CITY OF ROGERSVILLE
CONSTRUCTION SPECIFICATIONS
FOR
PUBLIC IMPROVEMENTS

2022 EDITION
CITY OF ROGERSVILLE, MISSOURI
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SECTION 01090 – DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.01 DEFINITIONS:

A. Basic definitions of general terms used in these Construction Specifications for Public Improvements are covered in this Section.

1. Agreement: The agreement, written contract or otherwise, between Developer and Contractor covering the Work to be performed, including any Public Improvements. The City of Rogersville shall not be a party to the Agreement between the Developer and the Contractor.

2. City: The City of Rogersville, Missouri. The governmental entity that will assume ownership
of the completed Work from the Developer/Owner following the City's inspection of the completed Work and finding that the completed Work meets all of the requirements set forth by the City for the construction of public improvements within the City.

3. City Public Works: The City departments representing the City during all phases of the Project. Building Inspection Department shall be the designated contact between the Developer and the City. The Public Works Department will perform reviews of Developer submitted construction drawings, will conduct periodic and final inspections of the Public Improvements Work, and will issue notices of approval and acceptance, when appropriate, of the Public Improvements Work.

4. Construction Easement: The land provided temporarily for use during the construction of the work.

5. Construction Specifications. The official City's General Conditions and Technical Specifications used on public improvements within the City and such other areas outside the corporate boundaries that may contract with the City for the provision of services. This document contains data for public improvements from the beginning stage of a project through the actual construction and acceptance of the project

6. Contractor: Any person, firm or corporation with whom the Developer/Owner enters into an Agreement to perform the Work for the Project, including any Public Improvements.

7. Developer/Owner: The person, firm, or corporation owning the property being developed and owning the Public Improvements Work until the Work is completed, approved and accepted by the City. The person, firm, or corporation who will transfer ownership of the Public Improvements Work to the City upon completion of the Work and the approval and acceptance thereof by the City.

8. Design Standards**.** The official City's design standards used for public improvements within the City and such other areas outside the corporate boundaries which may contract with the City for the provision of services. This document contains minimum design data for public improvements to be complied with in the design of public improvements.

9. Engineer: Engineer of Record, Developer's Engineering Consultant, Developer's Engineering Representative: The person, firm, or corporation, licensed to perform engineering services in the State of Missouri, whom the Developer/Owner employs to prepare drawings and specifications covering the Work, including any Public Improvements, and whom the Developer may designate as a representative to communicate with the City Planning & Development Department.

10. Harmful substances are contaminated soils and liquids containing micro-organisms that can cause infection and are toxic, such as paints, cleaners, blood and etc.

11. MoDNR: Missouri Department of Natural Resources.

12. MoDOT: Missouri Department of Transportation.

13. City approved or equal: In order to establish a basis of quality for items of the work, certain processes, equipment, proprietary products or materials and their manufacturer may be mentioned by name. Such mention is not intended to exclude other processes, equipment, proprietary products or materials and their manufacturers, provided they are satisfactory proven by the Contractor, to be equal in quality and performance to the same specified prior to their inclusion in the work.

14. Owner, or Developer shall mean the individual, corporation, partnership, joint venture, association or other legal entities associated with the construction of an improvement under a permit granted by the City.

15. Permit Holder shall mean the individual or other legal entity who obtain the permit(s) required by city/building codes for the accomplishment of the Work.

16. Project: The total construction of which the Work to be provided under the Construction Specifications may be the whole, or part as indicated elsewhere in the Construction Specifications or on the City's approved construction drawings.

17. Right of Way Manager: The appropriate governmental entity responsible for the management and oversight of a public right of way affected by the proposed work. For the City roads, it is the Public Works Director or his designee. For County roads, it is the Greene or Webster County Road Department Administrator or his designee. For State roads, it is the Missouri Department of Transportation District 8, Engineer, or his designee.

18. Sediment Control Officer, (as designated in the Stormwater Pollution Prevention Plan), is the individual responsible for inspecting best management practices, (BMP's), and enforcing the erosion control and stormwater portions of the Stormwater Pollution Prevention Plan, (SWPPP).

19. Standard Drawing Details. The official Standard Drawing Details used on public Improvements within the City and such other areas outside the corporate boundaries which may contract with the City for the provision of services. This document contains drawing details for public improvements to be followed and included in design drawings.

20. Work: The entire completed construction of the various separately identifiable parts thereof required to be furnished under the Construction Specifications and the City approved construction drawings. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Construction Specifications.

1.02 SPECIFICATION FORMAT AND CONTENT EXPLANATIONS:

A. Specification Format: The Construction Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) 16 -Division format and Master format numbering system. Some portions may not fully comply and no particular significance will be attached to such compliance or noncompliance.

1. Divisions and Sections: For convenience, a basic unit of Construction Specification Text is a "Section," each unit of which is numbered and named. These are recognized as the present industry consensus on uniform organization and sequencing of specifications. The Section title is not intended to limit meaning or content of Section, or to be fully descriptive of requirements specified therein, or to be an integral part of text.

2. Section Numbering: Used for identification and to facilitate cross-references in Construction Specifications. Sections are placed in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of Construction Specifications must be consulted to determine numbers and names of Specification Sections in these Construction Specifications.

3. Page Numbering: Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.

4. Parts: Each Section of Construction Specifications generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 - GENERAL, PART 2– PRODUCTS and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three" Parts" when not applicable, or may contain more than three "Parts" to add clarity to organization of Section.

5. Underscoring of Titles: Used strictly to assist reader of Specification in scanning text for keywords in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.

B. Specification Content:

1. These Construction Specifications use certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

a. Imperative and Streamlined Language: These Construction Specifications are written in imperative and abbreviated form. This imperative language of the technical Sections is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting “shall,” the Contractor shall,” and “shall be,” and similar mandatory phrases by inference in the same manner as they are applied to notes on the drawings. The words “shall be” shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

b. Specifying Methods: The techniques or methods of specifying requirements varies throughout the text, and may include “prescriptive,” “compliance with standards,” “performance,” “proprietary,” or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.

c. Abbreviations: Throughout the Construction Specifications are abbreviations Implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology. These are normally defined at first instance of use. Organizational and associated names and titles of general standards are also abbreviated.

1.03 STANDARDS AND ABBREVIATIONS:

A. Applicability of Standards: Except where the Construction Specifications include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Construction Specifications. Such standards are made a part of the Construction Specifications by reference and are stated in each section.

1. Referenced standards, referenced directly in Construction Specifications or by governing regulations, have precedence over no referenced standards which are recognized in industry for applicability to the Work.

2. Where an applicable code or standard has been revised and reissued after the date of

the Construction Specifications and before performance of Work affected, the revised or reissued code or standard shall apply.

3. Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Construction Specifications indicate otherwise. Refer requirements that are different but apparently equal, and uncertainties as to which quality level is more stringent, to the City for a decision before proceeding.

4. In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to the City for a decision before proceeding.

5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Construction Specifications. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

B. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Construction Specifications, they mean the recognized name of the trade association, standard generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 01090

SECTION 01200 – PROJECT MEETINGS AND CERTIFICATION

PART 1 - GENERAL

1.01 SUMMARY: This Section includes the following requirements:

A. Project Meetings:

1. Preconstruction conference.

B. Certification:

1. Engineer's Final Certification of Completion.

1.02 PROJECT MEETINGS

A. Preconstruction Conference:

1. The City will administer a meeting prior to commencement of any improvements to establish a working understanding between the parties as to their relationships during conduct of the Work. The developer/owner or his representative shall be responsible for contacting the Building Inspector to request the pre-construction conference. The Building Inspector will schedule and notify the parties of the date and time of the pre-construction conference.

2. Preconstruction conference shall be attended by:

a. Responsible Contractor and or superintendent/representative.

b. Representatives of principal Subcontractors.

c. Public Works Director, City Engineer, and appropriate Public Works Staff.

d. Developer/Owner/Engineer or his representative.

3. Agenda:

a. Projected construction schedules.

b. Critical Work sequencing.

c. Project coordination.

d. Procedures and Processing of:

(1) Field decisions.
(2) Substitutions.
(3) Submittals.

e. Designated truck routes.

f. Spoil/waste sites.

g. Borrow pit sites.

h. Procedures for testing.

i. Procedures for maintaining record documents.

j. All environmental and sediment control requirements.

k. Other items as required.

4. Location of Meeting: City Hall.

B. Coordination meetings as required.

1.03 CERTIFICATION:

A. Engineer's Final Certification of Completion:

1. The Engineer of Record shall perform site inspections as necessary to provide the City with a Certificate of Completion. Certificate shall state that all improvements have been constructed in general compliance with the City approved construction drawings and Construction Specifications. Certificate of Completion shall bear the name, signature, current date and Missouri Registration Number of the Engineer.

2. Upon satisfactory completion of any sanitary sewer or water mains, the Engineer of Record shall complete and submit all required documentation and testing data to the City and MoDNR to achieve acceptance and authorization for the sanitary sewer or water mains to be placed in service.

PART 2 - PRODUCTS - Not applicable.

PART 3 - EXECUTION - Not applicable.

END OF SECTION 01200

SECTION 01300 – SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes definitions, descriptions, transmittal, review of “Compliance” submittals, and record drawings.

B. Related Work Specified Elsewhere:

1. Project Meetings: SECTION 01200.

1.02 GENERAL INFORMATION:

A. Definitions:

1. Compliance Submittals include shop drawings and product data which are prepared by the Contractor, Subcontractor, Manufacturer, or Supplier and submitted by the Contractor with approval by the Engineer of Record to the City as a basis for approval of the use of equipment and materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties.

   a. Shop drawings include custom-prepared data of all types including drawings, diagrams, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.

   b. Product data includes standard printed information on materials, products and systems; not custom-prepared for this Project, other than the designation of selections from available choices.

2. Contractor shall maintain in a safe place at the site one record copy of all Drawings, Specifications and Addenda in good order and annotated to show all changes made during construction. Upon completion of the Work, these record documents will be delivered to the Engineer of Record who shall provide paper and pdf copies of the revised drawings to the City. The drafting of the record, (as-built), drawings shall comply with all of the same criteria as the construction drawings and shall be corrected to show the project as constructed. The drawings shall accurately and completely denote all changes made during the course of the work. The Engineer of Record shall gather field notes and shall conduct field surveys of all items, (fire hydrants, valves, manholes, storm boxes, exposed storm pipe ends, storm water detention basins etc.) to ensure the accuracy of the record, (as-built) drawings. Where changes occur, the Engineer of record shall verify and certify in writing that all design criteria are still met. Record as built drawings shall be submitted following acceptance of all construction and prior to approval of final plat.

3. Refer to ARTICLE 1.03 of this Part for detailed lists of documents and specific requirements.

B. Quality Requirements:

1. Submittals such as shop drawings and product data shall be of the quality for Legibility and reproduction purposes. Every line, character, and letter shall be clearly legible.

2. Documents shall be submitted in an organized manner to the Building Inspector. Any variations from specified materials/equipment/procedures shall be approved by the City. One copy of each Engineer of Record "Approved" shop drawing shall be submitted to the City upon completion of the work. Any unapproved material/equipment shall be removed and replaced with material/equipment specified herein.

C. Language and Dimensions:

1. All words and dimensional units shall be in the English language.

2. Metric dimensional unit equivalents may be stated in addition to the English units.

D. Submittal Completeness:

1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction and other information specified to enable the City/City Engineer to review the information effectively. All plan and drawing submittals shall meet the criteria outlined in the latest addition of the Design Standards.

E. Submittal Procedure:

1. Documents shall be submitted directly to the City Building Inspector.

2. The City shall submit documents to the City Engineer.

1.03 COMPLIANCE SUBMITTALS:

A. Items shall include, but not be limited to, the following:

1. Manufacturer's specifications.

2. Catalogs, or parts thereof, of manufactured equipment.

3. Shop fabrication and erection drawings.

4. Concrete mix design information.

5. All drawings, catalogs or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary.

6. Record drawings.

PART 2 - PRODUCTS - Not applicable.

PART 3 - EXECUTION - Not applicable.

END OF SECTION 01300

SECTION 01530 - TEMPORARY BARRIERS AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes General Requirements for:

1. Protection of Work.
2. Protection of existing property.
3. Barriers.
4. Environmental controls.
5. Traffic control and use of roadways.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION - 02200.
2. Trenching and Backfilling for Utilities: SECTION - 02222.
3. Right-of-Way Technical Specifications: SECTION -12000

C. See Details in the Standard Drawing Details.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.01 PROTECTION OF WORK AND PROPERTY:

A. General:

1. Provide protection at all times against rain, wind, storms, frost, freezing, condensation, or heat so as to maintain all Work and equipment and materials free from injury or damage. At the end of each day all new Work likely to be damaged shall be appropriately protected.

2. Construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, floors, pits, trenches, manholes, and ducts free of water.

B. Property Other than Developer's/Owner's:

1. Report immediately to the owners thereof and promptly repair damage to existing facilities resulting from construction operations.

2. Concerned agencies or utilities shall be contacted a minimum of 48 hours prior to performing Work, or closing streets and other traffic areas. Notify 1-800 DIG-RITE 48 hours prior to excavating near underground utilities or pole lines.

- Water
- Gas
- Sanitary sewers
- Storm drains
- Pipeline companies
- Telephone
- Electric
- Municipal streets
- Fire
- Police
- Cable Television
- Right of Way Manager

3. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

4. Where fences are to be breached on private property, the owners thereof shall be Contacted by the developer/contractor and arrangements made to ensure proper protection of any livestock or property thus exposed.

5. The applicable requirements specified for protection of the Work shall also apply to the protection of existing property of others.

6. Before acceptance of the Work by the City, restore all property affected by Contractor's operations to the original or better condition. Owner of affected property shall provide written agreement of satisfaction of property restoration to Contractor, of which, a copy shall be submitted to the City

3.02 BARRIERS

A. General:

1. Furnish, install, and maintain suitable barriers as required to prevent public entry, protect the public, and to protect the Work, existing facilities, trees, and plants from construction operations. Barriers shall be required on all unattended excavations and at the direction of the Public Works Department and Law Enforcement office. Remove all barriers and controls when no longer required.

2. Barrier materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards or regulatory agencies.

3. Barriers shall be of a neat and reasonable uniform appearance, structurally adequate for the required purposes.

4. Maintain barriers in good repair and clean condition for adequate visibility.

5. Relocate and adjust barriers as required by progress of Work.

6. Repair damage caused by installation and restore all disturbed area(s) to original or better condition.

7. Clean the total Work area.

3.03 ENVIRONMENTAL CONTROLS

A. Dust Control:

1. Provide positive methods and apply dust control materials to minimize raising dust from construction operations; and to prevent airborne dust from dispersing into the atmosphere.

B. Water and Erosion Control:

1. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.

2. Provide required temporary construction entrances and all silt and sediment controls prior to any land disturbance. Sediment basins and any required detention facilities shall also be installed prior to other land disturbance.

3. The contractor is responsible for controlling erosion and discharge of sediment from the site at all times during construction. The contractor shall provide necessary measures during all phases of his operations regardless of whether they are specifically noted on the plans and shall maintain and replace controls as necessary during the course of his operations. These necessary measures include cleaning both interior and adjacent streets as required after each rainfall and at the end of construction. The contractor shall be responsible for cleaning all accumulated sediment from storm drains prior to final approval.

4. The contractor's Sediment Control Officer, (as designated in the Stormwater Pollution Prevention Plan), is responsible for inspecting best management practices, (BMP's), both weekly and after rains in accordance with the MoDNR land disturbance permit. The Sediment Control Officer is responsible for maintaining copies of the Sediment

and Erosion Control Plan, the Stormwater Pollution Prevention Plan, (SWPPP) and the weekly inspection report on site at all time.

5. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, pits, tunnels, and other construction areas, and borrow and waste disposal areas, to prevent erosion and sedimentation. and to direct drainage to proper runoff. Hold the areas of bare soil exposed at one time to a minimum.

6. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.

7. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

8. All disturbed land area not receiving permanent stabilization such as pavement or facilities shall be revegetated and have vegetation established prior to removal of temporary sediment controls.

C. Debris Control and Clean-Up:

1. Keep the premises free at all times from accumulations of debris, waste materials, and rubbish caused by construction operations. Contractor's responsibilities shall include:

a. Adequate trash receptacles about the site, emptied promptly when filled.

b. Periodic cleanup; to avoid hazards of interference with operations at the site and to maintain the site in a reasonably neat condition.

c. The keeping of construction materials such as forms and scaffolding neatly stacked.

d. Contractor shall not dispose of any waste material on site and is punishable by 210.170 of the City of Rogersville Code.

2. Prohibit overloading of trucks to prevent spillage on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.

D. Pollution Control:

1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations. Provide concrete wash out areas when applicable.

2. Provide equipment and personnel and perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-site in approved locations deemed acceptable by the appropriate regulatory agency, and replace with suitable compacted fill and topsoil.

3. Take special measures to prevent harmful substances such as contaminated soils and liquids from entering public waters, sanitary sewers, or storm sewers.

3.04 TRAFFIC CONTROL AND USE OF ROADWAYS

A. Traffic Control:

1. The contractor shall be responsible for providing, operating, and maintaining equipment, services, and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at site entrances, on-site access roads, and parking areas. This includes traffic signals and signs, flagmen, flares, lights, barricades, and other devices or personnel as necessary to adequately protect the public. Flashers and barricades shall be a type approved by the Public Works Director and shall be as per Part VI of the latest edition of the Manual on Uniform Traffic Control Devices. All proposed traffic control measures shall be submitted a minimum of 48 hours in advance for review and approval by the Right of Way Manager.

2. The Contractor shall take every precaution to protect pedestrian and vehicular traffic. Whenever, in the opinion of the Public Works Director, the Contractor has not provided sufficient or proper safety precautions and safeguards, he shall do so immediately and to whatever extent the Public Works Director deems advisable.

3. Consult with governing authorities to establish public thoroughfares which will be used as haul routes and site access. All operations shall meet the approval of owners or agencies having jurisdiction.

4. Streets may not be closed to through traffic unless otherwise provided for in the Special Provisions. Streets shall not be closed to traffic until such closure has been approved by the Public Works Director. Any street closures that may be permitted shall be made in such a manner as to provide for maximum public safety and public convenience, and shall be opened to through traffic at such time as the work has been completed, or as the Public Works Director may direct.

5. Provide and maintain suitable detours or other temporary expedients if necessary. Detours both outside and within the limits of the project such as side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction for maintenance of traffic, and such related facilities for the maintenance of traffic shall be the sole responsibility of the Contractor. All detour signage shall conform to the standards set forth in the Manual on Uniform Traffic Control Devices, (MUTCD).

6. Private property shall be accessible at all times, except during some urgent stages of construction when it is impracticable to carry on the construction and maintain traffic simultaneously, such as for the placing and curing of pavement and deep excavations which prohibit safe travel of vehicular traffic. No private driveway may be closed without the approval of the Public Works Director, unless written permission has been provided to the Contractor by the owner of the property affected. Emergency traffic such as police, fire and disaster units shall be provided reasonable access at all times. The Contractor shall be liable for any damages which may result from his failure to provide such reasonable access.

7. Bridge over open trenches where necessary to maintain traffic.

8. Remove temporary equipment and facilities when no longer required. Restore grounds to original, better, or specified condition when no longer required.

B. Maintenance of Roadways:

1. Repair/replace roads, walkways, and other traffic areas damaged by operations. Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.

2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.

END OF SECTION 01530

SECTION 02200 - SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes site preparation activities and certain items of earthwork common to other related Work.

B. Related Work Specified Elsewhere:

1. Trenching and Backfilling for Utilities: SECTION 02222.

1.02 REFERENCES

A. Applicable Standards:

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

a. M80 – Standard Specification for Coarse Aggregate for Hydraulic Cement Concrete.

b. T104 – Standard Method of test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

2. American Society for Testing and Materials (ASTM):

a. D698-Laboratory Compaction Characteristics of Soil Using Standard Effort.

b. D1556-Density and Unit Weight of Soil in Place by Sand Cone Method.

c. D2167- Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

d. D3786-Bursting Strength of Textile Fabrics - Diaphragm Bursting Strength.

e. D4254-Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

f. D4491-Water Permeability of Geo-textiles by Permittivity.

g. D4632-Grab Breaking Load and Elongation of Geo-textiles.

h. D4751-Determining the Apparent Opening Size of a Geo-textile.

i. D4833-Index Puncture Resistance of Geomembranes, and Related Products.

j. D6938-In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

PART 2 - PRODUCTS

2.01 EARTHWORK

A. Materials suitable for use in embankment, structural backfill and fill include material free of debris, roots, organic matter, and frozen matter; and free of stone having any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas:

1. Cohesion-less materials include gravels, gravel-sand mixtures, sands, and gravelly sands exclusive of clayey material:

   a. Free-draining.

   b. Materials for which impact compaction will not produce well-defined, moisture density relationship curve.

   c. Maximum density by impact methods will generally be less than by vibratory methods.

   d. For which generally less than 15 percent by dry weight, of soil particles pass the No. 200 sieve.

