temperature will drop below thirty-five (35°) degrees Fahrenheit, the Contractor shall provide sufficient canvas and framework, other types of housing, or to

enclose and protect the concrete in such a way that the air surrounding the fresh concrete can be maintained at a temperature of not less than forty-five (45°) degrees Fahrenheit and the temperature of the concrete shall not exceed eighty (80°) degrees Fahrenheit. The above conditions shall be maintained for a period of on-hundred twenty (120) hours after the concrete is placed. The Contractor shall be responsible for the quality of concrete placed during cold weather, and any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense. When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary hearing and covering material shall be on hand ready for use before Engineer's permission is granted to begin placement.

23.5.3 **Mixing Concrete.**

23.5.3.1 **General:** The concrete may be mixed in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity, and shall comply with the applicable requirements of Section 23.4.2. Mixers shall be cleaned at suitable intervals. Equipment having components made of aluminum or magnesium alloys which would have contact with plastic concrete during mixing, transporting or pumping of Portland cement concrete, shall not be used.

The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. Mixing time shall be measured from the time all materials except water are in the drum. The flow of water shall be uniform, and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the flow of materials into the drum.

When mixed in a central mixing plant, the mixing time shall not be less than sixty (60) seconds nor more than ninety (90) seconds. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers shall be included in the mixing time. The contents of an individual mixer drum shall be removed before succeeding batch is emptied therein.

The mixer shall be operated at the drum speed recommended by the manufacturer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense. Mixers for central mix plants shall not be operated at a capacity greater than the manufacturer's guaranteed mixing capacity.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating trucks having special bodies. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed forty-five (45) minutes when the concrete is hauled in on agitating trucks, nor sixty (60) minutes when hauled in truck mixers or truck agitators. When high early strength concrete is used, agitator trucks only shall be used and the concrete shall be deposited in place at the site of the work within forty-five (45) minutes from the time water is added to the mix, regardless of the method of transportation, unless otherwise approved by the Engineer.

Re-tempering concrete by adding water or by other means will not be permitted. Concrete that is not within the specified slump limits at time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be used only when provided for in the

Contract, or permitted by the Engineer. The addition of admixtures to the mix shall be in accordance with the provisions of Section 23.5.2.1.

Tests for air content shall be made on samples of fresh concrete when and as directed. The air content shall be that specified under Section 23.6.1 of these Specifications and shall be determined in accordance with AASHTO T 152, T 196 or T 199.

23.5.3.2 **Ready Mixed Concrete:** Ready mixed concrete shall fully comply with ASTM C94 for Ready Mixed Concrete and to the requirements of these Specifications. Ready mixed concrete shall be discharged from the mixer within one (1) hour after the introduction of water, provided the air temperature or the concrete temperature does not exceed seventy (70°) degrees Fahrenheit. When the air temperature or concrete temperature exceeds seventy (70°) degrees Fahrenheit, the elapsed time between the addition of water to the mix and discharge shall not exceed thirty (30) minutes. The thirty (30) minute time limit for temperatures exceeding seventy (70°) degrees Fahrenheit may be extended to one (1) hour, provided an approved admixture is used. The admixture shall be a water reducing and retarding agent meeting the requirements of Section 23.3.6, Type D, and shall be used in accordance with the provisions of Section 23.5.2.1. The ready-mix plant furnishing the concrete shall have been inspected and approved for use as provided in Section 23.4. The delivery ticket accompanying each load of concrete shall show the class and quantity of concrete, the quantity of cement, aggregates, water, and additive used in the batch, and the time of batching. Materials used in the concrete shall be tested and approved.

23.6 Concrete Mix Design and Proportioning:

23.6.1 **General.** Unless otherwise specified in the Contract Documents, all concrete shall contain an air entraining admixture. The concrete shall contain between four (4%) percent and eight (8%) percent entrained air. Other admixtures may be used if specifically approved by the Engineer. The use of calcium chloride will not be allowed. The Engineer may specify differing compressive strengths for the concrete classification by notation on the Plans or in the Special Provisions, and those values shall govern over the values of these Specifications.

23.6.2 **Concrete Mix Design.** Prior to mixing any concrete for the project, the Contractor shall submit his proposed design mix and reports of tests for each classification of concrete to the City for approval. The design mix shall be submitted on a form that indicates the supplier and type of the concrete and materials to be used as well as the amounts of materials per cubic yard for at least the following items and units (based upon saturated surface dry aggregate):

Material:	Measure Unit:
Cement	Pounds per yd^3
Fine Aggregate	Pounds per yd^3
Air Entraining Admixture	Ounces per yd^3
Other Admixtures (if allowed)	Ounces per yd^3
Water	Pounds per yd^3
Fly Ash	Pounds per yd^3

23.6.3 **Proportioning.** Concrete shall be manufactured by combining the several materials prescribed in the design mix in the proportions necessary to obtain the specified compressive strength listed in the Standard Specifications, presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. Proportioning shall be based upon the specified cement content, and the amount of water for Class of concrete shall not exceed the quantity shown in the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, Section 604.03 (Class A concrete) or Section 615.09 (Class P concrete). Below this limit, the quantity of water shall be adjusted to meet the slump requirements. Aggregate weights shown in the Contractor's mix design(s) shall be based on saturated surface dry aggregate; batch weights shall be corrected to compensate for surface moisture on the aggregate in order to determine the amount of water to be added at the mixer.

23.6.4 **Changes in Mix.** When approved by the Engineer, the ratio of coarse and fine aggregate may be adjusted in order to assure better workability or to accommodate placement by pumping. However, in no case shall the fine aggregate exceed forty-four (44%) percent of the total aggregate. If during the progress of the Work, the specific gravity of one or both of the aggregates change more than plus or minus zero-point-zero-three (0.03) from those shown on the concrete design, the design weights shall be adjusted by a design change to conform to the new specific gravity.

23.6.5 **High-Early-Strength Concrete.** High-early-strength concrete may be required in the Plans and Specifications or substituted at the request of the Contractor, subject to the approval of the Engineer. When high-early-strength cement concrete is authorized, it shall conform to the requirements of the Tennessee Department of Transportation (Section 604.03 or 615.09), except that the 28 day strength shall be obtained in 7 days. The use of Type I or Type Ill cement for high-early-strength concrete will be optional with the Contractor. Up to 800 pounds per cubic yard of Type I cement may be used to produce high-early-strength concrete in lieu of using Type Ill cement. When Type I cement is used, the concrete shall have a minimum of 7.6 sacks (714 pounds) of cement per cubic yard of concrete. If admixtures are used to obtain high-early-strength concrete, such admixtures may only be used if previously approved by the Tennessee Department of Transportation for similar uses of the concrete and if specifically approved for the project by the Engineer. The gradation of fine and coarse aggregates shall be the same as that approved for the concrete for which the high-early-strength concrete is substituted. All materials entering into the high-early-strength concrete shall be of the same kind and class as the materials entering into the other part or parts of the facility constructed of the class of concrete for which high-early-strength concrete is being substituted. No additional compensation will be made if the Contractor elects to substitute high-early-strength concrete for any class of concrete. The unit price for the class for which the substitution is made shall be full compensation for the concrete.

23.7 Testing:

23.7.1 **Test Samples.** The Contractor will be responsible for obtaining the services of a qualified testing laboratory to prepare all test cylinders and test all samples. Testing ages will be seven (7) days and twenty-eight (28) days unless otherwise determined by the Engineer. Laboratory cylinders shall be used to determine the quality of concrete produced. The number of cylinders to be cast daily for any quantity of concrete and laboratory tested, shall be specified by the Engineer. With prior consent of the Engineer, the Contractor may prepare field cylinders. These cylinders may be used as a gauge for early safe removal of forms where the Contractor requests earlier removal than set out in the Specifications.

23.7.2 **Cement testing.** All cement used in the work shall be pretested before use. Cement may be used upon completion of a satisfactory three (3) day physical test made in accordance with current ASTM Specifications. Cement shall be tested by an approved commercial testing laboratory at the Contractor's expense.