2. Cohesive materials include silts and clays generally exclusive of sands and gravel:

   a. Materials for which impact compaction will produce a well-defined, moisture-density relationship curve.

B. Materials unsuitable for use in embankment and fill include all material that contains debris, roots, organic matter, frozen matter, stone (with any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas), or other materials that are determined by the Public Works Director or his representative during routine or random inspections to be too wet or otherwise unsuitable.

C. Waste materials include excess usable materials and materials unsuitable for use in the Work.

D. Borrow materials include all fill materials, structural backfill and topsoil obtained from locations on or off the jobsite.

2.02 RIPRAP:

A. Riprap Material:

1. All stone shall be durable and of suitable quality to ensure permanence in the structure and in the climate in which it is to be used.

2. Boulders or quarried rock may be used and shall be graded as per the construction drawings/specifications.

3. Quantity of rock with an elongation greater than 3:1 shall not exceed 20% of the mass. No stone shall have an elongation greater than 4:1.

4. Stone shall be free from cracks, seams or other defects that would tend to increase its deterioration from natural causes.

5. Objectionable quantities of dirt, sand, clay, and rock fines will not be permitted. Final determination of objectionable quantities will be made by the Public Works Director.

6. Not more than 10% of the stone shall show splitting, crumbling, or spalling when subjected to five cycles of the sodium soundness test as required by AASHTO T104.

7. Contractor may be required to furnish a sample of stone as part of the submittal process to the Public Works Department for acceptance.

B. Bedding material for riprap shall conform to all applicable requirements of AASHTO M80 and shall be reasonably well-graded within the following limits: Crushed rock conforming to the gradation specified may be used.

Sieve Size	Percent Passing By Weight
4-inch	100
3-inch	80-100
2-inch	70-90
3/4-inch	45-60
No. 4	20-30
No. 10	5-15
No. 40	0-5

2.03 STRUCTURAL BACKFILL

A. Crushed rock conforming to the following gradation may be needed.

Sieve Size	Percent Passing by Weight
1-1/2-inch	100
1-inch	75-95
½-inch	55-75
No. 4	35-55
No. 10	25-45
No. 40	14-30
No. 200	4-10

B. Structural backfill material shall be subject to approval of the Public Works Director and arranged for by the Contractor.

2.04 FILTER FABRIC

A. Filter fabric of non-woven geo-textile conforming to, American Society for Testing and Materials (ASTM), D3786, D4491, D4632, D4751 and D4833.

2.05 SOIL STERILANT

A. Sterilant shall be Krover as manufactured by E.I. DuPont De Nemours and Co or equal.

2.06 TOP SOIL

A. Materials:

1. Those materials obtained from excavation which is most suitable and stockpiled for such purpose:

2. Borrow when required.

3. Topsoil shall be a fertile, friable, and loamy soil of uniform quality, free from materials such as hard clods, stiff clay, and stone with any dimension greater than 1 inch, and similar impurities. Relatively free from grass, roots, weeds, and other objectionable plant material.

PART 3 – EXECUTION

3.01 GENERAL

A. Any disturbance of land exceeding one acre in size requires a Land Disturbance Permit from MoDNR. In addition, a copy of the permit shall be filed with the City.

B. All required erosion control Best Management Practices, (BMP's) including sediment basins shall be installed prior to any land disturbance. All BMP's shall be maintained throughout the construction project and shall remain in place until disturbed areas are stabilized with vegetation or permanent surfaces to the satisfaction of the Public Works Director.

C. The contractor shall adhere to any and all statutes regarding the notification of utilities prior to beginning any work. Relocation or protection of any existing utilities shall be governed by the applicable section of these Construction Specifications. The relocation and/or protection of any utility that is shown on the plans, that lies within a utility easement and is endangered by this construction shall be the responsibility of the contractor.

D. The contractor shall make every reasonable effort to protect private facilities. These facilities may not be shown on the plans. When these facilities are disturbed or damaged by work, the contractor shall make necessary arrangements for repairs to the facilities for continuous service prior to the close of that work day.

E. It shall be the responsibility of the contractor to protect all property lot corners and control monuments. Should it be necessary to disturb such monument, whether stake, pin, bar, disk, box, or other, it remains the responsibility of the contractor to reference such markers prior to removal, reset them, and file such relocations or monumentation documents as the law may require. Any such references, removal, replacement and certification of monuments shall be performed by a surveyor registered and licensed in the State of Missouri. A copy of all such certification documents shall be provided to the City prior to approval of the project.

F. Grading, excavation, and backfilling for all improvements, shall be made to the lines, grades and cross section indicated by the plans. In addition, to any erosion control measures shown on the plans, the contractor shall schedule and conduct his operation in such a manner and shall provide any necessary control facilities to protect downstream and adjacent properties from pollution, sedimentation or erosion caused by the grading operations. Any pollution or damage occurring as a result of the work shall be the responsibility of the contractor. The City will not get involved in disputes between adjacent property owners and Contractor and/or developer/owner.

G. During construction, the graded area shall be maintained by the contractor in such condition that it will be well drained at all times. Roadway ditches, channel changes, inlet and outlet ditches and other ditches in connection with the roadway shall be cut and maintained to the required cross section. All drainage work shall be performed in proper sequence with other operations. All ditches and channels shall be kept free of debris or obstructions.

3.02 SITE PREPARATION

A. Clearing and Grubbing:

1. Perform selective clearing and grubbing as indicated or as necessary to perform excavation, trenching, embankment, borrow, and other Work required, and as directed by the Engineer.

a. Clearing:

(1) Includes felling and disposal of trees, brush, and other vegetation. Trees, brush and vegetation shall not be buried on the job site.
(2) Conduct Work in a manner to prevent damage to property and to provide for the safety of employees and others.
(3) Keep operations within property lines as indicated.

b. Grubbing:

(1) Includes removal and disposal of tree stumps and roots larger than 3 inches in diameter. Stumps and roots shall not be buried on the job site.
(2) Remove to a depth of at least 18 inches below existing grade elevation
(3) Backfill all excavated depressions with approved material and grade to drain.

B. Protection of Trees:

1. Protect tops, trunks, and roots of existing trees on Project site which are to remain, as follows:

a. Box fence around, or otherwise protect trees before any construction work is started.

b. Do not permit heavy equipment or stockpiles within branch spread.

c. Trim or prune to obtain working space in lieu of complete removal when possible. Conduct operation as follows:

(1) With experienced personnel.
(2) Conform to good horticultural practice.
(3) Preserve natural shape and character.
(4) Protect cuts with approved tree paint.

d. Grade around trees as follows:

(1) Trenching: Where trenching is required around trees which are to remain, avoid cutting the tree roots by careful hand tunneling under or around the roots. Avoid injury to or prolonged exposure of roots.
(2) Raising Grades: Where existing grade at a tree is below the new finished grade and fill not exceeding 16 inches is required, place 1 to 2 inches of clean, washed gravel directly around the tree trunk. Extend gravel out from trunk on all sides at least 18 inches and finish 2 inches above finished grade at tree. Install gravel before earth fill is placed. Do not leave new earth fill in contact with any tree trunks.
(3) Lowering Grades: Re-grade by hand to elevation required around existing trees in areas where new finished grade is to be lowered. As required, cut the roots cleanly 3 inches below finished grade and cover scars with tree paint.

e. Remove and replace when damage occurs and survival is doubtful as determined by the Public Works Director.

C. Stripping:

1. Remove topsoil from all areas within limits of the construction easement and properly stockpiled and protected for reuse as required on the site.

D. Debris:

1. Dispose of debris from clearing, grubbing, stripping, and demolition at a location off the job site as arranged for by the Contractor.

3.03 EARTHWORK

A. Excavation:

1. Perform excavation as indicated or as required to complete the work. Normally materials to be excavated are earth and other materials which can be removed by power shovel, bulldozer, or other normal equipment, but not requiring the use of explosives or drills.

2. All suitable material removed by excavation shall be used as far as practicable in the formation of embankment as required to complete the work. The contractor shall sort all excavating material and stockpile when necessary, so as to provide suitable materials for embankments.

3. Rock encountered within the full width of a roadway, shall be under-graded to an elevation of 6 inches below the finished subgrade elevation. Rock shall be removed in such a manner as to not leave excessive water pockets in the surface. Areas under-graded shall be backfilled with either rock fragments or spalls, or a granular type material having a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve and no more than 40 percent will pass the No. 10 Sieve.

4. Blasting:

a. Drill and blast, including pre-split blasting, rock not removable by other excavation methods, in a manner that completes the excavation to lines indicated or acceptable and required for access, with the least disturbance to adjacent material. All blasting schedules and times shall be provided to the City for approval a minimum of 24 hours' in advance.

b. Blasting shall be performed only by persons who are qualified, competent, and thoroughly experienced in the use of explosives for rock excavation.

c. Locate charge holes properly and drill to correct depth for the charges used.

d. Limit charges in size to minimum required for reasonable removal of material by excavating equipment.

e. Determine spacing of drill holes, size of explosive charges, time delays and blasting techniques, including the use of approved explosion mats, to avoid excessive over break or damage to adjacent structures, equipment, utilities, or buried pipeline and conduit.

f. Contractor shall monitor blasting operations at necessary locations throughout all blasting activities. Peak particle velocities and/or displacements at adjacent structures, equipment, exposed or buried, pipelines and conduits shall not exceed the level of criteria as determined by United States Department of Interior, Bureau of Mines in their Figure B-1 from Report of Investigations 8507 by D.E. Siskind, et. al., unless otherwise directed by City/ City Engineer.

g. Contractor shall assume full liability for any damage to adjacent structures, equipment, new construction, utilities, or buried pipelines and conduit caused by blasting operations.

h. Blasting near utilities shall be subject to approval of owning agency.

i. Before delivery of any explosives at jobsite, Contractor must have obtained a blasting endorsement on his public liability and property damage insurance policy.

j. Remove overblast rock materials to competent rock and replace as directed by Engineer.

5. Dewatering:

a. Control grading around excavations to prevent surface water from flowing into excavation areas.

b. Drain or pump as required continually maintaining all excavations and trenches free of water or mud from any source, and discharging to approved drains or channels. Commence when water first appears and continue until Work is complete to the extent that no damage will result from hydrostatic pressure, flotation, or other causes.

c. Use pumps of adequate capacity to ensure rapid drainage of area, and construct and use drainage channels and sub-drains with pumps as required.

d. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material.

6. Stockpiling:

a. Stockpiling in amounts sufficient for and in a manner to segregate materials suitable for the following:

(1) Top soiling.
(2) Constructing embankments and fills.
(3) Backfilling.

b. Do not obstruct or prevent access to:

(1) Roads and driveways, (Stockpiling in public right-of-ways shall only be permitted by permission of the Public Works Director.
(2) Utility control devices.
(3) Ditches or natural drainage channels.

c. Perform in a manner to avoid endangering the work, stability of banks or structures, or health of trees and shrubs to be saved.

d. Maintain safe distance between toe of stockpile and edge of excavation or trench.

e. Stockpile in other areas or off site when adjacent structures, easement limitations, or other restrictions prohibit sufficient storage adjacent to the Work. Off-site areas shall be arranged for by Contractor and/or Developer/Owner.

7. Waste Materials:

a. Remove waste materials from Work area as excavated.

b. Deposit such materials in locations and within areas approved by City/ City Engineer and
as indicated.

c. Place excavated rock in the interior of waste area fills so that it will not be exposed to view.

d. Grade waste areas and leave them free draining and with an orderly and neat appearance.

B. Embankments:

1. Construct embankments to the contours and elevations indicated, using suitable City/ City Engineer approved material from excavations and borrow areas: Material removed from borrow areas shall be arranged for by the contractor. Borrow areas shall be graded to drain and to present a neat appearance. Place embankment only on sub grades approved by City/ City Engineer. Do not place snow, ice, or frozen earth infill; do not place fill on a frozen surface.

2. Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inches rises as the new fill is brought up in 12 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density. The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material removed before starting the embankment work.

3. Where embankments 2 feet or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted to the specified density. Where embankments greater than 2 feet in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than 6 inches maximum dimension, left in place and the embankment started thereon.

4. Earth shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of materials shall not exceed 12 inches maximum in thickness (loose state) and shall be compacted to not less than the required density before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading, or dozing will be required to level the surface and to insure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen or is snow covered.

5. When earth and stone or rock fragments are mixed in the embankment, all stones or rock fragments exceeding the thickness of the compacted lift shall be disposed of by being incorporated into the embankment outside the limits of the proposed surfaced areas. The thickness of the layer in these areas may be increased if necessary to accommodate the rocks, but shall not exceed 15 inches in thickness (loose state). The stones or rock fragments are to be placed so there will be no nesting.

6. When the excavated material consists predominantly of stone or rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, such material shall be placed in the embankment in layers having a thickness of approximate average size of the larger rocks but not to exceed 24 inches. Rock or boulders too large to permit placing in a 24-inch layer shall be reduced in size as necessary to permit placement. Rock shall not be dumped in place but shall be distributed by blading or dozing in a manner to insure proper placement in final position in the embankment.

C. Subgrades:

1. Excavate or fill as required to construct sub grades to the elevations and grades indicated. Coordinate required inspections with the Public Works Department. Remove all unsuitable material and replace with City/City Engineer approved fill materials. Perform all wetting, drying, shaping, and compacting required to prepare a suitable sub grade.

2. Sub grade for Fills and Embankment: Roughen by disking or scarifying. Wet or dry top 6 inches, as required, to bond with fill or embankment.

3. Sub grade for Roadways, Drives and Parking Areas:

a. Extend sub grade the full width of the roadbed plus one foot outside the edges of the overlying course to be placed.

c. Roadway/drives/parking area embankment earth (fill) materials shall be placed in horizontal layers not exceeding twelve (12) inches unless otherwise approved by the City/City Engineer and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction.

4. The newly finished subgrade shall be repaired from action of the elements or others. Any settlement or erosion that occurs prior to placing the pavement thereon, shall be repaired and the specific lines, grades and cross-section reestablished. Any subgrade that has become unacceptable shall be reworked as necessary to restore the subgrade to shape, tolerance, density, and moisture content range for such density, immediately prior to the placing of the pavement. The Contractor shall protect all existing improvements from damage resulting from his subgrade operation. Any improvement damaged shall be repaired or replaced by the Contractor at his own expense. Subgrade clean-up shall follow the work progressively. The Contractor shall remove from the project site all rubbish, equipment, tools, surplus or discarded material and temporary construction items.

D. Site Grading:

1. Excavate, fill, compact fill, and rough grade to bring Project area outside of structures to sub grades as follows:

a. For surfaced areas, to underside of respective surfacing or base course:

(1) Prepare sub grades as specified in this Section.

b. For lawn and planted areas, to 4 inches below finished grade.

2. Rock:

a. Includes rock encountered in grading areas outside of structures.

b. Excavate rock to depths as follows:

(1) Under surfaced areas, to 6 inches below the top of respective sub grades.
(2) Under lawn and planted areas, to 24 inches below finished grade:
(a) Boulder or protruding rock outcrop shall be left undisturbed where indicated.

c. Backfill to grade with approved earth fill compacted-in-place:

(1) Achieve minimum density specified for particular location.

3. Fill:

a. Fill as required to raise existing grades outside of structure areas to the new grades as indicated.

b. Such fill shall be performed as specified in PART 3, paragraph 3.03, B. – Embankment, this Section.

c. Remove all debris subject to termite attack, rot, or corrosion from areas to be filled.

4. Rough Grading:

a. All areas within the Project, including excavated and filled sections, and adjacent transition areas shall be reasonably smooth, compacted, and free from irregular surface changes.

b. Degree of finish shall be that ordinarily obtained from blade grader or scraper operations, except as otherwise specified.

c. Finished rough grades shall generally be not more than 0.5 foot above or below established grade or approved cross sections with due allowance for topsoil and sod.

d. Tolerance for areas within 10 feet of structures and areas to be paved shall not exceed 0.15 foot above or below established sub grade.

e. Finish all ditches, swales, and gutters to drain readily.

f. Unless otherwise indicated, slope the sub grade evenly to provide drainage away from structure walls in all directions at a grade not less than ¼ inch per foot.

g. Provide a suitable grading radius at top and bottom of banks and at other breaks in grade.

E. Top-soiling:

1. Includes placement of topsoil on all areas to be re-vegetated and not specified to receive paving or other surface treatment (including borrow or waste areas).

2. Subgrade Treatment:

a. Clear site of vegetation heavy enough to interfere with proper grading and tillage operations.

b. Clear surfaces of all stones or other objects larger than 3 inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.

c. Loosen sub grade by disking or scarifying to a depth of 2 inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the sub grade.

3. Placement of Topsoil:

a. Distribute over required areas without compaction in upper 1 foot, other than that obtained with spreading equipment.

b. To extent material is available within following limits:

(1) Not less than 4 inches in depth.
(2) Do not exceed 2 feet in depth.

c. Shape cuts, fills, and embankments to contours indicated.

d. Grade to match contours of adjacent areas and permit good, natural drainage.

e. Provide gentle mound over trenches.

4. Maintenance:

a. After topsoil has been spread, clear surface of stones or other objects larger than 1 inch in thickness or diameter and all other objects that might interfere with planting and maintenance operations.

b. Protect top soiled areas from the elements until grass is established and repair eroded areas as required.

c. Promptly remove topsoil or other dirt dropped upon paved surfacing.

3.04. RIPRAP:

A. Foundation Preparation:

1. Trim and dress areas requiring riprap to conform to cross sections indicated within an allowable tolerance of ±3 inches from the theoretical slope lines and grades.

2. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with bedding material.

3. Do not place bedding on the base until the base has been approved.

B. Filter Blanket Placement:

1. Place filter blanket only on foundation approved by City/City Engineer. Material for filter blanket shall consist of filter fabric meeting the requirements of this section.

2. Filter fabric will be inspected by City/City Engineer at the time of installation and will be rejected if damaged during manufacture, transportation or storage. The filter fabric shall be placed with its long dimension horizontal and shall be laid smooth and free of tension, stress, folds, wrinkles or creases.

a. Strips shall be placed to provide not less than 18 inches of overlap at each joint.

b. Contractor shall anchor filter fabric to prevent dislocation during placement of riprap. The method of anchoring shall be submittal for approval by the City/City Engineer.

c. Tracked or wheeled equipment will not be permitted on slopes covered with filter fabric.

d. Filter fabric shall be left exposed no more than one week prior to riprap placement.

C. Placement of Riprap:

1. Place on the slopes within the limits as indicated.

2. Place stone for riprap on the prepared base in such a manner as to produce a reasonably well-graded mass of rock with a minimum practicable percentage of voids.

3. Place to its full course thickness in one operation in a manner to avoid displacing the bedding material.

4. Finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Riprap shall be hand-place only if necessary to secure the desired results.

5. Maximum deviation from slope lines and grades indicated shall not exceed 6 inches. Maximum deviation shall not be continuous over an area greater than 10 square feet.

6. Maintain the riprap until approved and replace any material displaced by any cause.

3.05 SOIL STERILANT

A. Apply soil sterilant to the following areas:

1. Pump Station areas prior to placement of crushed rock surfacing.

2. Along base of fencing:

   a. Width of treated area shall not exceed 12 inches.

B. Apply according to manufacturer's recommendations.

3.06 FIELD QUALITY CONTROL

A. Compaction:

1. Contractor shall, through services of an independent testing laboratory, provide adequate tests for all embankments, fills, structural backfill and sub grades under this Project to determine conformance with specified density relationships. A copy of all test results shall be provided to the City.

2. The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction as designated on the drawings or as directed by the City/City Engineer. When the moisture content of the soil is not satisfactory to the City/City Engineer, water shall be added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. In no case, shall water be added without the consent of the City/City Engineer.