23.7.3 **Core Samples.** If the testing of cylinders indicates compressive strength less than required in the Plans or Standard Specifications for the class of concrete specified, the Contractor may, at his option, elect to drill core samples from the actual concrete placed. If the Contractor elects to drill (or is instructed by the Engineer to drill) core samples from the hardened concrete, the costs of obtaining the cores and of repairing the core holes with nonshrinking grout shall be the responsibility of the Contractor.

The cores shall be drilled as directed by the Engineer, at the same approximate locations from which the test cylinder concrete was obtained. The locations of the drilled cores shall be selected so that the remaining structure will not be impaired or sustain permanent damage after the holes are repaired by the Contractor. The drilled samples shall be tested for compressive strength, and the equivalent twenty-eight (28) day strength of the concrete placed and represented by the drilled core samples shall be determined. The Engineer shall use the test results of the drilled cores to determine the acceptability of the concrete.

23.7.4 **Methods of Sampling and Testing.** Test cylinders cast to determine acceptability for minimum AASHTO strength requirements shall be made and cured in accordance with AASHTO T23 and tested in accordance with AASHTO T22. Test cylinders cast to determine when a precast unit or a structure may be put into service or to determine when a tensioning load may be transferred shall be cured by methods identical to those used in curing the concrete member, and tested in accordance with AASHTO T22.

Drilled core samples shall be taken and tested in accordance with AASHTO T24. Due to possible fracturing effect of the coring operation, drilled core samples having a compressive strength of eighty-five (85%) percent or more of specified strength will be considered acceptable.

Slump shall be determined in accordance with AASHTO T119 on the job site during each placement.

The amount of air entrained shall be determined by pressure or volumetric meters of approved design and in accordance with AASHTO Method T152 or AASHTO Method T196, except that AASHTO Method T199 may be used after the accuracy of the Air Indicator has been determined by comparison tests.

23.7.5 **Concrete Failing to Meet Strength Requirements.** Concrete which has been mixed and placed in accordance with these Specifications, and which fails to meet the minimum 28 day strength requirements shall be removed and disposed of by the Contractor, at his expense, unless specifically authorized by the Engineer, in writing, to remain in place. The removal shall be in such manner as will not cause damage to the remaining concrete, other structures, or other facilities and property.

The Engineer may, at his discretion, allow concrete which fails to meet the minimum strength requirement to remain in place. Payment for this concrete will be at a reduced price, to compensate the City for loss of durability. The amount of the reduction shall be determined by the Engineer and shall be based on the particular circumstances.

23.8 Miscellaneous:

23.8.1 **Concrete Mixed and/or Batched off Project Site.** Concrete may be mixed and/or batched off the immediate project site, subject to specific approval of the Engineer and under the direct supervision of the Contractor. A delivery ticket (certified by the batch plant) showing the Compressive Strength required, mix design, quantity of cement, quantity of fine and coarse aggregate, moisture content, total water and gallons per cubic yard of concrete shall be furnished the Engineer with each delivery of concrete and the Contractor shall show to the satisfaction of the Engineer that the plant is so located and equipped as to produce and deliver concrete fully meeting the specification requirements.

23.9 Measurement: The methods of measurement for concrete shall be as specified elsewhere in these Specifications for each particular item constructed by the Contractor.

23.10 Payment: The methods of payment for concrete shall be as specified elsewhere in these Specifications for each particular item constructed by the Contractor.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Fibrous Concrete Reinforcing

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Fibrous Concrete Reinforcing:

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24.1 Scope: This work shall consist of providing Fibermesh fiber to concrete mix in the proper volume of zero-point-one (0.1%) percent as presented in the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

24.2 Materials:

24.2.1 **General.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Used materials in acceptable condition may be used for trench bracing, forms, falsework, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

24.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the specified design requirements of the material being supplied.

24.2.3 **Fibermesh Fiber.** Use only one-hundred (100%) percent virgin polypropylene or macro-synthetic specifically manufactured for use in concrete secondary reinforcement. Volume of fibrous reinforcement per cubic yard (yd^3) of concrete shall equal a minimum of zero-point-one (0.1%) percent (equal to on and 1.5 pounds per cubic yard). Materials shall meet the requirements of ASTM C1116/C1116M, Type III fiber for reinforced concrete.

24.2.4 **Physical Characteristics.** The Contractor is to submit three (3) copies of the manufacturer's printed product data for the fibrous concrete reinforcement material intended for use. Include in this submittal the manufacturer's batching and mixing instructions. Physical Characteristics of the fibermesh product shall be as follows:

Specific Gravity	0.91
Tensile Strength	80 – 110 Ksi
Fiber Length	Graded per Manufacturer

24.2.5 **Execution.** The fibrous concrete reinforcement is to be added to the concrete materials at the time the concrete is batched in amounts in accordance with approved submittals for each type of concrete required. The concrete is to be mixed in strict accordance with fiber reinforcement manufacturer's instructions and recommendations to ensure uniform and complete distribution. The batch tickets for each delivery truck shall indicate the type of concrete being delivered and the amount of fibrous concrete reinforcement added to the batch of concrete. The delivery ticket shall be given over to the City representative at the job site. Concrete shall be placed and finished in accordance with other sections of these Specifications.

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STANDARD SPECIFICATIONS

Bituminous Plant Mix Base (Hot Mix)

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Bituminous Plant Mix Base (Hot Mix):

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25.1 **Scope:** This work shall consist of a foundation composed of a hot mixture of aggregate and asphalt prepared in a hot bituminous mixing plant. It shall be constructed in one or more layers, on a prepared subgrade, granular sub-base, or base in accordance with these Specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

Work performed for the City of Germantown under this section to install a bituminous plant mix base shall be done in accordance with Section 307 of the Tennessee Department of Transportation Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 307 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

25.2 **Measurement:** The Bituminous Plant Mix Base (Hot Mix) will be measured by the ton as evidenced by truck delivery tickets that have been sealed by a Certified Public Weigher licensed by The State of Tennessee, collected at the job site. All truck delivery tickets for a day's run shall be delivered to a City Inspector at the end of that day. Tickets not collected by the Inspector in the field will not be considered for payment.

25.3 **Payment:** The accepted quantities of Bituminous Plant Mix (Hot Mix), complete in place, will be paid for at the contract unit price per ton. The cost of tack coat required will be incidental to the cost of the work and included in the contract price of other items of the work.

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Engineering Department

STANDARD SPECIFICATIONS

Tack Coat

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Tack Coat:

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26.1 **Scope:** This work shall consist of furnishing and applying bituminous material to a previously prepared base or surface to provide a bond for a superimposed course in accordance with these Specifications, details shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

Work performed for the City of Germantown under this section to apply tack coat shall be done in accordance with Section 403 of the Tennessee Department of Transportation Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 403 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

26.2 **Measurement:** This material is considered incidental to other work, therefore no measurement is required.

26.3 **Payment:** The method of compensation for the accepted quantities of bituminous material for tack coat shall not be made directly, but shall be considered incidental to other work. The Contractor shall include all costs for labor, equipment, and materials necessary to complete the proper application of bituminous material for tack coat in the unit costs of the superimposed course for which it is intended to provide proper bonds. No direct compensation for this work will be made.

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STANDARD SPECIFICATIONS

Bituminous Plant Mix Pavements (General)

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Bituminous Plant Mix Pavements (General):

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27.1 **Scope:** The Specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type, irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement used. Deviations from these general requirements will be indicated in the specific requirements of each type.

This work shall consist of one or more courses of bituminous mixture constructed in the prepared foundation in accordance with these Specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

Work performed for the City of Germantown under this section to install a bituminous plant mix base shall be done in accordance with Section 407 of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 407 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

27.2 **Measurement:** All measurements for work performed under this Section shall be made in accordance with the methods set forth in other related Sections of these Specifications.

27.3 **Payment:** All basis of payment for work performed under this Section shall be made in accordance with the methods set forth in other related Sections of these Specifications.

27.4 **Quality Assurance.** The Contractor shall be responsible for quality control of his plant and processes. To that end, he shall propose a quality control plan for use on this project at the pre-construction conference. The Contractor shall be responsible for implementing the approved Quality Control Plan. All payment requests will be accompanied by copies of the applicable test results of tests performed upon the materials placed. Failure to meet minimum requirements or to furnish proof of the tests performed may be considered as reason to withhold or adjust the amount of payment. Unacceptable work will be rejected by the Engineer.