3. After removal of roadway excavation material to the required section, all material between lines 1 foot outside the curbs shall be compacted to a density of at least ninety-five (95) percent of the maximum density for the material used for a depth of at least six (6) inches below the finished subgrade elevation and within the tolerance of the moisture for the type of material at ninety-five (95) percent of maximum density, as determined by the standard proctor test (ASTM D698) and with a tolerance of minus 3 percent and plus 2 percent of the optimum moisture at maximum density as determined by the Moisture Density Curve obtained. Any further compacted layers shall be accomplished in the same manner as specified. Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when additional passes of the roller do not bring the tamping feet closer to the surface of the lift, provided the entire weight of the roller is supported on the tamping feet and none by material directly in contact with the drum. Sand and gravel which cannot be compacted satisfactorily with a sheep-foot roller shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

4. Proof rolling of roadway subgrade with a heavy rubber-tired roller or other approved equipment will be required/performed by the City. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak (exhibit excessive pumping and those areas which fail) shall be ripped, scarified, wetted or dried if necessary and re-compacted to the requirements for density and moisture at the contractor's expense.

5. The subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil in areas not requiring fill. In areas where fill is required, the subgrade shall be compacted to ninety-five (95) percent of the maximum dry density as determined by ASTM D698 for cohesive soils or seventy (70) percent relative density as determined by ASTM D4254 for non-cohesive soils.

6. Before placing any embankment, the surface of the existing ground shall be prepared and moistened as required, and the top 6 inches compacted to a density of 90 percent as prescribed by the following paragraph.

7. All embankment shall be compacted to a density of at least 90 percent of the maximum density for the material used as determined by ASTM D-698 and within a tolerance of minus three percent and plus two percent of the optimum moisture at maximum density as determined by the Moisture Density Curve obtained.

8. In-place density and moisture content of the embankment will be determined by either ASTM D1556, or by ASTM D2167, or by, ASTM D6938 as appropriate.

B. Subgrades:

1. City/City Engineer will inspect all subgrades to determine conformance with indicated lines and grades.

2. Subgrades for roadways, drives, parking areas, and railroads shall have a maximum deviation of not more than ½ inch in any 10 feet when tested with a 10–foot straightedge applied parallel with and at right angles to the centerlines of sub grade areas, except that sub grades to receive aggregate-type surfacing shall have a maximum deviation of not more than 1 inch.

3.07 PROTECTION OF THE WORK

A. Maintenance:

1. Contractor shall protect newly graded and top soiled areas from actions of the elements.

2. Contractor shall fill and repair settling or erosion occurring prior to landscaping and shall re-establish grades to the required elevations and slopes.

B. Correction of Backfill Settlement:

1. Developer shall be responsible for correcting any settlement of backfill and damages created thereby within 1 year after acceptance of the Work by the City.

2. Developer shall make repairs within 10 calendar days from and after due notification by the City of backfill settlement and resulting damage.

3. Developer shall make own arrangements for access to the site for purposes of repair.

END OF SECTION 02200

SECTION 02222 – TRENCHING AND BACKFILLING FOR UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes:

1. Excavation, sheeting, bracing, and all operations necessary for the preparation of trenches for bedding of pipes and pipe appurtenances, conduit, and buried cable.

2. Pipe embedment and encasements.

3. Backfilling of trenches.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.

2. Concrete: SECTION 03300.

C. See the related Standard Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

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

a. T104 - Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

2. American Society for Testing and Materials (ASTM):

a. D4253 –Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

b. D4254 - Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

3. Occupational Safety and Health Administration (OSHA):

a. Part 1926 - Safety and Health Regulations for Construction.

4. State of Missouri Standard Specifications for Highway Construction.

1.03 SUBMITTALS

A. Submit as specified in DIVISION 1.

B. Includes, but not limited to, the following:

1. Steel reinforcement for concrete encasement.

2. Steel reinforcement for concrete cradle.

3. Concrete Submittals as specified in Section 03300.

C. Where selecting an option for excavation, trenching and shoring design from local, state, or federal safety regulations such as “OSHA Part 1926” or successor regulations, which request design by a registered professional engineer, the Contractor shall submit to the Engineer of Record (for information only and not for engineer approval) the following:

1. Copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems approved by a professional engineer registered in the State of Missouri and obtained by Contractor.

2. Documents provided with evidence of Registered Professional Engineer’s seal, signature, and date in accordance with appropriate State of Missouri licensing requirements.

PART 2 - PRODUCTS

2.01 GRANULAR PIPE EMBEDMENT

A. Material:

1. Coarse Aggregate No. 1 of the State of Missouri Standard Specifications for Highway Construction.

2. Gravel or crushed stone which shall not have a loss of more than 15% after five cycles when tested for soundness with sodium sulfate as described in AASHTO T104.

B. Gradation:

Percent Passing	Sieve Size
100	3/4-inch
60-100	1/2-inch
0-5	No. 4

2.02 EARTH PIPE EMBEDMENT FOR GROUNDWATER BARRIER

A. Barrier material shall be soil meeting classification GC, SL, CL, or ML-CL.

2.03 TRENCH BACKFILL MATERIALS

A. Obtain from the following:

1. Trenches and other excavations included in the Project.

2. Borrow from location off jobsite.

3. As specified for pipe embedment.

4. Combination of above.

B. Free from organic matter, refuse, ashes, cinders, frozen, or other unsuitable material.

C. Gravel, rock, or shale particle size limited as follows:

1. Not to exceed 1 inch in greatest dimension within 12 inches of pipe or conduit and 2 inches in the upper 18 inches of trench.

2. Maximum dimensions one-half the depth of layer to be compacted in other areas.

D. Contain sufficient fine materials to provide a dense mass free of voids and capable of satisfactory compaction.

E. Have moisture content enabling satisfactory placement and compaction.

F. Blended or otherwise processed to provide required gradation and moisture content.

G. Use granular material as specified for pipe embedment and trench stabilization unless otherwise indicated.

2.04 COMPACTED GRANULAR BACKFILL

A. Compacted granular backfill may be flowable fill or graded gravel as described below:

1. Flowable fill for compacted backfill shall be used for cuts in existing roadways, as approved by the City.

2. Gravel for compacted backfill shall conform to the following gradation.

Percent Sieve Size	Passing by Weight
1 inch	100
¾ inch	85-100
3/8 inch	50-80
No. 4	35-60
No. 40	15-30
No. 200	5-10

3. The gravel mixture shall contain no clay lumps or organic matter.

4. Other gradations may be submitted for approval to the City.

2.05 ENCASEMENT OR CARRIER PIPE MATERIALS

A. Smooth Steel Pipe:

1. Casing pipe shall be constructed of steel with welded joints conforming to AWWA C200-17 Steel Water Pipe, 6 Inches and larger.

2. Smooth wall casing pipe shall have a wall thickness as per details in the Standard Drawing Details.

B. Carrier Pipe Spacers:

1. Carrier pipe spacers shall be as per details in the Standard Drawing Details. The ends of the carrier pipe shall be sealed with end casing seals.

PART 3 - EXECUTION

3.01 TRENCHING

A. Equipment and Methods:

1. Types of Equipment and methods may be at Contractor's option, where structures or other facilities are not endangered.

2. Equipment and methods shall be subject to approval of jurisdictional agency where stability or usefulness of other facilities may be impaired.

3. Perform by hand methods when required to save or protect trees, culverts, utilities, or other structures above or below ground.

4. Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") below and on each side of all pipe(s) with an outside diameter of sixteen inches (16”) and smaller when placed in a soil trench.

5. Maximum length of open trench shall be limited to 200 feet in advance and to 200 feet behind pipe installation, except as approved by City/City Engineer.

B. Side Walls:

1. Make vertical within specified trench-width limitations below a horizontal plane 12 inches above top of pipe.

2. Vertical or sloped (stepped) as required for stability, above a horizontal plane 12 inches above top of pipe.

3. Sheet and brace where necessary. Comply with all safety requirements.

4. Excavate without undercutting.

C. Trench Depth:

1. Depth shall be sufficient to provide the minimum bedding requirements for the pipe being placed.

2. Do not exceed the indicated depth where conditions of bottom are satisfactory.

3. Increase depth as necessary to remove unsuitable supporting materials.

4. Minimum depth of cover over top of pressure pipe is 42 inches.

3. Maximum depth of cover over top of pressure pipe shall be 60 inches. Justification shall be provided for review and approval where additional depth is required.

D. Trench Bottom:

1. Protect and maintain when suitable natural materials are encountered.

2. Remove rock fragments and materials disturbed during excavation or raveled from trench walls.

3. Restore to proper sub grade with trench-stabilization material when over excavated:

a. Correct when trench is over excavated without authority or to stabilize bottom rendered unsuitable through negligence or improper operations.

b. Placement of Trench Stabilization Material:

(1) Compact in lifts not exceeding 6-inch loose thickness:
(A) With pneumatic or vibratory equipment.
(B) To density specified for granular pipe embedment.

E. Trench Width:

1. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. Minimum trench widths shall be as per the Standard Drawing Details.

2. Specified minimum sidewall clearances are not minimum average clearance but are minimum clear distances which will be required from the pipe side wall to the trench excavation wall or the trench protective system.

3. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be done only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits

F. Trenching in Fill Areas: Perform trenching in fill areas only after compacted fill has reached an elevation of not less than 1 foot above the top of the pipe.

G. Cutting Concrete Surface Construction: Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove to the full depth of the pavement, along each side of the trench and along the perimeter of cuts for structures.

1. Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than six inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench. See Standard Drawing Details.

2. Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

3. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3.02 PIPE EMBEDMENTS AND ENCASEMENTS

A. Class B bedding shall be used for all Polyvinyl Chloride (PVC) and Ductile Iron Pipe (DIP) pipelines. Class A arch encasement is not required unless improper trenching or unexpected trench conditions require its use. Concrete cradle and concrete encasement shall be provided where indicated as required.

B. Granular Pipe Embedment:

1. Place granular embedment as follows:

a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length.

b. Form depression under each joint so that no part of bell or coupling is in contact with trench when pipe is placed in position.

c. Add second layer simultaneously to both sides of the pipe with care to avoid displacement.

d. Complete promptly after completion of jointing operations and City/City Engineer approval to proceed.

e. Substitute for any part of earth backfill to within 2 feet of final grade at Contractor's option.

2. Compact granular embedment as follows:

a. In lifts not exceeding 6 inches in compacted depth.

b. Rod, space, or use pneumatic or vibratory equipment:

(1) As required to obtain not less than 95% of the maximum density as determined by ASTM Method D4253 and D4254.
(2) Throughout depth of embedment.

3. See Standard Detail for Embedment of Pipe in the Standard Drawing Details.

C. Arch and Total Concrete Encasement:

1. Include in locations indicated or where approved by City/City Engineer to correct over width trench condition.

2. Form to dimensions indicated or construct full width of trench.

3. Start and terminate encasement at a pipe joint:

    a. Exclude joints from encasement:

        (1) Applies only to joints at either end of encasement.

4. Install keyed construction joints coincident with pipe joints at 30- to 36-foot intervals. Provide separation of at least 75% of cross-section area at construction joints. Do not run horizontal steel through joint.

5. Suitably support and block pipe to maintain position and prevent flotation.

6. Place arch encasement promptly after installation of granular embedment.

7. Protect against damage from heavy equipment with layer of earth. Use hand methods to a horizontal plane 12 inches above top of encasement.

D. Concrete Cradle:

1. Include in locations indicated and where designated by Engineer to reinforce unstable trench bottom.

2. Place on undisturbed trench bottom or on stabilized sub base.

3. Form to dimensions indicated or construct full width of trench.

4. Start and terminate concrete cradle at a pipe joint:

    a. Exclude joints from cradle:

        (1) Applies only to joints at either end of cradle.

5. Place without horizontal construction joints other than indicated.

6. Suitably support and block pipe to maintain position and prevent flotation.

7. Provide anchorage where indicated.

E. Pipe Embedment for Groundwater Barrier:
   1. Include pipe embedment for groundwater barrier 20 feet upstream of each manhole and at intervals not to exceed 400 feet for pressure lines.
   2. Use at impervious trench checks.
   3. Shape trench bottom to fit pipe and backfill throughout depth of trench with compacted impervious materials.
   4. Soil shall be compacted to 95 percent of maximum density.

3.03 BACKFILLING

A. Placement:

1. All utilities shall be inspected and approved by the City prior to backfilling. A minimum of twenty-four hours' notice shall be provided for inspections.

2. Complete promptly after City/City Engineer approval to proceed:

   a. Upon completion of pipe embedment.
   b. Only after concrete encasement has obtained 70% of design strength. Determination of design-strength percentage obtained shall be as specified in SECTION 03300.

3. Use hand methods to a horizontal plane 12 inches above top of pipe-barrel conduit or duct banks.

4. Use approved mechanical methods where hand backfill is not required.

5. Place in layers of thickness within compacting ability of equipment used.

6. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. The distance may be increased 2 feet for each additional foot of cover. Backfill conduit trenches in layers of 4 to 8 inches.

7. Tracer wire shall be placed on top of water mains and water and sewer services and attached to the pipe with duct tape every 4 foot. The tracer wire shall be properly grounded at all ends and at 500' maximum intervals.

8. The top portion of backfill beneath established lawn areas shall be finished with at least six, (6) inches of topsoil corresponding to, or better, than, that underlying adjoining lawn areas.

B. Compacted Granular Backfill:

   1. Compacted granular and flow able backfill (Section 02222-2.04) shall be required for the full depth of the trench above the embedment and to within six inches of finish grade or

to the base of pavements in the following locations, as approved by the City.

a. Where beneath pavements, driveways, curbs, parking lots, sidewalks.

b. Where in streets, roads, alleys or shoulders.

c. Where trench walls are within two feet of the back of the street curb.

d. When the trench for one pipe passes beneath the trench for another pipe, backfill for the lower trench shall be compacted to the level of the bottom of the upper trench."

2. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 95 percent of the maximum density.

C. Temporary Street Repairs:

1. Reference is made to details in the Standard Drawing Details, specifying temporary trench backfill measures required within streets, roads, alleys or highway shoulders.

D. Uncompacted Backfill:

1. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement. Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two inches in diameter, debris, or other corrosive material, but may contain rubble and detritus from rock excavation, stones and boulders, in certain portions of the trench depth. Uncompacted backfill material above embedments shall be placed by methods, acceptable to the Engineer, which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and which will not result in displacement of, installed pipe. Compact masses of stiff clay or other consolidated material more than one cubic foot in volume shall not be permitted to fall more than five feet into the trench unless cushioned by at least two feet of loose backfill above pipe embedment. No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper 18 inches of the trench, nor shall any stone larger than eight inches in its greatest dimension be placed within three feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3.04 TUNNEL EXCAVATION Pipelines shall be constructed in tunnels or bores in conformity with the following requirements.

A. Smooth Steel Casing Pipe:

1. Casing conduit shall be installed by jacking into place. Earth and/or rock displaced by

The conduit shall be removed through the interior of the pipe by hand, auger or other Acceptable means.

2. Sections of the casing conduit in its final position shall be straight and true in alignment and grade as required by the drawings.

3. There shall be no void space between the earth and the outside of the casing.

B. Carrier Pipe Spacers:

1. Suitable thread lubricant shall be used on all stainless steel fasteners to prevent galling.

2. Maximum spacing of the spacers shall be as per Standard Drawing Details with a maximum distance from female end of joint of 12 inches.

C. End Seals:

1. Both ends of each casing conduit shall be sealed per manufacturer's recommendations.

2. End seal shall be secured to the casing and carrier pipes with all stainless steel worm gear clamps.

3. Lubricants approved by the end seal manufacturer maybe used to aid in installation of the end seal.

3.05 FIELD QUALITY CONTROL

A. Concrete: Contractor shall test all concrete for use in encasements, cradles, and concrete cut-off walls to determine conformance with Specifications. Method of test shall be as specified in SECTION 03300.

B. Contractor will, through services of an independent laboratory, test all granular bedding and backfill at intervals as required to verify conformance with specified density relationships. A copy of all test results shall be provided to the City/City Engineer.

END OF SECTION 02222

SECTION 02512 – ASPHALTIC CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes asphaltic concrete pavement for roads.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.

C. See Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. Missouri Standard Specifications for Highway Construction.

a. Section 304 - Aggregate Base Course.

b. Section 401 - Plant Mix Bituminous Base and Pavement

c. Section 401.2.2 - Recycled Asphaltic Material

d. Section 403 - Asphalt Concrete Pavement.

e. Section 404 - Bituminous Mixing Plant.

f. Section 407 - Tack Coat.

g. Section 408 - Prime Coat.

2. American Society for Testing and Materials, (ASTM);

a. D2950 – Density of Bituminous Concrete in Place by Nuclear Method.

1.03 SUBMITTALS

A. Submit as specified in DIVISION 1.

B. Mix Design:

1. Contractor shall provide mix designs and a job mix formula for each mixture specified. Mix designs shall be accomplished by a qualified, independent, commercial testing laboratory.

2. Furnish copies of the proposed job mix formula, including the laboratory test report, to City/City Engineer for approval not less than 30 days prior to beginning production of paving mixture. Test reports shall indicate the following:

a. Gradation: Each component aggregate and combined aggregates.

b. Asphalt cement content in percent of total mix by weight.

c. Graphic plots of:

(1) Density versus asphalt content.
(2) Stability versus asphalt content.
(3) Percent voids total mix versus asphalt content.
(4) Flow versus asphalt content.

C. Submit certificates accompanied by a copy of the refinery test report for bituminous materials for:

1. Tack coat.

2. Asphalt cement.

D. Samples:

1. Core or saw undamaged samples from the completed pavement courses.

a. Core samples shall be not less than 2-inch diameter and shall be full depth of the layer to be tested.

b. Samples shall be taken at roadway ends and at 300 foot intervals. No less than 3 samples shall be taken on any roadway.

c. Deliver the samples to an independent laboratory for testing. Samples may be tested for density and extraction.

2. Replace pavement at sample location with fresh bituminous mixture and thoroughly compact repaired area.

1.04 TESTING

A. Completed pavement will be tested at the expense of the contractor to determine density, gradation, and asphalt content, (by extraction).

1. Density shall be determined by the direct transmission nuclear method in accordance with ASTM D2950 or as specified in the Missouri Standard Specifications for Highway Construction.

2. The mixture shall be tested at least once every 1000 tons of production or a minimum of once per day for the gradation, density, deleterious content and the asphalt content.

B. Contractor shall perform such other tests as he deems necessary to assure production of asphaltic concrete conforming to specified quality.

C. Contractor shall test surface smoothness by applying a 10-foot straightedge both parallel and at right angles to the centerline of paved areas:

1. Test at 50-foot (maximum) intervals, or more frequently when requested by the City.

2. The City will observe straightedge testing.

3. A properly calibrated rolling straightedge of the “Skorch” type may be used at the Contractor’s option.

1.05 TOLERANCES

A. Density of completed pavement shall not be less than the following percentage of the density of the laboratory mix design:

1. All Lifts; 95% minimum.

B. Smoothness shall be such that variation from a 10-foot straightedge does not exceed the following limits:

1. Final Lift of Base Course: 1/2-inch.

2. Surface Course: 1/4-inch.

PART 2 - PRODUCTS

2.01 GENERAL

A. Equipment and Materials shall conform to the requirements of Missouri Standard Specifications for Highway Construction.

2.02 MATERIAL

A. Base Rock

1. Aggregate: Type 1 per the latest edition of MoDOT's Standard Specifications for Highway Construction, Section 1007.

B. Bituminous Material:

1. Asphalt Cement: Penetration grade 60 to 70 or 85 to 100.

2. Tack Coat: shall comply with the latest edition of MoDOT's Standard Specifications for Highway Construction, Section 407.

3. Any Prime Coat required shall comply with the latest edition of MoDOT's Standard Specifications for Highway Construction, Section 408.

C. Asphaltic Concrete Mixture:

1. Mixtures

a. Black Base Course: Section 401 Plant Mix Bituminous Base or Section 403 Asphaltic Concrete Pavement, Type SP190 or Type SP250, Missouri Standard Specifications for Highway Construction.

b. Surface Course: Section 401, Type BP-2 or Section 403, Type SP125, Missouri Standard Specifications for Highway Construction.

PART 3 - EXECUTION

3.01 GENERAL

A. Performance shall conform to the requirements of Missouri Standard Specifications for Highway Construction, Sections 304, 401 and 403.

B. Where a new street is to connect to an existing street, all deteriorated or cracked asphalt within five (5) feet of the connection point shall be removed to a point where sound material is found. If full-depth pavement removal is required, the subgrade will be recompacted to 95% of standard density.

3.02 TACK COAT

A. Apply tack coat to the surface of all existing pavement and all previously placed asphalted concrete lifts or courses before placing the succeeding lift.

B. Apply at the following rates:

1. Emulsion: Minimum 0.02 and maximum 0.10 gallon per square yard.

2. Liquid Asphalt: 0.15 ± 0.05 gallon per square yard.

END OF SECTION 02512

SECTION 02525 – CURBS, GUTTERS, SIDEWALKS, DRIVEWAY APPROACHES, AND PAVED DRAINAGE:

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes concrete curbs, gutters, sidewalks, driveway approaches, and paved Drainage where indicated.

B. Related Work Specified Elsewhere:

1. Storm Drainage System: SECTION 02720

2. Concrete: SECTION 03300.

C. See related Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. American Concrete Institute (ACI):

a. 305 - Hot-Weather Concreting.

b. 306 - Cold-Weather Concreting.

2. American Society for Testing and Materials (ASTM):

a. A615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

b. A616 - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

c. C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

d. D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

e. D1752 - Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

f. D6690 -Joint and Crack Sealer, Hot-Applied, for Concrete and Asphalt Pavement.

3. Federal Specifications (FS):

a. TT-S-00227 - Sealing Compound; Elastomeric Type, Multi Component. (For caulking, sealing, and glazing in buildings and other structures.)

1.03 WEATHER LIMITATIONS

A. Concrete shall not be placed upon frozen subgrade. All concrete shall be effectively protected from freezing until a minimum compressive strength of 3000 psi has been attained. The contractor shall provide a method, meeting the approval of the Public Works Director, of monitoring the concrete that demonstrates that the concrete has been protected from freezing. Regardless of precautions taken, the contractor shall assume all risks, and all frozen concrete shall be replaced at the contractor's expense.

1. Conform to ACI 306 when temperature is below 40ºF within a 24-hour period after placement of concrete.

2. Conform to ACI 305 when temperature is above 90ºF, or is likely to rise above 90ºF within a 24-hour period after placement of concrete.

B. To protect against rain, the contractor shall have on location at all times material for the protection of the edges and surface of the unhardened concrete. The contractor shall protect the concrete from damage due to rain. Failure to properly protect unhardened concrete may constitute cause for the removal and replacement of defective concrete at the contractor's expense.

PART 2 - PRODUCTS

2.01 CONCRETE

A. All curbs and gutters and sidewalks shall be constructed with 4,000 psi concrete as specified in SECTION 03300.

B. Reinforcing steel as specified in SECTION 03200.

C. Concrete slump reduced as necessary for slip-form construction, construction on steep slopes, and consolidation of concrete in curb back sections.

2.02 JOINT DOWELS

A. Smooth round dowels having at least one-half the length of each dowel coated to ensure that no bond is developed between dowel and concrete.

B. Conform to ASTM A615, Intermediate Grade or ASTM A616, Regular Grade.

2.03 DETECTABLE WARNING TILES

A. Detectable warning Surfaces and their components shall be manufactured and/or supplied in a safety yellow color homogenous throughout the tile and matching the pattern shown in Standard Detail Drawings with a slip resistant surface, such as that manufactured by “Armor-Tile” or equal. The coloring shall be made an integral part of the detectable warning surface.

B. Truncated domes shall have a diameter of 0.9 inches at the bottom, a diameter of 0.4 inches at the top, a height of 0.2 inches and a center to center spacing of 2.35 inches measured along diagonal of a square alignment.

2.04 EXPANSION JOINT FILLER

A. Preformed material cut and shaped to the required cross-section.

B. Thickness of ½ inch unless otherwise indicated.

C. Conform to ASTM D1751 for all expansion joints except for those in sidewalks.

D. Conform to ASTM D1752, Type II or Type III, for expansion joints in sidewalks.

2.05 JOINT SEALER

A. Conform to ASTM D6690 for all joints required to be sealed except those in sidewalks.

B. For Expansion Joints in Sidewalks:

1. Conform to FS TT-S-00227.
2. Non-tracking after initial cure.
3. Two-component, cold-applied.
4. Compatible with preformed expansion joint filler.
5. Black or gray color.

2.06 CURING COMPOUND

A. Conform to ASTM C309, Type I or Type I-D.

2.07 FORMS

A. Wood or metal.

B. Straight and strong enough to resist springing during placement of concrete.

C. Sufficient bearing surface to prevent tipping.

D. Height equal to full depth of section to be constructed.

2.08 SLIP-FORM MACHINE

A. Designed to produce finished concrete items true to line, grade, and cross section.

B. Designed to extrude and compact concrete by means of extrusion form accurately shaped to the required cross-section.

C. Line and grade controlled automatically from erected taut wire or string line.

D. Equipped with trailing side form when necessary to support material behind the extrusion plate.

E. Equipped with finishing devices to produce type of finish specified.

PART 3 - EXECUTION

3.01 PREPARATION

A. Sub grade preparation is as specified in SECTION 02200.

3.02 INSTALLATION

A. Forms:

1. Use flexible forms for all curved form lines except:

   a. Curves having a radius of 200 feet or greater may be formed in 10-foot or shorter chords.

   b. Curves having a radius of 100 feet to 200’ may be formed in 5-foot or shorter chords.

2. Thoroughly clean oil, securely stake, brace, and hold forms to line and grade.

3. Remove forms from front face of curb section at the time necessary to permit finishing concrete. Leave other forms in place not less than 12 hours after placement of concrete.

B. Joints:

1. Contraction Joints:

a. Construct at locations indicated and as follows:

(1) Divide concrete curb, curb and gutter, driveway approaches, and paved drainage into monolithic sections not greater than 15 feet in length.
(2) Match contraction joint spacing of adjacent Portland cement concrete pavement.
(3) Divide sidewalks into approximately square areas.

b. Form contraction joints by the following methods:

(1) Cut a groove in the fresh concrete to a depth of at least one-fourth the section thickness by use of a jointer having a radius of 1/8inch and thickness not exceeding 1/8 inch.
(2) Saw the hardened concrete before shrinkage cracking occurs. Depth of cut shall not be less than1/4 the section thickness and width of key shall not exceed 3/16-inch.

2. Expansion Joints:

a. Construct at the following locations:

(1) Locations as indicated on the Standard Details.
(2) All points of curvature and points of tangency of curves having a radius of 100 feet or less, and at intervals not exceeding 50 feet in tangent sections for hand laid sidewalks and not more than 100 feet for machine laid sidewalks.
(3) Locations matching expansion joint spacing of adjacent Portland cement concrete pavement.
(4) Locations where curb, curb and gutter, sidewalk, driveway approaches, or paved drainage abut each other or other structures and slabs.

b. Stake, support, and secure local transfer dowels and preformed joint filler in position to prevent displacement during placing and finishing operations.

c. Round edges of joints with an edging tool of 1/8 inch radius.

3. Key Joints: Construct at locations indicated for paved drainage and curb and gutter adjacent to Portland cement concrete pavement.

4. Construction Joints:

a. Locate to coincide with contraction, expansion, or key joints.

b. When concrete placement is interrupted between joint locations for a sufficient time for the concrete to take its initial set, remove concrete to the nearest joint location before resuming placement.

c. Make transverse construction joints in paved drainage having a thickness of 6 inches or greater by either key joints or expansion joints.

C. Concrete:

1. Placing Concrete:

a. Place only on compacted and City/City Engineer approved sub grade and base. All sub-grade and base shall be inspected and approved by the City prior to placing concrete.

b. Lightly moisten surface of dry sub grade before placing concrete.

c. Place concrete in manner to avoid displacement of forms and joint materials.

d. Tamp or vibrate concrete sufficiently to eliminate all voids and bring the mortar to the top for finishing.

2. Finishing Concrete:

a. Edge concrete with proper edging tools.

b. Tool radii as soon as possible after concrete has taken its initial set.

c. Remove curb face forms and rub with rubbing block and water until all blemishes, forms, and tool marks have been removed.

d. Float-finish with wood float or other approved means until concrete is true to line, grade, and cross section, and is uniform in texture.

e. Brush with a hard bristle broom as follows:

(1) Curb and curb and gutter parallel to the line of curb.
(2) Sidewalk perpendicular to its longitudinal axis.

f. Do not use mortar topping or sand and cement dryer.

D. Tolerances:

1. Applies to conventional and slip-form construction.

2. Alignment deviation of finished concrete Work not to exceed ¼ inch in 10 feet from true line and grade.

3.03 SLIP-FORM CONSTRUCTION

A. Prepare sub grade to a sufficient additional width as necessary to provide support and tracking for the slip-form machine.

B. Adjust slump (reduce) and control concrete mix as necessary to provide satisfactory slip form construction.

C. Use supplementary hand-finishing operation when necessary to produce uniform finishes free from blemishes and of the types and textures specified.

3.04 CONCRETE CURING AND PROTECTION

A. Curing:

1. Spray all exposed surfaces after finishing with curing compound.

2. Apply curing compound at a rate of not less than 1 gallon per 225 square feet of surface area.

3. Apply second coat at a rate of not less than 1 gallon per 275 square feet 30 minutes after first-coat application when the atmospheric temperature exceeds 100°F.

B. Protection

1. Protect the finished Work from damage until final acceptance.

2. Repair, replace, or clean all concrete damaged or discolored prior to final acceptance.

3.05 SEALING JOINTS

A. Seal all expansion joints and contraction joints ¼ inch or greater in width.

B. Do not seal portions of expansion joints located in vertical parts of curbs.

C. Remove curing compound and other material from joint surfaces before sealing. Joint shall be clean and surface dry at time of sealant application.

D. Apply joint sealant using methods and equipment necessary to ensure complete filling of the joint space without voids or air bubbles.

E. Apply sealant to conform to sealant manufacturers instructions.

F. Fill each joint with sealer from 1/8” below to level with adjacent concrete surface.

G. Protect adjacent surfaces to prevent contamination with sealant material.

H. Protect sealant until it has set up or cured sufficiently to preclude pickup or tracking.

3.06 DETECTABLE WARNING SURFACES

A. Detectable warning surfaces consisting of truncated domes aligned in a square grid pattern shall be provided where a curb ramp or landing connects to a crosswalk.

B. The detectable warning surfaces shall be located so that the nearest edge is between 6 and 8 inches from the back of the curb line and shall extend a minimum of 24 inches in the direction of travel and the full width of the curb ramp, normally 4 feet.

C. There shall be a minimum of 70 percent contract in light reflectance between the detectable warning and the adjoining surface.

E. See Standard Drawing Details.

END OF SECTION 02525

SECTION 02605 – MANHOLES AND WETWELLS

PART I - GENERAL

1.01 SUMMARY

A. This Section includes the following structures and related appurtenances:

1. Manholes. (Sewer lamp holes are prohibited).

2. Pumping station wetwells.

B. Related Work Specified Elsewhere:

1. Concrete: SECTION 03300.

2. Submersible Wastewater Pumping Station: SECTION 11151.

C. See Details in the Standard Drawing Details.

D. Submittals; Drawings and data covering precast concrete sections and castings shall be submitted in accordance with the submittal section.

E. Delivery and Handling; Precast concrete sections shall not be delivered to the job until representative concrete control cylinders have attained a strength of at least 80 percent of the specified minimum.

1.02 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A48 - Gray Iron Castings.

b. C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

c. C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

d. C478 – Circular Precast Reinforced Concrete Manhole Sections.

e. C497- Standard Test Methods for Concrete Pipe, Manhole Sections or Tile

f. D3575 – Flexible Cellular Materials Made from Olefin Polymers

1. Federal Specifications, (FS):

    a. SS-S-00210 – Sealing Compound, Preformed Plastic, for Expansion Joints and pipe joints.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Concrete: Reinforced, 4000 psi. Conform to SECTION 03300.

B. Castings:

1. Manhole frames and covers.

    a. ASTM A48, Class 30B, pattern as specified for each structure under PART 3, this Section.

    b. Interchangeable within same pattern.

2. Conform to drawings in all essentials of design. Weight shall be within 10 percent of that listed for pattern.

3. Machine-bearing surfaces to provide even seating.

4. Coat with Blackhawk Liquid Asphalt or equal.

C. Gasket material shall meet FS SS-S-OO210 and be K.T. Snyder “Ram-Nek” or equal.

D. Grade adjustment rings shall be precast reinforced concrete.

PART 3 - EXECUTION

3.01 MANHOLES

A. The flow-line angle for manholes shall not be less than 90 degrees. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all line intersections; and at a distance not greater than four hundred (400) feet. Manholes shall have eccentric cone unless otherwise approved by the City. Construction shall conform to the details in the Standard Drawing and the following:

1. Manholes shall either be precast manholes with cast-in-place base or precast concrete base or cast-in-place reinforced concrete manholes.

a. Precast manholes shall conform to ASTM C478 and C497.

b. Minimum wall thickness equal to 1/12 of inside diameter plus one inch.

c. Precast cone section shall be eccentric.

d. Precast manholes shall be provided with mastic gasket to seal joints between sections.

e. Drop manholes shall be inside drop type. Outside drop manholes are not allowed.

f. Drop connections for precast manholes shall not enter the manhole at a joint.

g. Manholes shall be provided without interior steps.

2. Submit compliance submittal for precast and cast-in-place reinforced concrete manholes prior to installation.

3. Repair any leaks or remove entire work and rebuild to obtain watertight construction. Any repair method must be approved by the City.

B. Manhole Frames and Lids:

1. Type A frames and lids shall be suitable for all use areas except areas subject to flooding.

2. Type B frames and lids shall be bolt-down type. Type B frames and lids shall be installed in all areas subject to flooding and as determined by the Public Works Director.

3. All frames should be set so that top of lid is two inches, (maximum), higher than finish grade, matching improved surfaces as per Design Standards or as directed by the City. If at any time, the finish grade is adjusted or top soil or sod is added, then the frame/lid shall be readjusted to the new grade by the individual responsible for the change in grade. The adjusted manhole may require retesting for leakage as per Section 02620.

4. Type B frames shall be bolted to each manhole by four anchor bolts. Bolt holes shall be located 90 degrees apart.

5. Type A and B frames shall be anchored to the manhole by mastic gasket material.

C. Connections:

1. Install all piping using an “A-Lok” flexible rubber entrance hole gasket joint.

2. Provide stub outs, located to provide appropriate drop through manhole, for future connections where indicated.

3. Place pipe stub in manhole wall with bell or coupling outside manhole wall to provide flexible joint. Stubs shall not be less than 3’-0” nor more than 5’-0”.

4. Include plug or stopper capable of withstanding 10 feet (4.3 psi) internal or external pressure without leakage for future connections.

5. Connections of new pipe to existing structure shall be made with an “A-Lok” flexible connector. A-Lok connection shall be installed in strict conformance with manufacturer’s recommendations along with redevelopment of the concrete invert to accommodate the new pipe flow.

D. Manhole Base;

1. Form invert channel with 4000 psi Type II Portland cement concrete.

2. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits.

3. Make changes in size and grade smoothly and uniformly.

4. Slope floor of manhole adjacent to channels as indicated in Standard Details.

5. Finish channel bottom smoothly without roughness, irregularity or pockets.

6. The minimum drop of invert from inlet to outlet shall be 0.2’ inlet to outlet in standard and shallow manholes. The maximum drop shall be 2.0’.

7. If cast-in-place concrete bases are used, concrete shall be placed on undisturbed earth in accordance with applicable requirements of the concrete specification section.

8. If precast concrete bases are used, the subgrade materials shall be excavated to undisturbed earth and to a uniform elevation which will permit at least 4 inches of granular embedment material, as specified in the earthwork specification section, to be installed and compacted. The surface of the granular material shall be carefully graded and the base section accurately set so that connecting pipes will be on proper line and grade. The elevation of the granular material shall be adjusted as required until proper grade and alignment of the base section has been attained.

9. No wedging or blocking under precast concrete bases will be permitted.

10. In no case shall the invert section through a manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects.

E. Waterproofing:

1. Apply 1 coat of ErgonArmor “Blackhawk Liquid Asphalt, 5011” coating to exterior walls, including bottom of the base, on all manholes from base to finish grade.

2. Grout shall only be permitted on manhole to fill in lifting holes.

F. Corrosion Protection for Manholes: Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection as approved by the Public Works Director shall be provided on the interior of the manholes. Corrosive conditions are considered to be present where sewer mains are 12” or larger in size or where discharge is occurring from a force main. Where discharge is from a force main an additional two manholes downstream shall be lined. The interior protection shall be epoxy made up of a minimum of 90% solids. A concrete admixture of “Con-Shield” or equivalent may be substituted for epoxy lining.

3.02. PUMPING STATION WETWELLS

A. Design: Construct wet wells of reinforced concrete pipe conforming to ASTM C76, Class III.

1. Minimum inside diameter 96 inches, unless approved by the Public Works Director.

2. Minimum wall thickness equal to 1/12 of inside diameter plus one inch.

3. Submit compliance submittal for wet wells prior to installation.

B. Joints: Conforming to ASTM C443.

C. Top:

1. Provide 10’ minimum diameter reinforced concrete wet well top with opening for embedded access hatch for submersible pumping stations.

2. An aluminum access hatch shall be furnished and installed where indicated on the drawings and as specified herein. Access hatch shall be of the size indicated on the drawings, shall contain a double door and be manufactured by Bilco Company, Halliday Products, or equal.

D. Bottom:

1. Provide 10’ minimum diameter reinforced concrete bottom.

2. Provide six inches of compacted granular fill beneath bottom.

3. Provide concrete fill, on 1:1 slope, at bottom of wet well to form wet well bottom sump.

4. The placement of the wetwell bottom shall conform to the same requirements as indicated in Section 3.01.D.7, 8, and 9; and the applicable sections located in the concrete specification section.”

E. Connections:

1. Install all piping using an “A-Lok” flexible rubber entrance hole gasket joint.

2. Place pipe stub in wet well wall with bell or coupling outside wet well wall to provide flexible joint.

F. Waterproofing: Apply exterior waterproofing as specified for Manholes in this Section.

END OF SECTION 02605

SECTION 02610 – SANITARY SEWER PIPE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes all gravity sanitary sewer pipe, fittings and specials.

B. Related Work Specified Elsewhere:

1. Trenching and Backfilling for Utilities; SECTION 02222.

2. Pipe Installation and Testing: SECTION 02620.

1.02 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A746 - Ductile Iron Gravity Sewer Pipe.

b. D1784- Rigid Poly, (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

c. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

d. D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

e. D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS)and Poly Vinyl Chloride (PVC) Composite Sewer Piping

f. D3034 –PSM Polyvinyl Chloride Sewer Pipe and Fittings.

g. D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

h. F477-Elastomeric Seals, (Gaskets) for Joining Plastic Pipe.

2. American Water Works Association (AWWA):

a. C110 - Ductile-Iron and Gray-Iron Fittings.

C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

b. C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Submit the following for acceptance prior to fabrication:

1. Pipe and joint details.

2. Special, fitting and coupling details.

3. Laying and installation schedule.

4. Manufacturer's design calculations.

C. Certificates and Affidavits:

1. Submit as specified in accordance with the submittal section.

2. Furnish the following prior to shipment:

a. Affidavit of compliance with applicable standard.

b. Test certificates.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. Experienced in the design, manufacture and commercial supplying of the specific material for a minimum period of five years.

2. Experienced in the design, manufacture, and commercial supplying of the specific size of pipe for a minimum period of one year.

3. Certify to above minimum experience requirements.

PART 2 - PRODUCTS

2.01 PIPE REQUIREMENTS

A. Furnish pipe of materials, joint types, sizes, and strength classes indicated or specified. Higher strengths may be furnished at Contractor's option. Furnish maximum pipe lengths produced by the manufacturer.

B. Pipe shall be designed to withstand all stresses resulting from external loads including both earth load (120 lb/cu. ft.) and truck loads based on AASHTO H-20 truck (submit manufacturer's design calculations).

C. Pipe Bedding: As specified. Embedment materials for bedding, haunching and initial backfill, Class I, II or III as described in ASTM D2321, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type of soil encountered and potential groundwater conditions. Except as described in ASTM D2680, the bedding, haunching and initial backfill requirements for composite pipe shall be the same as for plastic pipe.

D. Pipe Marking:

1. All pipe, fittings and specials shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.

E. Pipe Gaskets: All elastomeric gaskets and seals shall be synthetic rubber.

F. Length of Pipe: Furnish the maximum pipe lengths as manufactured by the manufacturer.

2.02 POLYVINYL CHLORIDE PIPE (PVC)

A. Design and Manufacture of Pipe:

1. PVC Pipe shall conform to ASTM D 3034, SDR 26 with minimum 46 psi stiffness per ASTM D2412 rating.

2. All materials used in the manufacture of pipe, fittings and accessories shall conform to ASTM D1784, Class 12454-B.

2. Tees shall be SDR-26. Sewer services shall be Schedule 40 PVC.

B. Joints:

1. Provide push-on joints conforming to ASTM D3212 with elastomeric seals conforming to ASTM F477.

2. Field cut joints and connections to other piping material shall be made with Can-Tex "C-T Adapters" with stainless steel bands or equal.