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STANDARD SPECIFICATIONS

Asphaltic Concrete Surface (Hot Mix)

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Asphaltic Concrete Mix (Hot Mix):

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28.1 **Scope:** This work shall consist of a foundation composed of a hot mixture of coarse aggregate, fine aggregate, mineral filler, if specified or required, and asphalt cement, prepared in an Asphalt mixing plant. It shall be constructed in one or more layers, on a prepared subgrade, granular sub-base, or base in accordance with these Specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

The provisions of Section 27, Bituminous Plant Mix Pavements (General) of these Specifications shall apply to this construction unless otherwise stipulated.

Work performed for the City of Germantown under this section to install a bituminous plant mix base shall be done in accordance with Section 411 of the Tennessee Department of Transportation bureau of Highways Nashville Standard Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 411 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

28.2 **Measurement:** The Asphaltic Concrete Surface (Hot Mix) will be measured by the ton as evidenced by truck delivery tickets that have been sealed by a Certified Public Weigher licensed by The State of Tennessee, collected at the job site. All truck delivery tickets for a day's run shall be delivered to a City Inspector at the end of that day. Tickets not collected by the Inspector in the field will not be considered for payment.

28.3 **Payment:** The accepted quantities of Asphaltic Concrete Surface (Hot Mix), complete in place, will be paid for at the contract unit price per ton. The cost of tack coat required will be incidental to the cost of the work and included in the contract price of other items of the work.

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Traffic Control

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Traffic Control:

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29.1 **Scope:** This work shall consist of traffic control in advance of, through and after the construction area. Placement of signs, temporary markings, cones, barrels, flashing arrow boards, flagmen, temporary traffic signal operation and flashing warning lights shall be in accordance with these Specifications, as shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. This work includes continuous maintenance or adjustment of any control device used during the course of the construction. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

All traffic control shall be in conformance with the Manual of Uniform Traffic Control Devices (MUTCD manual) and in particular Section VI on traffic control in construction work zones.

29.2 **Measurement:** The Traffic Control will be paid for by a 'Lump Sum', therefore no measurement is required.

29.3 **Payment:** The accepted quantities of Traffic Control will be paid for at the contract price or unit price. The cost of maintenance of devices, labor, and replacement of devices will be incidental to cost of the work and included in other items of the work.

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STANDARD SPECIFICATIONS

Roadway Signage

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Roadway Signage:

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30.1 Scope: This work shall consist of the construction of roadway signage foundations and supports, fabricating, furnishing, assembling, and erecting traffic signs on supports, including delineators, when specified, for a section of roadway, its intersections with roads or streets affording immediate access to the roadway. Unless noted otherwise, construction shall be in accordance with these Specifications, and in reasonably close conformity with the lines, grades shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

Roadway signs and devices shall be constructed and erected in accordance with these Specifications and the Manual on Uniform Traffic Control Devices (MUTCD), FHWA, latest edition, and The Tennessee Department of Transportation, Tennessee Supplement, at the locations and within reasonably close conformity to the lines and grades indicated on the Plans or as otherwise directed by the Engineer.

The Plans will indicate the extent and general arrangement of the signs. The Plans are to be used for the general guidance of the Contractor, and any commission or omission shown or implied shall not be cause for deviating from the Plans and Specifications. If any departures from the Plans and Specifications are deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Engineer for approval. No such departure shall be made without the prior written approval of the Engineer. For any departure from the Plans, the Contractor shall submit for approval by the Engineer, three copies of drawings showing complete design of said departure and any information necessary to complete the sign assembly.

Work performed for the City of Germantown under this section to install roadway signage shall be done in accordance with Section 713 of the Tennessee Department of Transportation bureau of Highways Nashville Standard Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 713 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

30.2 Measurement: Roadway sign assemblies, including any foundations, anchor bolts, mounting hardware, poles, supports and sign faces and any miscellaneous hardware shall be measured as a completed assembly.

30.3 Payment: The accepted Roadway Signage assembly of the specific type noted in the plans shall be paid for at the contract unit price each sign, complete in place.

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Pavement Markings

2023

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Pavement Markings:

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31.1 Scope: This work shall consist of furnishing and supplying pavement markings in accordance with these Specifications, the latest revision of the Manual of Uniform Traffic Control Devices, FHWA Latest Edition, and The Tennessee Department of Transportation, Tennessee Supplement, and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the Plans, stipulated in the Contract Documents, or directed by the Engineer. The work shall include furnishing all labor, material, and equipment required to successfully complete the work.

Work performed for the City of Germantown under this section to install a bituminous plant mix base shall be done in accordance with Section 716 of the Tennessee Department of Transportation bureau of Highways Nashville Standard Specifications for Road and Bridge Construction and any current Special Provisions of said Section issued by the Tennessee Department of Transportation.

Section 716 and any Special Provisions of the Standard Specifications for Road and Bridge Construction shall be considered a part of these Specifications as if printed herein verbatim with those exceptions as noted below.

31.2 Measurement: The accepted quantities of Pavement Markings will be measured at the contract unit price as follows:

Measurement Item	Unit
Plastic Pavement Marking (4”)	LF
Plastic Pavement Marking (Turn-Arrow)	EA
Plastic Word Pavement Marking (ONLY)	EA
Plastic Pavement Marking (X-Walk)	LF
Plastic Pavement Marking (Stop-Line)	LF
Painted Pavement Marking (4”)	LF
Removal of Pavement Marking (Line)	LF

31.3 Payment: The accepted quantities of Pavement Markings will be paid for at the contract unit price as follows**:**

Pay Item	Unit
Plastic Pavement Marking (4”)	LF
Plastic Pavement Marking (Turn-Arrow)	EA
Plastic Word Pavement Marking (ONLY)	EA
Plastic Pavement Marking (X-Walk)	LF
Plastic Pavement Marking (Stop-Line)	LF
Painted Pavement Marking (4”)	LF
Removal of Pavement Marking (Line)	LF

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City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Water Utility – Trace Wire

2023

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Water Utility – Trace Wire:

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32.1 Scope: This work shall consist of the installation of trace wire on all water mainline construction within the City of Germantown. The installation of trace wire shall be accomplished in accordance with these Specifications, in conformity with the details shown on the Plans, and/or under directions furnished by the Engineer.

32.2 Materials: The Contractor will furnish and maintain in good condition all materials as required for the proper execution and inspection of the work. All materials will be on site and subject to approval by the Engineer before work will be permitted to begin.

32.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

32.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the requirements of the material being supplied.

32.2.3 **Trace Wire**. All trace wire and trace wire products shall be domestically manufactured in the U.S.A. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

32.2.3.1 **Open Trench:** Trace wire shall be #12 AWG Copper Clad Steel. High Strength with minimum 450 lb. break load and minimum 30 mil HDPE insulation thickness.

32.2.3.2 **Directional Boring:** Trace wire shall be #12 AWG Copper Clad Steel. Extra High Strength with minimum 1,150 lb. break load and minimum 45 mil HDPE insulation thickness.

32.3 Construction Requirements:

32.3.1 **General.**

32.3.1.1 Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

32.3.1.2 A mainline trace wire shall be installed and connected to the water system mainline to ensure full tracing/locating capabilities from a single connection point.

32.3.1.3 All conductive and non-conductive water system mainlines shall include trace wire.

32.3.1.4 Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

32.3.1.5 Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

32.3.1.6 Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at five (5) foot maximum intervals.

32.3.1.7 In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors.

32.3.2 **Connectors.** Non locking friction fit, twist on or taped connectors are prohibited.

32.3.2.1 **Mainline Trace Wire:** All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

32.3.2.2 **Direct Bury Wire Connectors:** Shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any un-insulated wire exposure.

32.3.3 **Termination.** A minimum of two (2) feet of excess (slack) wire is required at all trace wire termination points.

32.3.4 **Access.** A minimum of two (2) feet of excess (slack) wire is required at all trace wire access points.

32.3.5 **Grounding.** Trace wire must be properly grounded at all dead ends.

32.3.6 **Testing.** All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, prior to acceptance of the work. Continuity testing in lieu of actual line tracing shall not be accepted.