2.03 DUCTILE-IRON PIPE

A. Design and Manufacture of Pipe:

1. Ductile iron gravity sewer pipe shall conform to ANSI A21.51, AWWA C151, ASTM A536, Grade 60-42-10; thickness Class 50, ASTM A746, Pressure Class 350.

3. With laying condition Type 5.

3. Use E' of 700 and bedding angle of 150 degrees.

4. With a maximum 5 percent design deflection for trench load calculations.

5. Net calculated thickness shall include standard casting tolerances plus 0.08-inch additional service allowance.

6. Select special class thickness next above total calculated thickness.

B. Dimensions:

1. The minimum pressure class for ductile iron pipe shall be 350 psi.

C. Joints:

1. Provide push-on joints conforming to ANSI A21.11 and AWWA C111 except gasket shall be synthetic rubber. Natural rubber will not be acceptable.

D. Fittings:

1. Conform to AWWA C110 and be ductile iron.

2. Provide all specials, taps, and plugs as specified or indicated.

E. Lining:

1. Line all gravity sewer pipe, fittings and specials with a nominal 40 mils thickness of ceramic epoxy (Protecto 401 or equivalent) .

F. Coating:

1. All pipe and fittings shall be coated with 1.5-2.5 mils of Bituminous Coating per Manufacturer's Standard unless otherwise required by the Public Works Director.

PART 3 – EXECUTION

3.01 INSTALLATION Specified in SECTION 02620.

3.02 FIELD TESTING Specified in SECTION 02620.

END OF SECTION 02610

SECTION 02615 - PRESSURE PIPE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes all pressure pipe, fittings, specials and appurtenances.

B. Related Work Specified Elsewhere:

1. Trenching and Backfilling for Utilities; SECTION 02222.

2. Pipe Installation and Testing: SECTION 02620.

3. Valves, Hydrants and Accessories: SECTION 02640.

4. Disinfection of Piping; SECTION 02675.

1.02 REFERENCES

A. Applicable Standards:

1. American Water Works Association (AWWA):

a. C110 - Ductile-Iron and Gray-Iron Fittings.

b. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

c. C150 - Thickness Design of Ductile-Iron Pipe.

d. C151 -Ductile-Iron Pipe, Centrifugally Cast

e. AWWA C900- Polyvinyl Chloride (PVC) Pressure pipe and Fabricated Fittings shall be used for all pressure sewers and water piping.

f. M23 – Manual, Pipe Design and Installation of PVC Pipe.

2. American Society for Testing and Materials (ASTM):

a. D2241 - Polyvinyl Chloride (PVC) Pressure Rated Pipe, (SDR Series).

b. D2737 – Polyethylene (PE) Plastic Tubing.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Submit the following for acceptance prior to fabrication:

1. Pipe and joint details.

2. Special, fitting and coupling details.

3. Laying and installation schedule.

4. Specifications, data sheets and affidavits of compliance for protective shop coatings and linings.

5. Manufacturer's design calculations.

C. Certificates and Affidavits: Furnish the Following Prior to Shipment:

1. Affidavit of compliance with applicable standard.

2. Test certificates.

1.04 QUALITY ASSURANCE

A. Manufacturers shall be experienced in the design and manufacture of pipe, fittings, and specials or appurtenances for a minimum period of 5 years.

1.05 STORAGE AND HANDLING

A. Pipe, fittings, and accessories shall be handled in accordance with Chapter 6 of the AWWA Manual M23, to ensure installation in sound, undamaged condition. Pipe shall not be stored in direct sunlight.

PART 2 - PRODUCTS

2.01 PIPE REQUIREMENTS

A. Furnish pipe of materials, joint types and sizes as indicated or specified.

B. Pipe Marking: All pipe and fittings shall be marked conforming to the applicable standard specification under which the pipe is manufactured and as otherwise specified.

2.02 DUCTILE-IRON PIPE

A. Design and Manufacture of Pipe:

1. Ductile-iron pipe shall conform to AWWA C150 and C151 except as otherwise specified.

2. With laying condition Type 5.

a. Use E' of 700 and bedding angle of 150°.

b. 3% deflection limit.

c. Add service allowance and standard casting tolerances of AWWA C150.

d. Select standard pressure-class thickness or special thickness class next above total calculated thickness.

B. Dimensions: The minimum thickness as defined by pressure class for mechanical or push on-type joint ductile iron pipe shall be 350 psi.

C. Joints:

1. Push-On:

a. All pipes shall be provided with push-on joints unless otherwise noted.

2. Restrained:

a. Provide restrained joint pipe where required.

b. Provide restrained joints of following approved types:

(1) Restrained mechanical joint.
(2) Restrained push-on joint.
(3) Boltless or bolted ball and socket joint.
(4) Anchored couplings.
(5) Foster Adapters.

c. Retainer glands shall be Megalug manufactured by EBAA Iron, Inc. or equal.

d. Fittings:

(1) Fittings shall be ductile iron and conform to AWWA C110 with a pressure rating of not less than that specified for pipe.
(2) Fittings for pipe with mechanical joints shall have mechanical joints.
(3) Fittings for pipe with push-on joints shall have mechanical joints.
(4) Include all specials, taps, plugs, flanges and wall fittings as required.
(5) Service line fittings shall be as follows:
    (a) Saddles - Brass, A. Y. McDonald Model 3892 or equal.
    (b) Curb Stops - Ball type, A. Y. McDonald Model 76101 or equal.

e. Lining:

(1) Line all pipe, fittings and specials for potable water service with cement lining.
(2) Line all pipe, fittings and specials for sewer service with a nominal 40 mils thickness of ceramic epoxy (Protecto 401 or equivalent).
(3) Lining shall extend from edge of plain end to the gasket seat in the bell socket.

f. Coating:

(1) All buried iron pipe and fittings shall be coated with manufacturer's standard bituminous coating.

2.03 POLYVINYL CHLORIDE PRESSURE PIPE

A. Design and Manufacture of Pipe:

1. PVC pipe shall conform to AWWA C900, Pressure Class 235 and a thickness class of DR18.

B. Fittings:

1. Fittings shall be ductile iron and conform to AWWA C153.

2. Fittings shall be mechanical joint.

C. Joints:

1. Joints of PVC pipe to PVC pipe shall be push-on type and meet the requirements of ASTM D 2241.

2. Joints of PVC pipe to ductile iron shall meet the requirements of AWWA C111.

3. Gaskets shall be synthetic rubber. Natural rubber will not be acceptable.

D. Service Line:

1. A service connection shall be provided for each lot between the water main and the meter setter. The service line shall be a minimum 1-inch diameter 200 PSI, SDR-9 PE 3408, ASTM-D2737, CTS-OD pipe.

2.04 GASKETS

A. Provide all gaskets, bolts, lubricant, and other accessories required to install pipe, fitting and specials complete and ready for service.

PART 3 - EXECUTION

3.01 INSTALLATION Specified in SECTION 02620.

3.02 FIELD TESTING Specified in SECTION 02620.

END OF SECTION 02615.

SECTION 02620 - PIPE INSTALLATION AND TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Handling, installation and testing of pipe, fittings, specials and appurtenances as indicated or specified.

2. Concrete anchor and thrust blocks.

3. Sewer service connections.

4. Water service connections and related items.

5. Tracer wire

B. Related Work Specified Elsewhere:

1. Manholes and Wet wells: SECTION 02605.

2. Sanitary Sewer Pipe: SECTION 02610.

3. Pressure Pipe: SECTION 02615.

4. Valves, Hydrants and Accessories: SECTION 02640.

5. Concrete: SECTION 03300.

C. See Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. American Water Works Association (AWWA):

a. C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems

b. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

c. C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

2. American Standard Testing and Materials (ASTM):

   a. C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure, (Vacuum), Test Prior to Backfill

   b. F1417 - Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low Pressure Air.

1.03 DELIVERY, STORAGE AND HANDLING

A. Handle in a manner to ensure installation in sound and undamaged condition.

1. Do not drop or bump.

2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings and coatings.

B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.

C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

PART 2 – PRODUCTS: Specified in respective Sections, except as included below.

2.01 TRACER WIRE

A. General; All tracer wire shall have High Density Polyethylene, HDPE, insulation intended for direct bury and color coded per American Public Works Association, (APWA), standards for the utility being marked. See details in Standard Drawing Details.

B. Tracer wire for open trench shall be a minimum #12 AWG fully annealed, high carbon 1055 grade steel, high strength solid copper-clad steel conductor (HS-CCS) rated at 30 volts, insulated with 30 mils, high density, high molecular weight polyethylene (HDPE) insulation rated for direct burial use at 30 volts. HS-CCS conductor must be at 21% conductivity for locate purposes. Break load of 452 lbs.

B. Grounding of tracer wire shall be achieved with a drive-in magnesium grounding anode rod, (Copperhead or approved equal), with a minimum of 20 feet of ground wire. Ground wire shall be #14 AWG insulated, (red), CCS solid single strand wire.

D. Access boxes for tracer wire access points not corresponding to a valve or other structure shall be provided. Proper connectors such as Copperhead SnakeBite connectors or other moisture displacement connectors shall be used at all connections.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Utilize equipment, methods, and materials ensuring installation to lines and grades indicated. Sewers mains shall be laid with uniform slope and straight alignment between manholes and alignment shall be checked by either a laser beam or lamping.

1. Maintain within tolerances specified or acceptable laying schedule.
    a. Alignment: ±1 inch per 100 feet in open cut or tunnel.
    b. Grade: ±1 inch per 100 feet.
    c. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than two feet (2') per second.

2. Do not lay on blocks unless pipe is to receive total concrete encasement.

3. Accomplish horizontal and vertical curve alignments with appropriate elbows and bends with adequate blocking. Alignment by deflection shall not be permitted.

B. All water mains and sanitary sewer force mains shall have a minimum cover of 42" and a maximum cover of 60". Justification shall be provided where additional depth is required. Not less than 48" of cover shall be provided over top of gravity sanitary sewer mains in all areas unless otherwise approved by the Public Works Director. In areas where grading activities will take place, the water main shall not be installed until final grade has been achieved in the location of the proposed water main. The City shall not be responsible for required relocating or lowering of installed water mains due to insufficient pre-construction grading activities. No public water or gravity sewer main shall be constructed less than eight (8) inches in diameter.

C. Sanitary sewer mains shall be constructed on the opposite sides of streets from water mains. Sanitary sewers mains and water mains shall be located within right-of-ways and easements to provide the least interference with the location of other utility lines unless topography dictates otherwise.

D. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage. Sanitary sewers shall be laid at least 50 feet in horizontal distance from any existing or proposed water supply well. Wastewater pumping stations and pressure sewers shall be installed at least 100 feet in horizontal distance from any existing or proposed water supply well.

E. Maximum joint deflection for pressure pipe shall be 1°.

F. Planting of trees within roadway right-of-way and water and sanitary sewer main easements shall not be permitted.

G. Open cutting of streets shall be permitted only where approved by the Public Works Director. At locations where open cutting is not permitted, the street crossing shall be made by boring or tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the Public Works Director. The diameter and length of the casing pipe to be used shall be in accordance with details in the Standard Drawing Details.

H. Install pipe of size, materials, strength class, and joint type with embedment indicated or specified for plan location. All PVC sewers shall be SDR 26. Vitrified Clay sewer pipe is not permitted. Used pipes, fittings, and appurtenances are not permitted.

I. Commence laying at downstream end of line and install pipe with bell ends in direction of laying. Obtain approval for deviations there from.

J. Water and sewer mains shall be extended to the property lines for future potential extension. Manholes shall be placed at the ends of these mains with an invert formed for future connection. There shall also be a 5’ pipe stubout and plug placed at the manhole invert for future connection.

K. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during installation and at discontinuance of installation.

1. Close open ends of pipe during any break in work, lunch, end of day, etc. Pipes shall be sealed with inflated rubber ball plugs.

2. Do not let water control measures prove inadequate. The trench shall be kept free from water during pipe installation until the pipe has been installed, embedded and backfilled.

3. Remove water, sand, mud and other undesirable materials from trench before removal of end seal.

L. Brace or anchor as required to prevent displacement after establishing final position.

M. Perform only when weather and trench conditions are suitable. Do not lay in water.

N. Observe extra precaution when hazardous atmospheres might be encountered.

O. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. Only ductile-iron pipe with restrained joints shall be used unless otherwise approved by the Public Works Director.

P. For stream crossings, construction methods that will minimize siltation and erosion shall be employed. Clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven days.

Q. Cleanouts and lampholes are not permitted on sanitary sewer mains.

R. Construction of sidewalks longitudinally above sanitary sewers or water mains is not permitted. No sanitary sewer or water main shall be constructed under storm boxes.

S. Force mains shall be designed to withstand all pressures (including water hammer and associated cyclic reversal of stresses), and maintain a velocity of at least 2 feet per second.

3.02 STEEP SLOPE PROTECTION FOR SANITARY SEWER MAINS

A. Steep slope protection. Sanitary sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete slope anchors or equal, spaced as follows:

1. Not over thirty-six feet (36') center-to center on grades twenty percent (20%) and up to thirty-five percent (35%;

2. Not over twenty-four feet (24') center-to center on grades thirty-five percent (35%) and up to fifty percent (50%);

3. Slopes shall not exceed fifty percent (50%).

3.03 JOINTING

A. General Requirements:

1. Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks and structures.

2. Perform conforming to manufacturer’s recommendations.

3. Clean and lubricate all joint and gasket surfaces with lubricant recommended.

4. Utilize methods and equipment capable of fully homing or making up joints without damage.

5. Check joint opening and deflection for specification limits.

6. Mechanical joints shall be carefully assembled in accordance with the manufacturer’s recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over tightening of bolts to compensate for poor installation practice shall not be permitted.

B. Special Provisions for Jointing Ductile-Iron Pipe:

1. Conform to AWWA C600.

2. Visually examine while suspended and before lowering into trench.

a. Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.

b. Remove turpentine and cement by washing when test is satisfactorily completed.

C. Polyethylene Encasement: All cast iron fittings, tapping sleeves, valves, or other cast iron accessories shall be provided with polyethylene tube or sheet protection installed in accordance with AWWA C105.

3.04 CUTTING

A. Cut in neat manner without damage to pipe.

B. Observe specifications regarding joint locations.

C. Cut cast-iron, ductile-iron, and steel pipe with carborundum saw or other acceptable method per manufacturer's instructions.

1. Smooth cut by power grinding to remove burrs and sharp edges.

2. Repair lining as required and approved.

D. Cut PVC pipe with a fine toothed saw and mitre box or tube cutter. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and beveled in accordance with the manufacturer's instructions.

3.05 CLOSURE PIECES

A. Connect two segments of pipeline or a pipeline segment and existing structures with short sections of pipe fabricated for the purpose.

B. Observe Specifications regarding location of joints, type of joints, and pipe materials and strength classifications.

C. Field-fabricated closures, where required, shall be concrete encased between adjacent flexible joints.

D. May be accomplished with solid sleeve.

3.06 TEMPORARY PLUGS

A. Furnish and install temporary plugs at each end of work for removal by others when completed ahead of adjacent contract.

B. Plugs:

1. Test plugs as manufactured by pipe supplier.

2. Fabricated by Contractor of substantial construction.

3. Watertight against heads up to 20 feet of water, or 150% of test pressure, whichever is greater.

4. Secured in place in a manner to facilitate removal when required to connect pipe.

3.07 SEWER SERVICE CONNECTIONS

A. Install one sewer service connection, at locations indicated on the drawings, for future connection of building lateral to main sewer. Sewer service connections shall be provided for every lot and every structure and shall be centered in the lot frontage where feasible.

B. Sewer Service connections installed coincidentally with the main shall be gasketed “tees” or “wyes”.

C. Sewer Service connections installed sub-sequentially to the main shall be accomplished by saddle type fittings. The fitting shall be supported by flowable fill. The flowable fill shall completely encase the service fitting and main and extend to a minimum of one foot above the point of connection to the main. Granular pipe embedment shall be used for an additional one-foot lift.

D. Install lateral to right-of-way, permanent easement or property line, reference details in the Standard Drawing Details. No split services, (except R3 zoning), or 90° turns are permitted. Service connections on the mains shall have a minimum of five (5) feet of separation and shall be located a minimum of five (5) feet from the exterior wall of a manhole.

E. No clean outs shall be located within public right-of-way.

F. Provide a schedule 40 PVC cap at end of lateral line in accordance with details in Standard Drawing Details.

3.08 WATER SERVICE LINE

A. Tapping saddles and valves shall be used where required to connect to existing in-service water mains. Connections to existing water mains shall be made in such a manner as to provide the least amount of interruption to water service. In the event closing of valves to make a connection will affect a customer who cannot be without service, provision shall be made for a temporary service at the expense of the developer/applicant.

B. A minimum 1-inch diameter for single setters, SDR-9 PE 3408, ASTM-D2737, CTS-OD, 200 PSI roll tubing water service line shall be installed from the main line to the meter setter, for each service connection. All service lines shall be bedded in conformance with Section 02222-3.02.

C. Connect water service line to main line with brass saddle.

D. Connect water line to saddle with corporation stop valve.

E. Install meter box, lid and meter setter in accordance with details in the Standard Drawing Details.

F. For both existing and new systems, each service connection shall be individually metered. Single family units, each unit of a townhome, duplex, triplex and four-plex shall normally be provided with separate water meters for each living unit unless otherwise approved by the City. Multi-family apartment units shall be provided with one water meter for the entire facility. A separate commercial water meter shall be provided for each separate commercial unit unless otherwise approved by the City. Irrigation systems may be provided with separate water meters.

3.09 CONNECTIONS TO EXISTING STRUCTURES

A. Connect pipe to existing structures and pipelines where indicated.

B. Prepare structure by making an opening with at least 3 inches clearance all around fitting to be inserted or as indicated.

C. Observe pertinent articles of Specifications pertaining to joint locations and closures.

D. Repair wall opening with concrete or as indicated.

E. Connections of new sanitary sewer pipe to existing manholes shall be made with a field cast A-Lok flexible connection.

3.10 TRACER WIRE

A. A tracer wire shall be provided for all water mains and water and sewer services. The tracer wire shall be attached to the top of the pipe with duct tape every 4 feet. Tracer wire shall be installed in a manner that allows access for connection of the line tracing equipment, proper locating of wire without loss or deterioration of low frequency, (512Hz), signal for distances in excess of 500 linear feet and without distortion of signal caused by multiple wires being installed in close proximity to one another. The tracer wire shall be installed as a single continuous wire, except where using approved connectors. The tracer wire shall be extended to the surface at a maximum spacing of 500 feet. Access boxes for tracer wire access points shall be provided. Such an access box shall not be located within any driving or parking surface. Tracer wire shall be installed for all water service lines to the meter box and shall be connected to the water main's tracer wire. The tracer wire for the sewer service line shall be connected to an anode at the sewer main and extended to a capped clean out. Proper connectors shall be used at all connections. Provide proper grounding at dead ends and at spacing not to exceed 500'. The grounding anode shall be buried at the same depth as the tracer wire. See details in Standard Drawing Details.

B. Where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified and be completely waterproof to prohibit corrosion and loss of conductivity.

C. Any damage occurring during installation of the tracer wire must be immediately repaired in an approved waterproof method. Taping and/or spray coating shall not be allowed.

D. The following products and methods shall not be allowed or acceptable:

1. Uninsulated tracer wire.
2. Tracer wire insulations other than HDPE.
3. Twist-on wire connectors.
4. Brass or copper ground rods.
5. Wire connections utilizing taping or spray-on waterproofing.
6. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another.
7. Brass fittings with tracer wire connection lugs.
8. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes and etc.

9. Connecting tracer wire to existing conductive utilities.

3.12 CONCRETE ANCHOR AND THRUST BLOCKS

A. Install at tees, elbows, bends, and dead ends where indicated. See details in Standard Drawing Details

B. Place against undisturbed earth or rock and install so that all joints are accessible for repair.

C. Of design indicated or specified.

1. Removable thrust blocks shall be constructed by utilizing a sheet of ¼-inch plywood to prevent concrete adherence to pipe, fittings or accessories.

2. Apply two coats of coal tar coating to minimum 20 mils dry film thickness on anchor bars, straps and hardware.

3.13 SEPARATION OF WATER MAINS WITH SANITARY SEWERS

A. Horizontal Separation:

1. All sanitary sewers, storm sewers, or manholes shall be laid at least 10 feet, horizontally, from a water main. The distance shall be measured from edge to edge of pipes. In cases where it is not practical to maintain a ten-foot separation, deviation may be allowed on a case-by-case basis, if supported by data from the design engineer. Such a deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer. Where it is impossible to obtain separation as described, the sewer shall be constructed of slip-on or mechanical joint pipe or continuously encased and be pressure tested to 150 psi. to ensure water-tightness. A request for variance shall be submitted to the DNR Public Drinking Water Branch and the City for approval. This request shall include proposed alternate installation configuration.

B. Vertical Separation:

1. Water mains crossing sanitary sewers, house sewers, or storm sewers shall be constructed to provide a minimum clear distance of 18 inches between the outside of the water main and the outside of the sewer. This clearance is required whether the water main is above or below sewer pipes. At crossings, the full length of water pipe shall be located so that both joints will be as far from the sewer as possible but in no case less

than 10 feet. Special structural support for the upper pipe may be required. In areas where the proper separation cannot be maintained as stipulated above, either the water main or sewer line must be constructed of mechanical joint pipe or cased in a continuous casing.

C. Special Conditions:

1. No waterline shall be located closer than 25 feet to any on-site disposal facility, agricultural waste facility or landfill.

2. Waterlines which cross surface waterways shall meet the requirements of Section 8.7 of MoDNR "Design Guide for Community Water Systems". All appropriate construction parameters shall be included on the construction drawings.

3. Separation provisions between noncommunity water systems utilizing groundwater and wastewater facilities shall be in accordance with "Standards of Non-Community Public Water Supplies, 1982," as published by Missouri Department of Natural Resources.

3.14 FIELD TESTING

A. Acceptance Tests for Gravity Sanitary Sewer:

1. General:

a. All sewers shall be visually inspected, mandrelled and tested for infiltration and exfiltration.

b. Exfiltration testing shall be achieved by a low-pressure air leakage test.

c. The Contractor shall furnish all labor, equipment, tools and materials and shall perform all acceptance tests.

d. All tests shall be witnessed and recorded by City Personnel. All testing after backfilling will be conducted by the contractor. The contractor shall provide a minimum of a 48-hour notice to the City prior to testing.

2. Alignment:

a. Sewer shall be inspected (lamped) by flashing a light between manholes or by physical passage where space permits. Each section of sewer line between manholes shall be straight and uniformly graded.

b. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.

c. Determine from Lamping or Physical Inspection:

(1) Presence of any misaligned, displaced, or broken pipe.
(2) Presence of visible infiltration or other defects.

d. Correct defects as required prior to conducting leakage tests.

3. Leakage Tests: The leakage tests shall be performed on the full length of all sewer mains prior to acceptance.

a. Air leakage testing. The Contractor shall perform low pressure air testing of the sewer mains for exfiltration testing. Air testing shall comply with ASTM F1417.

(1) The general testing procedure shall be as follows: Raise pressure to 4.0 psi in sections being tested, throttle the air supply to maintain between 4.0 and 3.5 psi for at least 2 minutes in order to allow equilibrium between air temperature and pipe walls to be obtained. After temperature has stabilized, allow the pressure to decrease to 3.5 psi. At 3.5 psi begin timing to determine the time required for pressure to drop to 2.5 psi. If the time for the air pressure to decrease from 3.5to 2.5 psi is greater than that shown in the table below, the pipe shall be presumed free of defects.

Required Time for Length (min:sec)

Pipe Size (in.)	100 L.F.	200 L.F.	300 L.F.	400L.F.
8	7:34	7:34	7:36	10:08
10	9:26	9:26	11:52	16:49
12	11:20	11:24	17:05	22:47
15	14:10	17:48	26:42	35:36
18	17:00	25:38	38:27	51:16
21	19:50	34:54	62:21	69:48

If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. In areas where ground water is known to exist, increase the test pressure by 0.43 psi for each foot of depth that the ground water is above the top of the pipe.

b. Manhole Testing: The Contractor shall perform a vacuum exfiltration test on each manhole in accordance with ASTM C1244. Manholes shall be tested after completion of adjacent work to avoid disturbing the manhole. No manholes shall be raised after testing. Any manhole disturbed or raised shall be retesting. Vacuum testing equipment shall be as manufactured by Cherne Industries, P.A. Glazier, Inc. or approved equal. Vacuum testing shall be conducted following manhole construction, including connection to piping and setting of the lid and frame. No grout shall be placed in horizontal joints until manhole has passed the vacuum test. All lifting holes shall be grouted. Manholes which fail the test shall be reconstructed as required to adequately seal the manhole. Grouting of leak from the interior or exterior will not be acceptable. Plug all pipes entering manhole. Securely brace all plugs as required. Install testing lead in manhole frame and inflate seal in accordance with manufacturer's recommendation. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With all valves closed, measure the time required for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time is greater than 120 seconds for a 48-inch diameter manhole and 150 seconds for a 60-inch diameter manhole. If a manhole fails the test, perform necessary repairs and retest until an acceptable test meeting the above requirement is achieved.

c. Wet Well Testing: The Contractor shall perform an exfiltration test on the wet well by blocking off all wet well openings filling the wet well to the top with water and measuring the water required to maintain a constant level in the wet well. Maintain test as necessary to determine the leakage but not less than 2 hours. Repeat as necessary after repairs until leakage does not exceed 50 gallons per inch of wet well diameter per day per mile of wet well (0.0375 gallons per inch of wet well diameter per hour per 100 feet of wet well.) Wet well shall be considered as section of pipe of the diameter and height of the wet well.

4. Mandrel Testing:

a. Mandrel testing shall not be conducted prior to 30 days after backfilling is complete.

b. Each reach of PVC gravity sewer shall be checked for excessive deflection by pulling a mandrel through the pipe without a mechanical pulling device.

c. The mandrel shall be rigid and have nine, (9) or more odd number of flutes or points.

d. Mandrel diameter shall not be less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on which is specified in the

ASTM specification, including the appendix, to which the pipe is manufactured.

e. Pipe with diametral deflection exceeding 5 percent shall be uncovered and the bedding and backfill replaced to prevent excessive deflection.

f. Repaired pipe shall be retested after repair.

g. Contractor shall submit all deflection test results to the City/Engineer.

5. All tracer wire installations shall be located using typical low frequency, (512Hz), line tracing equipment witnessed by the City prior to acceptance. Continuity testing in lieu of actual line tracing shall not be accepted.

5. After final grading, the City's representative will verify proper final grade at all manhole rims.

B. Acceptance Tests for Pressure Pipelines:

1. Perform hydrostatic pressure and leakage tests.

a. Conform to AWWA C600 procedures.

(1) As modified herein.
(2) Shall apply to all pipe materials specified.

b. Perform after backfilling.

2. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.

a. Select test segments such that adjustable seated valves are isolated for individual checking.

b. Contractor shall furnish and install test plugs.

(1) Including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs. Bracing against structure walls isn't allowed.
(2) Be responsible for any damage to public or private property caused by failure of plugs.

3. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 1 fps.

4. Contractor shall make arrangements with the City for water required for testing. There will be charges for flushing, sampling and testing.

5. Pressure and Leakage Test:

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a. Test pressure: The pipeline shall be subjected to 150 percent of the working pressure at the point of the test, but not be less than 125 percent of normal working pressure at the highest elevation in the pipeline. Working pressure is defined as the maximum anticipated sustained operating pressure.

b. Be at least 2-hour duration or longer if necessary for the City to inspect the pipeline. Maintain pressure throughout test ±5 psi of test pressure.

c. Leakage test shall be conducted concurrently with the pressure test.

d. Acceptable when leakage does not exceed that determined by the following formula:

Q = 0.0075 DLN = maximum permissible leakage in gallons per Hour
L = length of pipe tested in thousand feet
D = nominal internal diameter of pipe being tested in inches
N = square root of the average test pressure in Psig

e. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.

f. When hydrants are in the test section, the test shall be made against the closed hydrant.

g. Repeat test as necessary.

(1) After location of leaks and repair or replacement of defective joints, pipe, fittings, valves or hydrants. All visible leaks are to be repaired regardless of the amount of leakage.
(2) Until satisfactory performance of test.

h. The City Representative shall witness pressure and leakage test. The contractor shall provide a minimum of a 48-hour notice to the City prior to testing.

END OF SECTION 02620

SECTION 02640 - VALVES, HYDRANTS AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes all valves and accessories.

B. Related Work Specified Elsewhere:

1. Pipe Installation and Testing: SECTION 02620.

C. See Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. American Water Works Association (AWWA):

a. C111-Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

b. C502 - Dry Barrel Fire Hydrants.

c. C515 - Resilient Seated Gate Valves for Water Supply Service.

d. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.

2. American National Standards Institute.

a. B16 Standards for Pipes and Fittings.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Include, but not limited to, the following:

1. Catalog data or illustrations showing principal dimensions, parts and materials.

2. Spare parts list referenced to illustration of parts.

3. Assembly and disassembly or repair instructions.

C. Certificates and Affidavits: Furnish prior to shipment. Include the following:

1. Test certificates.

2. Affidavit of compliance with applicable AWWA Standard.

1.04 QUALITY ASSURANCE

A. Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.

B. Protect valves from damage.

1.06 WRENCH NUTS

A. Wrench nuts shall be provided on all buried valves.

B. All wrench nuts shall comply with Section 3.16 of AWWA C500.

C. Contractor shall provide two operating keys (T-bars) for operation of the wrench nuts.

1.07 ROTATION

A. Direction of rotation of the wrench nut to open the valve shall be to the left (counterclockwise).

B. Each valve body shall have cast thereon the word “OPEN” and an arrow indicating the direction to open.

1.08 ENDS

A. All 3-inch or larger buried valves shall have mechanical joint ends unless otherwise specified.

B. All 2-1/2 inch or smaller valves shall have threaded ends.

C. Mechanical joints shall conform to AWWA C 111.

PART 2 - PRODUCTS

2.01 GATE VALVES

A. Acceptable Manufacturers:

1. Clow Corporation.
2. Mueller.
3. Kennedy.

B. All gate valves shall conform to AWWA C515.

C. All gate valves shall be resilient seated wedge type.

D. All gate valves shall be non-rising stem type with “O-ring seals.

E. All gate valves shall be mounted in the vertical position.

2.02 CHECK VALVES

A. Acceptable Manufacturers:

1. American Valve and Hydrant.
2. Dresser.
3. Mueller.

B. Check valves for sewage pump discharges 4-inch and larger shall be of the unobstructed waterway, quick closing, spring-loaded, external level arm, Horizontal swing type with iron body, flanged ends, and bronze trim.

C. Hinge pins shall be stainless steel with both ends extending through bronze-bushed bearings and outside stuffing boxes with grease lubricated packing or O-ring seals.

D. Flanges shall be flat-faced with ANSI B16.1, Class 125 diameter and drilling.

2.03 FIRE HYDRANTS

A. Acceptable Manufacturer/Model:

1. Mueller Centurion, Model A423.

2. Clow Medallion, Model F2545.

3. Kennedy Guardian, Model K-81D.

B. Fire hydrants shall conform to AWWA C502, Standard for dry-barrel fire hydrants.

C. Fire hydrant shall have a nominal 5-1/4-inch main valve with 6-inch mechanical joint inlet connection.

D. Outlet nozzles shall be National (American) fire hose coupling screw threads and be as follows:

1. Two - 2-1/2-inch hose nozzles.

2. One - 4-1/2-inch pumper nozzle.

E. Main valve shall be equipped with “O”-ring seals and shall open to the left (counterclockwise).

F. Fire hydrant shall be of the break-flange safety-top type.

2.04 VALVE BOXES

A. Acceptable Manufacturers:

1. Clay and Bailey Manufacturing Company.

2. Clow Corporation.

3. Dresser Industries, Inc.

4. Mueller Company.

5. Neenah Foundry Company.

6. Tyler Company.

B. Provide for all buried valves.

C. Design:

1. Boxes shall be cast-iron slide type with 5-1/4-inch shaft.

2. Provide extension stem to bring operating nut within 3 feet of valve box top.

3. Cover shall be marked “WATER”.

2.05 SHOP PAINTING

A. Prepare surfaces and paint or coat all valves, fire hydrants, valve boxes, corporation stops, and all related accessories standard of the manufacturer unless otherwise indicated or specified herein.

B. Paint and coatings shall be suitable for the service intended.

C. Submit type of paint or coating proposed with drawings and data prior to fabrication.

2.06 BACKFLOW PREVENTER

A. Acceptable Manufacturers

1. Watts Backflow Assembly or approved equal. Use only double check valve assemblies or reduced pressure principle assemblies included on the current Missouri Department of Natural Resources approved assemblies list. Backflow preventers and their installation shall conform to Missouri Department of Natural Resources Regulations 10 CSR 60-11.010.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with provisions of AWWA C600 and as specified.

B. Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.

C. Hydrants should be placed at or near each street intersection and at intermediate points when block lengths become long. Hydrants shall be provided within 50' of any lift station, but not within the fenced area. Under no circumstances shall the spacing of fire hydrants exceed five hundred (500) feet in residential areas nor three hundred (300) feet in commercial areas, (measured in street driving distance). Fire Hydrant installations shall conform to the Standard Drawing Details. As a rule, hydrants shall be oriented with the pumper outlet perpendicular to the curb which faces the street. Hydrants shall be protected if subject to mechanical damage. The means of protection shall be arranged in a manner that will not interfere with the connection to, or operation of, hydrants. In poor load-bearing soil, special construction such as support collars may be required. Thrust restraint shall be provided for throttling valve so that the hydrant may be removed without shutting down the supply main. Set fire hydrants with lowest nozzle 18 inches above finished grade and a minimum of 3' horizontal clearance beyond all nozzles. If at any time, the finish grade is adjusted or top soil/sod is added, then the fire hydrant height shall be readjusted to the new grade by the individual responsible for the change in grade. Check and fill stem bonnet lubricant reservoir.

D. Extension stems shall be provided for buried valves when the operating nut is more than three feet below finished grade. Each extension stem for a buried valve shall extend to within three feet of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

E. Gate valves shall be used in all water mains. Sufficient isolation valves shall be provided on water mains to allow a system to be adequately flushed and so that inconvenience and sanitary hazards to customers will be minimized during repairs. The weight of the valve shall not be carried by the pipe. Valves shall be provided with proper support, such as crushed stone, concrete pads or a well compacted trench bottom. Where new water mains connect to an existing main, a valve shall be installed on the new line. As a rule of thumb, no more than four valves should require closing to isolate a pipe. At a reducer, a valve shall be placed in the smaller pipe within 20 feet of the reducer. In municipalities, valves shall be located at not more than 300-foot intervals in commercial areas and at not more than one block or 500-foot intervals in residential or other areas. Valves and valve boxes shall be set plumb with finish grade. If at any time, the finish grade is adjusted or top soil is added, then the valve box shall be readjusted to the new grade by the individual responsible for the change in grade. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. A concrete collar is required around the top of the valve box.

F. Reinstalled Valves: Valves that are scheduled to be removed by the Contractor from existing work and reused as a part of the new work shall be reinstalled in accordance with the valve manufacturer's recommendations. New gaskets shall be provided between the existing valves and the new connecting pipe as required.

3.02 BACKFLOW PREVENTION DEVICES.

A. An approved backflow prevention device shall be installed on each service line to a consumer's water system serving premises where, in the judgment of the Public Works Director, actual or potential hazards to the public potable water system exist. Backflow prevention devices for domestic water services shall be located on the consumer's side of the water meter. Backflow prevention devices for fire lines shall be located in an appropriate vault as close to the water main as is reasonably practical. In certain cases, the domestic water service may be supplied from the fire line with the approval of the Public Works Director. The fire line would remain the responsibility of the property owner. The City's Code book, Section 705.115 shall be referenced for additional backflow prevention details.

B. The following requirements shall be met for water loading stations.

1. An appropriate backflow prevention arrangement shall be incorporated in the piping so there is no backflow to the public water supply. A filling device shall be used so the hose does not extend into the water vessel to prevent contaminants being transferred from a hauling vessel to others subsequently using the station. Hoses shall be short enough that they do not contact the ground or any constructed platform. Hanging brackets or rope and pulley hoist is acceptable.

3.03 FIELD TESTING

A. Perform on piping and valves as specified in SECTION 02620.

END OF SECTION 02640

SECTION 02675 – DISINFECTION OF PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. This section covers disinfection of potable water piping with a strong chlorine solution.

B. Disinfecting may be performed concurrently with pressure and leakage testing or after pressure and leakage testing at the Contractor's option.

C. All necessary disinfection equipment and materials shall be provided by the Contractor.

D. Related Work Specified Elsewhere:

1. Pipe Installation and Testing – Section 02620.

E. Disinfection work shall conform to the requirement of AWWA C651, Standard for Disinfecting Water Mains as modified herein.

F. In all cases where it is necessary to interrupt service for testing purposes, permission by the City shall by obtained at least 48 hours before the service will be interrupted. The Contractor shall notify the City a minimum of 48 hours to allow City representatives to be present during cleaning and/or disinfection of the water line.

1.02 REFERENCES

A. Applicable Standards

1. American Water Works Association

a. B300-Hypochlorites.

b. B301-Liquid Chlorine.

c. C651 – Disinfecting Water Mains.

d. M12-Simplified Procedures for Water Examination.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Includes, but not limited to the following:

1. Product data: Manufacturer's technical data, specification, safety precautions for chlorine products.

2. Results of bacteriological testing on each section of pipe.

C. Disinfection Plan: Two weeks prior to starting any disinfection work, the Contractor shall submit to the City a detailed disinfection plan. The plan shall cover the method and procedure proposed, necessary coordination, equipment to be used, manner of filling and flushing the lines, chlorine injection points, sample points, testing schedule, potable water source, neutralization, and disposal of wasted water. Personnel performing the disinfection shall demonstrate a minimum of 5 years of experience in the chlorination and dechlorination of similar pipelines.

PART 2 - PRODUCTS

2.01 CHLORINE

A. Calcium Hypochlorite - 70 percent available chlorine.

B. Liquid chlorine - 99.5 percent available chlorine.

PART 3 - EXECUTION

3.01 FLUSHING

A. All water mains shall be thoroughly flushed prior to disinfection at a velocity of not less than 3.0 feet per second. Booster pumps shall be used if required to obtain the necessary volume or velocity of water.

B. Contractor shall verify that discharge points have adequate drainage to prevent flooding of surrounding area. Location of discharge point shall be approved by the City.

C. Flushing shall continue until discharge stream is visibly clean (clear) or three pipe volumes have been replaced, whichever is greater.

D. The City will charge for the cost of water used for flushing, as well as costs for sampling and testing accomplished by the City.

3.02 FEEDING

A. Chlorine gas shall be used only as a solution. Introduction of chlorine gas into pipeline directly will not be permitted. Proper feeding operation shall utilize a chlorinator and booster pump with injector.

B. Calcium hypochlorite shall be made into a solution and pumped into the pipeline with a suitable chemical feed pump.

3.03 APPLICATION

A. Pipeline shall be disinfected by the continuous feed method.

B. Required chlorine to produce 50 milligrams per liter concentration in 100 feet of pipes – by diameter shall be as follows:

Pipe Size (In.)	100 Percent Chlorine (lb.)	1 Percent Chlorine Solution (gal.)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

C. Water from the existing distribution system shall be introduced at a constant measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine which is fed at a constant measured rate.

1. The chlorine feed shall be proportioned to the rate of water flow into the pipeline so that the entering water contains at least 50 mg/l of available chlorine. Chlorine application shall be continuous until the entire pipeline is filled with the chlorine solution.

2. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the latest edition of Standard Methods for the Examination of Water and Wastewater or AWWA Manual M12 or using appropriate chlorine test kits.

3. Amount of chlorine required for each 100 feet of pipe of various diameters is indicated in paragraph 3.03 (B) above. Solutions of 1 percent chlorine shall be prepared with calcium hypochlorite by mixing one pound of calcium hypochlorite with 8 gallons of water.

4. During the application of chlorine, valves shall be positioned to prevent chlorine solution from flowing back into the line supplying the water. The chlorinated water shall be retained in the pipeline for at least 24 hours during which time all valves and hydrants

in the section treated shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period, the treated water in all portions of the pipeline shall have a residual of not less than 25 mg/l free chlorine.

D. Existing mains which could have been contaminated during work requiring connections to the new waterline, involving either tapping or cutting into operations, shall be flushed and disinfected in accordance with Section 10 of AWWA C651.

3.04 FINAL FLUSHING

A. After the applicable retention period, heavily chlorinated water shall be flushed from the pipeline until chlorine residual is no higher than that generally prevailing in the system.

B. Apply a chlorine reducing agent to the water to be wasted to neutralize the chlorine residual.

C. All chlorinated wastewater to be discharged shall be neutralized by chemical treatment and disposed of in accordance with AWWA C651. Schedule and coordinate rates of flow and locations of discharge of disinfection and flushing water with the City. Contact shall be made with State and local regulatory agencies to ensure compliance with all applicable rules and regulations.