32.4 Measurement: This material is considered incidental to other work, therefore no measurement is required.

32.5 Payment: The method of compensation for the accepted quantities of trace wire shall not be made directly, but shall be considered incidental to other work. The Contractor shall include all costs for labor, equipment, materials, and testing necessary to complete the proper installation of trace wire. No direct compensation for this work will be made.

City of Germantown

Engineering Department

STANDARD SPECIFICATIONS

Underground Detectable Tape

2023

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Underground Detectable Tape:

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33.1 Scope: This work shall consist of the installation of underground detectable tape and shall be accomplished in accordance with these Specifications, in conformity with the details shown on the Plans, and/or under directions furnished by the Engineer.

33.2 Materials: The Contractor will furnish and maintain in good condition all materials as required for the proper execution of the Work. All materials will be on site and shall be subject to approval by the Engineer before work will be permitted to begin.

33.2.1 **New Material.** All material furnished by the Contractor will be new, high quality and free from defects. All materials shall be subject to sampling, testing, and approval or rejection by the Engineer. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

33.2.2 **Qualifications of Manufacturers.** The source or supply for each material to be supplied by the Contractor shall be subject to approval by the Engineer before orders are placed. Products shall be the industry standard product of a manufacturer of established good reputation in the industry and manufactured to meet the requirements of the material being supplied.

33.2.3 **Underground Detectable Tape**. All detectable underground utility marking tape shall be a minimum of three (3) inches wide**.** All underground detectable tape shall be intended for direct bury, color coated per APWA standard for the specific utility being marked and shall conform to the following requirements:

Thickness:	ASTM D2103	5.0 MIL
Tensile Strength:	ASTM D882	5600 PSI
Elongation:	ASTM D882-88	<50% at Break
Printability:	ASTM D2578	>50 Dynes/CM2
Flexibility:	ASTM D671-81	Pliable Hand print
Inks:	MFG Specs.	Heat-Set
Message Repeat:	MFG Specs.	Every 20” – 30”
Foil:	MFG Specs.	Dead Soft / Annealed
Top Layer:	MFG Specs.	Virgin PET
Bottom Layer:	MFG Specs.	Virgin LDPE
Lamination:	MFG Specs.	Virgin Hot LDPE

A continuous message shall be permanently reverse printed on the underside of the polyester layer of the tape to insure that the bold black letters cannot be affected by soil corrosion or scratched off manually. The tape shall be inscribed with the proper warning message for the utility that it is protecting and shall contain burying instructions and a diagram.

The detectable underground utility marking tape shall be capable of being detected/located by either conductive or inductive location techniques. The detectable underground utility marking tape shall consist of a minimum: 5mil (0.005’) overall thickness, five (5) ply composition; ultra high molecular weight, one-hundred (100%) percent virgin polyethylene; acid alkaline and corrosion resistant.

The detectable, underground, utility marking tape shall have a 35 gauge (0.0035") solid aluminum foil core encapsulated within a 2.55 mil (0.00255") polyethylene backing and a 0.6 mil (0.006") PET cover coating. The laminate on each side shall consist of a 0.75 mil (0.0075") layer of hot LDPE, poly-fusing the tape without use of adhesives.

Detectable tapes utilizing reprocessed plastics or resins shall not be acceptable.

33.3 Construction Requirements:

33.3.1 **General.** Each utility shall be marked by means of direct burial of the appropriate APWA recommended color-coded detectable, underground, utility marking tape.

33.3.2 **Sanitary Sewer System.**

33.3.2.1 A detectable underground utility marking tape must be installed on all sewer mainlines.

33.3.2.2 The burial depth of the tape shall be at an elevation of not less than twelve (12) inches above the utility mainline.

33.3.3 **Water System.**

33.3.3.1 A detectable underground utility marking tape must be installed on all water mainlines.

33.3.3.2 The burial depth of the tape shall be at an elevation of not less than twelve (12) inches above the utility mainline.

33.4 Measurement: This material is considered incidental to other work, therefore no measurement is required.

33.5 Payment: The method of compensation for the accepted quantities of detectable underground utility marking tape shall not be made directly, but shall be considered incidental to other work. The Contractor shall include all costs for labor and materials necessary to complete the proper installation of detectable underground utility marking tape. No direct compensation for this work will be made.