3.05 BACTERIOLOGICAL TEST

A. After final flushing and before the water main is placed in service, samples shall be collected from the main, shall be tested for bacteriological quality in accordance with the Standard Methods for the Examination of Water and Wastewater and shall show the absence of coli form organisms.

1. At least two (2) samples shall be taken from each sample point with 24 hours separation between sets of samples. Both sets of samples shall show the absence of coli form organisms.

2. Samples points shall be as follows:

a. At 1200 foot intervals along the water main.

b. At the end of the water main.

c. At the end of each branch water main.

B. No hose or fire hydrant shall be used in collection of samples. A suggested combination blow off and sampling tap consists of a standard corporation cock installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

3.06 RE-DISINFECTION (REPETITION)

A. If the initial disinfection fails to produce two successive satisfactory bacteriological samples, the water main shall be re-chlorinated by the continuous-feed method of chlorination until two successive satisfactory results of the bacteriological testing are obtained.

END OF SECTION 02675

SECTION 02720 – STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes storm drainage pipe and appurtenances.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.

2. Trenching and Backfilling for Utilities: SECTION 02222.

3. Curbs, Gutters, Sidewalks, Driveway approaches and Paved Drainage: SECTION 02525.

4. Concrete: SECTION 03300.

1.02 REFERENCES

A. Applicable Standards.

1. American Society for Testing and Materials (ASTM):

a. C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

b. C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

c. C478 – Circular Precast Reinforced Concrete Manhole Sections.

d. C506- Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.

e. C507-Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.

f. D2321-Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

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

3.04 M294 – Corrugated Polyethylene Pipe 12 to 60” Diameter.

3.05 M252 – Corrugated Polyethylene Pipe 4 to 12” Diameter.

3.06 M274 – Steel Sheet, Aluminum-Coated for Corrugated Steel Pipe

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Includes, but not limited to, the following:

1. Pre-cast structures.

2. Cast-in-place structures.

3. Reinforced concrete pipe (certification only).

4. Corrugated (metal or polyethylene) pipe (certification only).

5. Joints and fittings (certification only).

PART 2 - PRODUCTS

2.01 GENERAL

A. See Details in the Standard Drawing Details.

B. The minimum allowable pipe size for storm sewers is dependent upon a diameter practical from a maintenance standpoint. For storm sewers in public right-of-way or public drainage easement less than fifty feet (50') in length, the minimum allowable diameter is fifteen (15) inches. All pipe over fifty feet (50') in length shall have a minimum diameter of eighteen (18) inches. The maximum allowable diameter is six feet (6') unless otherwise approved.

2.02 REINFORCED CONCRETE

A. Conform to applicable requirements of SECTION 03300.

B. Concrete shall be 4,000 psi concrete.

2.03 CORRUGATED METAL PIPE

A. Pipe, both arch and round, flared end sections and coupling bands shall conform to AASHTO M274 and shall be aluminum-coated.

B. Coupling bands shall be of the same base metal as the pipe.

C. Flared end sections shall be provided with toe plates.

2.04 REINFORCED CONCRETE PIPE

A. Design of circular pipe to conform to ASTM C76, Class III except as modified herein.

B. Concrete arch culvert and elliptical culvert shall conform to C506 and C507.

C. Furnish in lengths of not less than 4'-6", except fittings, closure pieces, and specials.

D. Joints shall be rubber and concrete to conform to ASTM C443. Rubber gaskets shall be O-ring cross section.

E. Select an independent testing laboratory acceptable to City to perform testing and inspection of all material except reinforcing steel.

F. Storm sewers shall be designed for H-20 loadings.

2.05 CORRUGATED POLYETHYLENE PIPE

A. Pipe and fittings shall conform to AASHTO M294 and M252 and shall have a circular cross section.

B. End sections shall be polyethylene flared type with toe plates unless otherwise indicated.

C. Joints shall be provided with neoprene or manufacturer's standard gaskets.

PART 3 - EXECUTION

3.01 TRENCHING AND BACKFILLING

A. Perform trenching and backfilling of trenches as specified in SECTION 02222.

3.02 PIPE LOCATION

A. All storm sewer having trench walls within 2 feet of the back of curb shall be backfilled with compacted granular materials.

B. The permitted locations for storm sewer within a street right-of-way are behind the curb. The outside edge of the pipe shall be located a minimum of 6" behind the back edge of curb. Except for crossings, storm sewers shall not be located under streets.

C. Storm sewers located on private property shall be located within drainage easements and shall be aligned parallel with property lines unless otherwise approved. Where storm drains exit the street right-of-way between residential lots, the pipe shall be extended a minimum of forty feet (40') past the front yard setback line, or to the estimated location of the rear of the dwellings, whichever is more. The outside edge of the pipe shall be located a minimum of five feet (5') from the easement line.

D. Reinforced concrete pipe shall be used under paved areas or where trench wall is within two (2) feet of back of curb.

E. Corrugated polyethylene or corrugated metal pipe is permitted in locations outside of right-of-ways or where trench wall is more than two (2) feet from back of curb.

3.03 PIPE INSTALLATION

A. All pipes shall be carefully laid true to lines and grades indicated. The Contractor shall be responsible for establishing the horizontal and vertical alignment of all storm sewers. The contractor shall provide and maintain in good working order, on the site, at all times, a laser beam or other appropriate equipment to ensure proper alignment. Pipe laid in the trench shall not be covered until approved by the Public Works Director or his representative. Storm pipe alignment between manholes shall be straight except when approved by the Public Works Director. Curved alignments are not allowed. Storm sewer crossings shall be perpendicular to the street. Any pipe which is not in true alignment or which shows undue settlement after laying shall be removed and re-laid at the Contractor's expense.

B. The recommended minimum slope for storm drain piping is 0.5% (five-tenths percent). Maximum recommended grade is 10% (ten percent). Proper anchorage may be required for grades above 10% (ten percent) and will be required for grades above 20% (twenty percent).

C. Culverts shall be positioned to match both the vertical and horizontal alignment of the existing watercourse to the greatest degree practical.

D. When changing pipe diameters, the inside tops of the pipes shall be set at the same elevation. Pipe size shall never be reduced downstream even though pipe slope and theoretical capacity may increase. A minimum vertical drop of 0.2' (two-tenths feet) shall always be provided across a junction structure, unless otherwise approved.

E. Siphons or inverted siphons are not allowed in the storm sewer system.

F. Under or within two feet (2') of streets or paved areas, the top of the pipe shall be located a minimum of twelve inches (12") below the pavement or curb subgrade, or greater if required to meet minimum cover and strength requirements for the type of pipe specified to withstand an AASHTO HS-20 loading. Outside of paved areas, the top of the pipe shall be located a minimum of twelve inches (12") below finished earth grade. Box culverts or other relatively wide and flat conveyance structures may be required to have additional cover if deemed necessary to support grass or other vegetative cover.

G. Corrugated Metal Pipe:

1. Install to conform to manufacturer's recommendations. All corrugated metal pipe shall be installed using Class B embedment as defined in section 02222.

2. Lift or roll pipe to protect coating. Do not drag over gravel or rock. Avoid striking rocks or hard objects when lowering into trench. Pipe on which coatings have been damaged shall be rejected at the site of the work regardless of previous approvals.

3. Join pipe sections with firmly bolted coupling bands of the same materials as the pipe.

H. Reinforced Concrete Pipe:

1. Install to conform to manufacturer's recommendations and as follows:

2. Concrete Stormwater Piping shall be installed using Class B embedment as defined in Section 02222.

3. Each length of pipe shall be laid on an even, firm bed, so that no uneven strain will exist to prevent the pipe from bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each joint as specified. Pipe laying shall commence at the low point of the project and progress upgrade, unless otherwise expressly permitted by the City/Engineer. The bell-end of the pipe shall be laid upgrade. The end of each joint of pipe shall be truly centered and fully positioned into the abutting pipe.

4. Pipe jointing material shall be Ram-nek or equal.

5. Clean joints thoroughly, and coat bell-and-spigot and gasket with recommended lubricant before jointing.

6. Check that rubber gasket is properly positioned prior to shoving pipe home.

7. Fill exterior pipe joint with a 1:2 cement mortar of pouring consistency and cover with a waterproof paper or cloth diaper wired in position. Rod mortar with a stiff wire curved to the radius of the pipe.

8. Fill interior of joint with stiff mix of 1:1 cement mortar troweled into place to provide a continuous smooth surface across joint (pipe 24 inches in diameter and larger).

I. Corrugated Polyethylene Pipe:

1. Installation to conform to ASTM D2321 with Class B embedment as defined in Section 02222.

2. Clean joints thoroughly, and coat bell, spigot and gasket with recommended lubricant before jointing.

3.04 STORM DRAINAGE STRUCTURES

A. Bends and Junctions:

1. A manhole or junction structure must be provided at each change in direction or grade of the piping, except that bends may be located at junction structures in order to provide a perpendicular connection. Bends must be provided at junction structures if the angle of entry is less than sixty (60) degrees. Pipes shall be aligned such that the direction of flow of any incoming pipe is not less than perpendicular to the direction of flow of the outflow pipe (i.e. flow "against the grain" shall be avoided).

2. Access manholes or junction structures shall not be located within the pavement area of public streets. Access manholes or junction structures shall be located such that the outside edge is twelve inches (12") minimum behind the curb or from the edge of a retaining wall or other obstruction. Access manholes shall be provided at a maximum of five hundred feet (500') spacing along the pipe.

3. Precast circular manholes, square cast-in-place or precast junction boxes, or inlets may be used for junction structures.

B. Curb Inlet Boxes

1. Standard curb opening inlets as shown on details in the Standard Drawing Details shall be used for public streets with curb and gutter. In general, the use of grated inlets in streets, which require adjustment when streets are repaved, will not be permitted. Curb inlet boxes shall be placed to match the slope of the street centerline and adjacent curb line.

C. Storm Sewer Outlets

1. All storm sewer outlets into open channels shall be constructed with a headwall and wingwalls or a flared-end-section. Flared end sections and headwalls shall have a toewall extending a minimum of eighteen inches (18”) below grade at their downstream end to prevent undercutting. Approved energy dissipation material shall be provided at all outlets as required.

D. Others

1. All other storm drainage structures shall be installed as per construction drawings.

E. Reinforced Portland cement Concrete:

1. All reinforced Portland cement concrete storm drainage structures shall have a paved invert and a smooth grade from pipe invert to pipe invert in structures having more than one pipe.

2. Cast-In-Place: Conform to all applicable requirements of Section 03300.

3. Precast: Structures shall be of precast construction where indicated or as approved by Engineer and The City. Precast structures shall have cast-in-place reinforced concrete base conforming to Section 03300.

END OF SECTION 02720

SECTION 02831 - CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes chain-link fabric fence, gates, and related components.

B. Related Work Specified Elsewhere:

1. Concrete: SECTION 03300.

C. See Details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A121 – Metallic-Coated Carbon Steel Barbed Wire.

b. A123 -Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.

c. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

d. A392 - Zinc-Coated Steel Chain-Link Fence Fabric.

e A1011 – Steel, Sheet and Strip, Hot-rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

f. F1083 - Pipe, Steel, Hot Dipped, and Zinc-Coated (Galvanized) Welded, for Fence Structures.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Includes, but not limited to, the following:

1. Product data: Manufacturer’s technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.

2. Shop Drawings: Showing layout, location of fence, gates, posts, and including details illustrating fence height, sizes of posts, rails, braces, gates, hardware list, and accessories.

3. Mill certification that materials meet specifications of member size, strength, wall thickness, and coatings.

1.04 QUALITY ASSURANCE

A. Provide chain-link fences and gates as complete units, including necessary erection accessories, fittings, and fastenings, from a single source or manufacturer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

1. Galvanized Steel Fencing and Fabric:

a. Allied Tube and Conduit Corp.

b. Anchor Fence, Inc.

c. Cyclone Fence, USK Corp.

d. Or Approved equal.

2.02 GENERAL

A. Fence height and gate width(s) shall be as indicated.

B. Dimensions indicated for pipe, roll-formed, and H-sections are outside dimensions, exclusive of coatings.

2.03 FABRIC

A. Steel Fabric:

1. No. 9 gauge, 2-inch diamond-mesh steel, chain-link fabric. Furnish 1-piece fabric widths for fencing up to 12’-0” high.

2. Galvanized: Conform to ASTM A392 with zinc coating, Class 2, 2.0 ounces minimum per square foot of wire surface.

3. Top and bottom selvage knuckled for fabric 5’-0” and under.

2.04 FRAMING AND ACCESSORIES

A. Steel Framework:

1. General: Galvanized steel, ASTM F1083 or ASTM A123, with not less than 1.8-ounce zinc per square foot of surface, or steel conforming to ASTM A569 externally triple coated with hot-dip galvanizing at 1.0 ounce/square foot, chromatic conversion coating and clear acrylic polyurethane and coated internally with zinc-rich coating.

2. Fittings and Accessories: Galvanized, ASTM A153, with zinc weights per Table I.

2.05 STEEL POSTS, TOP RAIL AND BRACES

A. Minimum size and weight of steel components shall be as follows:

1. Posts for Fabric Height Over 6 Feet:

a. End, Angle, Corner, or Pull Posts: 2.875 inches OD at 5.79 pounds per foot.

b. Line Posts - 6-Foot to 8-Foot Fabric Height: 2.375 inches OD at 3.65 pounds per foot.

c. Line Posts - Over 8-Foot Fabric Height: 2.875 inches OD pipe at 5.79 pounds per foot.

In lieu of pipe specified above, steel pipe conforming to ASTM A1011 of greater strength but less wall thickness, will be acceptable.

2. Posts for Fabric Height 6 Feet or Less:

a. End, Angle, Corner, or Pull Posts: 2.375 inches OD at 3.65 pounds per foot.

b. Line Posts: 1.90 inches OD at 2.70 pounds per foot.

c. In lieu of pipe specified above, steel pipe conforming to ASTM A1011 of greater strength but less wall thickness, will be acceptable.

3. Gate Posts:

   a. Furnish posts for supporting single-gate leaf, or one leaf of a double-gate installation, for nominal gate widths as follows:

Leaf width	Gate Post	lbs/lf.
Up to 6’	3.5” x 3.5” roll-formed	4.85
	Section or 2.l875” OD pipe	5.79
Over 6’ to 13’	4.000” OD pipe	9.11

4. Top Rail:

   a. 1.660 inches OD at 2.27 pounds per foot.

   b. 18-foot minimum length of each section.

   c. Expansion-type couplings for each joint, approximately 6 inches long.

5. Post Bracing:

   a. Diagonal adjustable rods 3/8 inch in diameter equipped with adjustable tightener.

   b. Horizontal Braces: 1.660 inches OD at 2.27 pounds per foot.

6. Post Tops:

   a. Designed as a weather tight closure cap for tubular posts.

   b. Furnish caps with openings to permit passage of top rail.

   c. Malleable iron or pressed steel.

7. Stretcher Bars:

   a. One piece, full height of fabric.

   b. 3/16-inch x ¾-inch, galvanized.

   c. Bands of galvanized steel or malleable iron.

8. Barbed Wire:

    a. Galvanized, ASTM A121, Class 2 or Aluminum coated.

    b. Two 12-1/2 gauge steel wire with 4 point barbs.

    c. Three strands of barbed wire located above top rail.

9. Bottom Tension Wire:

    a. Galvanized or aluminum coated coil spring wire, 7 gauge.

2.06 GATES

A. Manual-Swing:

1. Framing:

    a. Fabricate perimeter frames of gates from metal and finish to match fence framework.

    b. Provide intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware, and accessories. Space so that frame members are not more than 8 feet apart unless otherwise indicated.

    c. Frames assembled by welding or watertight galvanized steel rigid fittings.

    d. Provide with same fabric as for fence. Install fabric with stretcher bars at vertical and top and bottom edges.

    e. Diagonal cross bracing of 3/8-inch-diameter adjustable truss rods to ensure frame rigidity without sag or twist.

    f. Where barbed wire is indicated or specified, extend gate end members 1 foot above top members to receive barbed wire.

2. Hardware:

    a. Hinges of pressed or forged steel, or malleable iron, nonlift-off type, offset to permit 180° gate opening, 1-1/2 pair per leaf.

b. Latches and Gate Stops: Double-leaf.

(1) Plunger-bar type latch, full gate height, designed to engage gate stop of flush-plate type, with anchors.
(2) Locking device and padlock eyes an integral part of latch.
(3) Keeper to automatically engage gate leaf and secure free end of gate in open position.

c. Latches: Single-leaf.

(1) Forked type to permit operation from either side of gate.
(2) Padlock eye as integral part of latch.

3. Coating: Galvanize conforming to A153.

B. Sliding Cantilevered:

1. Cantilevered gates may be either exposed rollers type or trolleys within a built-in channel type. Exposed rollers shall be provided with roller guards.

2. Framing:

a. Inverted channel track, roller ball-bearing truck assemblies, guides, stays, bracing, hardware, and accessories as required.

b. Intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware, and accessories. Space so that frame members are not more than 8 feet apart unless otherwise indicated.

c. Frames assembled by welding or watertight galvanized steel rigid fittings.

d. Diagonal cross bracing of 3/8-inch-diameter adjustable truss rods to provide frame rigidity.

e. Where barbed wire is indicated or specified, extend gate end members 1 foot above top members to receive barbed wire.

2.07 CONCRETE As specified in Section 03300.

PART 3 - EXECUTION

3.01 PREPARATION

A. Grading: Perform final grading prior to installation of fence.

3.02 INSTALLATION

A. Fence:

1. Follow general contour of ground and properly alignment. Install as indicated.

2. Posts:

a. Set in concrete bases 3 feet below finish grade. Trowel-finish tops of footings and dome to direct water away from posts.

b. Temporarily brace until concrete in bases has set.

c. Install plumb and in straight alignment.

d. Space 10 feet center-to-center maximum.

e. Install pull posts every 300 feet if no corner posts are encountered in that distance.

f. Install corner posts at changes in direction of 30° or more.

g. Install pull posts at changes in direction of 10° to 30°.

h. Install pull posts at all abrupt changes in grade.

3. Post Bracing:

a. Install at each end, pull and gate post, and each side of each corner post.

b. Install after concrete in post bases has set.

c. Install so posts are plumb when diagonal rod is under tension.

4. Top Rails:

    a. Run continuously through post caps or barbed wire supporting arms. (Bend to radius for curved runs.)

    b. Install expansion couplings at each joint.

5. Fabric:

    a. Run continuously through post caps or barbed wire supporting arms. (Bend to radius for curved runs.)

    b. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.

    c. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.

    d. Fasten fabric to steel posts with wire ties spaced 12 inches OC maximum.

    e. Fasten fabric to top rail with wire ties spaced at 24 inches OC maximum.

6. Stretcher Bars:

    a. Thread through or clamp to fabric 4 inches oc.

    b. Secure to posts with metal bands spaced 15 inches oc maximum.

    c. Install at each gate, pull and end post, and each side of corner post.

7. Post Tops: Install on each post.

8. Barbed Wire: Mount strands on 45-degree extension arms.

9. Bottom Tension Wire:

    a. Install approximately 6 inches above grade.

    b. Attach wire to each post and securely anchor to terminal gate posts.

B. Manual-Swing and Cantilevered Sliding Gates:

1. Install plumb and level.

2. Install all hardware, tracks, framing, supports, and appurtenances as required for gate type.

3. Install keepers, ground-set items, and flush plate in concrete for anchorage.

4. Adjust and lubricate as necessary for smooth operation.

C. Repairing Damaged Coatings:

1. Repair any damaged coatings in the shop or field by recoating with compatible and similar coating.

2. Apply per manufacturer's recommendations.

E. Grounding:

1. Grounding of fencing shall be in accordance with the fencing details in the Standard Drawings.

2. A grounding ring (loop) shall be installed around all water supply well houses, water storage tanks, booster pumping stations, wastewater pumping stations and wastewater treatment facilities.

END OF SECTION 02831

SECTION 02930 – SEEDING AND SODDING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following areas of Work:

1. Preparation of areas for seeding and sodding.

2. Seeding.

3. Sodding.

4. Mulching.

5. Fertilizing seed and sod areas.

6. Maintenance.

B. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: SECTION 02200.

1.02 SUBMITTALS

A. Certificates:

1. Seed and fertilizer shall be accompanied by certificate from vendors certifying they meet requirements of these Specifications, stating botanical name, percentage by weight, percentage of purity, germination, and weed seed for each grass seed species.

PART 2 - PRODUCTS

2.01 TOPSOIL Specified in SECTION 02200.

2.02 GRASS SEED

A. Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America and as required below.

B. Be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested:

1. Seed Mixture:

    a. Meet the following minimum percentage requirements for purity and mix ratio:

Common and Botanical Name	Minimum Pure Live Seed (%)	Rate of Pure Live Seed (Pounds per Acre)
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior, variation Arundinces)	75	100
Rye Grass (Lolium Perenne or L. Multiflorum)	80	25
Kentucky Blue Grass (Pac Pratensis)	75	15
Creeping Red Fescue (Festura Ruera)	85	10
Total		150 pounds

2. Moldy seed or seed that has been damaged in storage shall not be used.

2.03 SOD

A. Machine cut, strongly rooted, certified turf-grass sod, at least 2 years old, and be relatively free of weeds or other undesirable native grasses. Provide sod capable of vigorous growth and development when planted (viable, not dormant).

B. Be composed principally of the following:

1. Kentucky bluegrass.

C. Moisten sod to depth at which it is to be cut when stripped during dry periods.

D. Provide sod in uniform thickness of 5/8-inch, plus or minus ¼-inch, measured at time of cutting and excluding top growth and thatch. Strips shall be of supplier's standard size of uniform length and width with maximum 5% allowable deviation in either length or width. Broken or torn pads or pads with uneven ends are not acceptable.

E. Sod pads shall be capable of supporting their own weight and retaining size and shape when pad is suspended vertically from a firm grasp on upper 10% of pad.

F. Handle sod with care to prevent loss of native soil from roots.

2.04 LIMING MATERIAL

A. Shall consist of agricultural liming materials conforming to the Missouri Agricultural Liming Materials Act of 1976.

B. Material used for soil neutralization, unless otherwise specified, shall be agricultural lime with not less than 90% passing the No. 8 sieve and containing not less than 65% calcium carbonate equivalent.

C. Manufacturer's certification shall include the minimum pounds of ENM (effective neutralizing material) per ton of the material to be supplied.

2.05 FERTILIZER

A. Commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 4% phosphoric acid, 2% potassium, and percentage of nitrogen required to provide not less than 1.0 lb. of actual nitrogen per 1,000 square feet of lawn area. Provide nitrogen in form that will be available to the lawn during initial period of growth.

B. Deliver to site in labeled bags or containers.

2.06 MULCH

A. Vegetative Anti-Erosion Mulch: Seed-free salt hay or threshed straw of wheat, rye, oats, barley, or other approved materials.

B. Wood Cellulose Fiber:

1. Not contain germination or growth-inhibiting ingredients.

2. Dyed an appropriate color to aid in visual inspection.

3. Be easily and evenly dispersed when agitated in water.

4. Supply in packages of not more than 100-pound gross weight, and be marked by the manufacturer to show the air dry weight content.

2.07 JUTE NETTING

A. Uniform, open, plain weave mesh of smolder-resistant, unbleached single-jute yarn:

1. Yarn of loosely twisted construction and not vary in thickness by more than one-half its normal diameter.

B. Furnish in rolled strips and as follows:

1. Minimum width of 42 inches.

2. 5.5 wrap yarns by 3.5 filling yarns per inch.

C. Staples of No. 11 gauge or heavier steel wire, U-shaped and not less than 6 inches in length.

PART 3 – EXECUTION

3.01 SOIL PREPARATION

A. Dispose of any growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.

B. Thoroughly loosen and pulverize topsoil to a depth of at least 4 inches.

C. Grade planting areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas which can be planted within immediate future.

D. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting. Do not create a muddy soil condition.

E. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

F. Spread planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement.

G. Allow for sod thickness in areas to be sodded.

3.02 LIMING AND FERTILIZING

A. Lime and fertilizer shall be applied separately, but may be incorporated into the soil in one operation.

B. Lime and fertilizer shall be applied not more than 48 hours before the seeding or sodding unless otherwise authorized by the City.

C. Contractor shall take a minimum of three samples of the topsoil stockpile and through the services of an independent laboratory have test run to ascertain the rates of application of soil amendments required to provide at least the quantity of effective neutralizing material and fertilizers to nourish new growth.

D. Apply lime and fertilizer at the rates recommended by soil analysis in pounds per acre to prepared seedbeds and sod beds.

E. Incorporate fertilizer into the soil to a depth of at least 3 inches by disking, harrowing, or raking, except where applied hydraulically on slopes steeper than 2 horizontal to 1 vertical.

3.03 SEEDING

A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

B. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.

C. Sow not less than rate of 100 pounds per acre.

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

E. Seasonal Limitations:

1. Perform seeding only during the following seasons:

    a. March 1 to June 15.

    b. September 1 to October 30.

F. Methods of Application:

1. Dry Seeding: Spreader or seeding machine.

2. Hydro seeding: Mix seed, fertilizer and pulverized mulch with water and constantly agitate. Do not add seed to water more than 4 hours before application:

a. On slopes of 3 horizontal to 1 vertical or flatter, apply seed separately from fertilizer. Cover seed with soil to an average depth of ½ inch by raking or other approved methods.

b. On slopes steeper than 3 horizontal to 1 vertical, a Type 3 Mulch, meeting the content and application requirements specified in Section 802 of the Missouri Standard Specifications for Highway Construction is required.

3.04 MULCHING

A. Apply mulch covering to all seeded areas.

B. Apply vegetative mulch to loose depth of 1-1/2 inches by means of a mechanical spreader or other approved methods.

C. Apply wood-cellulose fiber mulch hydraulically at the rate of 1,000 pounds per acre:

1. Mulch and seed may be applied in a single operation.

2. Apply mulch to achieve a uniform coverage of the soil surface.

D. Immediately follow the application of the mulch, water the seeded area in one watering, in sufficient amount to penetrate the seedbed to a minimum of 2 inches. Perform so as not to cause erosion or damage to the seeded surface.

E. Protect seeded areas against hot, dry weather or drying winds by applying mulch not more than 24 hours after completion of seeding operations.

3.05 SODDING NEW LAWNS

A. Do not place sod during a drought or during the period from June 15 to September 1, except as authorized by the City.

B. Lay sod within 24 hours from time of stripping. Do not lay dormant sod or if ground is frozen.

C. Sod shall be moist at the time it is placed.

D. Lay sod strips along contour lines, by hand, commencing at the base of the area to be sodded and working upward:

1. Carefully lay sod to produce tight joints. Butt ends and sides of sod strips; do not overlap.

2. Stagger transverse joints of sod strips.

3. Work from boards to avoid damage to sub grade or sod.

4. Tamp or roll lightly to ensure contact with sub grade. Work sifted soil into minor cracks between pieces of sod, removing excess to avoid smothering adjacent grass.

E. On slopes of 3 horizontal to 1 vertical and steeper, anchor sod by wooden pegs. Pegs shall be ½" x 12", driven into the ground on about 2-foot centers. Top of peg after driving shall be not less than ½-inch but not more than 1 inch above top of sod.

F. Water sod with fine spray immediately after planting. During first week, water daily or more frequently as necessary to maintain moist soil to depth of 4 inches.

3.06 RECONDITIONING EXISTING GRASS AREAS

A. Recondition existing grass areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition the areas where settlement or washouts occur or where minor regarding is required. Recondition other existing grass areas where indicated.

B. Provide fertilizer, seed or sod, and soil amendments as specified for new grass and as required to provide satisfactorily reconditioned grass growth. Provide new planting soil as required to fill low spots and meet new finish grades.

C. Cultivate bare and compacted areas thoroughly to provide good, deep planting bed.

D. Remove diseased or unsatisfactory grass areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.

E. Where substantial grass remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply seedbed mulch, if required, to maintain moist condition.

F. Water newly planted areas and keep moist until new grass is established.

3.07 PROTECTION

A. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period until lawn is established.

3.08 MAINTENANCE

A. Mow grass to a height of 2 inches as soon as there is enough top growth to cut with mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted.

B. Remove weeds by pulling or chemical treatment.

C. Perform maintenance as indicated in the previous paragraphs A and B until the date of final acceptance by City.

D. Seeded Areas:

1. Water as required by good practice and as necessary to obtain a flourishing cover.

2. Repair any portion of the seeded surface which becomes gullied or otherwise damaged or the seeding becomes damaged or destroyed.

E. Sodded Areas:

1. Thoroughly water daily for a period of 15 days after placing.

2. Maintain sod in good live condition. Replace any sod not in good growing condition with fresh live sod.

3. Water thoroughly whenever sod evidences excessive drying.

F. Apply second fertilizer application after first mowing and when grass is dry. Use fertilizer which will provide not less than 1.0 pound of actual nitrogen per 1,000 square feet of lawn area.

3.09 ACCEPTANCE OF LAWNS

A. When lawn work is substantially complete, including maintenance, the City will, upon request, make an inspection to determine acceptability:

1. Lawn work may be inspected for acceptance in parts agreeable to the City, provided work offered for inspection is complete, including maintenance.

B. Replant rejected work and continue specified maintenance until re-inspected by the City and found to be acceptable.

C. Seeded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, uniform, close stand of specified grass is established free of weeds, bare spots, and surface irregularities.

D. Sodded lawns will be acceptable provided requirements, including maintenance, have been complied with and healthy, well-rooted, even-colored, viable lawn is established free of weeds, open joints, bare areas, and surface irregularities.

3.10 CLEANUP

A. Promptly remove soil and debris created by lawn Work from paved areas. Clean wheels of vehicles prior to leaving site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

END OF SECTION 02930

SECTION 03200 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes steel reinforcement bars, ties, welded wire fabric, bolsters, chair supports, and accessories.

B. Related Work Specified Elsewhere:

1. Concrete: SECTION 03300.

1.02 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

b. A1064 –Carbon - Steel Wire, Plain and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

2. American Concrete Institute (ACI):

a. 301 - Specifications for Structural Concrete.

b. SP-66 - Detailing Manual.

c. 318 - Building Code Requirements for Structural Concrete.

3. Concrete Reinforcing Steel Institute (CRSI):

a. Manual of Standard Practice.

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Include, but not limited to, the following:

1. Complete bar schedule, bar details, and erection drawings to conform to ACI SP-66.

2. Drawing with each type of bent bar marked with identification mark. Straight bars shall have mark number or be identified by size and length.

3. Erection drawings shall be clear, easily legible, and to a minimum scale of:

a. ¼ inch = 1 foot.

b. 1/8 inch = 1 foot if bars in each face are shown in separate views.

4. Size and location of all openings.

5. Concrete protective cover.

6. Grade of steel.

7. Lap splice lengths.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store steel reinforcement blocked-up off the ground and in orderly stacks.

B. Store only bars with the same identifying label in the same stack.

1.05 TESTING

A. Perform at the mill for each heat.

B. Submit certified test results for acceptance upon request.

PART 2 - PRODUCTS

2.01 REINFORCEMENT BARS, TIES, AND STIRRUPS

A. Materials:

1. Conform to ASTM A615, Grade 60, except as otherwise specified.

2. Cold-drawn wire for spiral column ties shall conform to ASTM A1064.

B. Fabrication of Bars:

1. Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318.

2. Fabricate bars according to the tolerances given in ACI 301, Chapter 5.

3. Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel.

4. Attach metal or plastic tags with identifying mark or length corresponding to mark number or length on Drawing. Bent bars shall have mark number.

5. Contractor may, at his option, continue steel reinforcement through openings in walls and slabs, then field-cut the opening so that there will be the required concrete cover between ends of bars and edge of opening.

2.02 WELDED WIRE FABRIC

A. Conform to ASTM A1064 using bright basic wire.

B. Wire size W 1.4 and smaller shall be galvanized.

C. Mats only.

2.03 BOLSTERS, CHAIRS, AND ACCESSORIES

A. Conform to ACI SP-66 and the CRSI Manual of Standard Practice.

B. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during the concrete placement.

C. Metal accessories shall be plastic-coated where legs will be exposed in finished concrete surfaces.

D. Do not use rocks, broken bricks, wood blocks, reinforcement driven into the ground, concrete fragments or any other unauthorized materials for support of reinforcement.

2.04 PRECAST CONCRETE BLOCK BAR SUPPORTS

A. May be used only for bar supports in slabs on ground.

B. Blocks shall be made with a minimum of nine sacks of cement per cubic yard and have a minimum compressive strength of 6,000 psi in 28 days.

C. Each block shall have a minimum of 9 square inches of bearing area. Space as required by the particular condition of weight, bearing surface, and rigidity of the steel reinforcement.

PART 3 - EXECUTION

3.01 PLACEMENT OF CONCRETE REINFORCEMENT

A. Place in accordance with Chapter 5 of ACI 301, Chapters 7 and 12 of ACI 318, and the CRSI Manual of Standard Practice.

B. Tie securely with 16-gauge or larger annealed iron wire.

C. Place to maintain concrete cover to conform to Chapter 5 of SCI 301 and Chapter 7 of ACI 318, unless otherwise indicated.

D. All protruding reinforcement, onto which construction personnel could fall, shall be guarded to eliminate the hazard of impalement.

E. Splice steel to conform to Chapter 12 of ACI 318.

1. Unless otherwise indicated, lap splices shall be Class B as defined by ACI 318.

F. Lap welded wire fabric in accordance with Section 12.19of ACI 318, but not less than the length of one mesh plus 2 inches.

END OF SECTION 03200

SECTION 03300 – CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes concrete and related items.

B. Related Work Specified Elsewhere:

1. Concrete Reinforcement: SECTION 03200.

1.02 REFERENCES

A. Comply with the provisions of the following codes, specifications, and standards, except as otherwise indicated.

B. Applicable Standards Where Referenced Herein:

1. American Society for Testing and Materials (ASTM):

a. C31 - Making and Curing Concrete Test Specimens in the Field.

b. C33 - Concrete Aggregates.

c. C39 - Compressive Strength of Cylindrical Concrete Specimens.

d. C40 - Organic Impurities in Fine Aggregates for Concrete.

e. C88 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

f. C94-Ready-Mixed Concrete

g. C143 - Slump of Hydraulic-Cement Concrete.

h. C150 - Portland Cement.

i. C172 - Sampling Freshly Mixed Concrete.

j. C192 - Making and Curing Concrete Test Specimens in the Laboratory.

k C231 - Air Content of Freshly Mixed Concrete by the Pressure Method.

l. C233 – Air-Entraining Admixtures for Concrete.

m. C260 - Air-Entraining Admixtures for Concrete.

n. C289 – Potential Alkali-Silica Reactivity of Aggregates, (Chemical Method).

o. C295 - Petrographic Examination of Aggregates for Concrete.

p. C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

q. C494 - Chemical Admixtures for Concrete.

r. C566 - Total Evaporable Moisture Content of Aggregate by Drying.

s. C1193 Use of Joint Sealants.

t. D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Non-extruding and Resilient Bituminous Types).

u. D1752 - Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

2. American Concrete Institute (ACI):

a. 211.1 - Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

b. 304 - Practice for Measuring, Mixing, Transporting, and Placing Concrete.

c. 305 - Hot-Weather Concreting.

d. 306 – Standard Specification for Cold-Weather Concreting.

e. 308 – Standard Specification for Curing Concrete.

f. 309 - Guide for Consolidation of Concrete.

g. 318 – Building Code Requirements for Structural Concrete.

3. Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Bureau.

4. Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.

5. Corps of Engineers Specification for Non-Shrink Grout, CRD-C621.

6. National Bureau of Standards (NBS) Specifications for Scales.

7. National Ready-Mix Concrete Association, “Truck Mixer, and Agitator Standards of the Truck Mixer Manufacturers Bureau.”

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Include, but not limited to, product data and Shop Drawings of the following:

1. Non-shrink grouts.
2. Admixtures.
3. Bonding agents.
4. Curing agents.
5. Expansion joint materials.
6. Expansion joint sealants.
7. Water stops.

C. Mill Certificates:

1. Submit a minimum of one copy for each cement shipment.

D. Concrete Mix Design Proportions:

1. Submit as specified in PART 2 - Mix Proportions, this Section.

2. Submit for each mix design.

3. Resubmit for any change in each mix design.

E. Production Test Reports: Submit as specified in accordance with the submittal section.

1.04 QUALITY ASSURANCE

A. Field Testing:

1. Tests of concrete shall be performed by an ACI concrete Field Testing Technician Grade 1.

2. Submit two certified copies of the qualification records as evidence of qualification prior to placing concrete.

B. Finishing:

1. Finishing of concrete shall be supervised by an ACI Concrete Flatwork Technician/Finisher.

2. Submit two certified copies of qualification records as evidence of qualification prior to placing concrete.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Materials:

1. Portland cements Type II. Type II shall conform to ASTM C150 except the tricalcium aluminate content shall not exceed 5%.

2. Fine Aggregate:

a. Conform to ASTM C33.

b. Approved service record of 3 years with a history indicating that the fine aggregate is not chemically reactive.

c. For a new fine aggregate source, or when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in accordance with petrographic examination by ASTM C295 and tests conforming to ASTM C289.

d. Fine aggregate considered deleterious or potentially deleterious shall not be used without approval.

e. Maintain fine aggregate free of ice and frozen lumps.

3. Coarse Aggregate:

a. Conform to ASTM C33.

(1) Limits for deleterious substances and physical property requirements shall conform to Table 3 and applicable class designation 5S, 5M, or 1N.

b. Approved service record of 3 years with a history indicating that the coarse aggregate is not chemically reactive.

c. For a new coarse aggregate source, when 3 years' approved service records are not available, or when the service records are unacceptable; the aggregate shall be evaluated for potential reactivity. Aggregate must be considered innocuous in accordance with petrographic examination by ASTM C289.

d. Coarse aggregate considered deleterious or potentially deleterious shall not be used without approval.

e. Blast furnace slag shall not be permitted.

f. Maintain coarse aggregate free of ice and frozen lumps.

g. Grading Requirements:

(1) From 1 inch to No. 4 for all concrete unless otherwise specified.

4. Mixing Water:

a. Only potable water will be acceptable without testing. The Contractor shall pay expense of testing water.

b. Non-potable water may be used if it produces concrete with at least 95% of the strength of similar specimens of the same mix design made with potable water, subject to approval of qualitative analysis.

5. Admixtures:

a. Water-Reducing Type:

(1) Conform to ASTM C494, Type A.
(2) Conform to manufacturer's recommendations for use.
(3) Technical assistance of the manufacturer's field representative shall be furnished upon request.

b. Air-Entraining Type:

(1) Conform to ASTM C260.
(2) Conform to manufacturer's recommendations for use.
(3) Technical assistance of the manufacturer's field representative shall be furnished upon request.
(4) Testing of air-entraining admixtures shall conform to ASTM C233.

c. Other Admixtures: Used only with Engineer's written concurrence.

(1) Water-Reducing, Retarding Type: Conform to ASTM C494, Type D, and shall not contain any chloride ions added during manufacture.

d. Storage:

(1) Admixtures shall be stored in such a manner as to avoid contamination, evaporation, freezing, temperature changes, settling, or any damage which would adversely affect their characteristics.

B. Laboratory Testing of Materials for Use in Concrete:

1. An approved independent testing laboratory shall be selected and paid by the Contractor to perform all required laboratory tests of materials proposed for use in the production of concrete and to determine mix proportions when laboratory trial batches are required.

2. Contractor shall deliver representative Samples of all proposed concrete materials to the laboratory for the following testing:

a. Fine Aggregate:

(1) ASTM C33.
(2) ASTM C40.
(3) ASTM C88.

b. Coarse Aggregate:

(1) ASTM C33.
(2) ASTM C88.

c. Mixing water, if other than potable water is proposed for use and in the opinion of the Engineer there is reason to suspect its acceptability:

(1) With the design mix the laboratory shall make two Concrete test cylinders using proposed water and two concrete test cylinders using potable water conforming to ASTM C192.
(2) All cylinders shall be tested conforming to ASTM C39. Age of cylinders at test shall be 28 days unless an earlier age is authorized by the Engineer.

3. The laboratory test results shall be part of the design mix as specified in this PART 2 -Mix Proportions, of this Section.

C. Concrete Qualities Required:

1. Compressive Strength:

a. Minimum 28-day compressive strength = 4,000 psi for all construction unless otherwise indicated or specified.

b. Minimum 28-day compressive strength = 3,000 psi for fill concrete and seal coats.

c. Compressive strength determinations shall be made from 6” diameter x 12” long concrete cylinders tested in accordance with ASTM C39.

2. Slump of concrete shall be 3 inches, ±1 inch as tested in accordance with ASTM C143.

3. Air Content: 5% to 7% as tested in accordance with ASTM C231.

4. Minimum Cement Content: 564 pounds per cubic yard of concrete.

5. Water-Cement Ratio:

a. In addition to the aforementioned requirements, the water-cement ratio shall not exceed 0.45.

D. Mix Proportions:

1. Concrete shall be proportioned to conform to ACI 211.1.

2. Mix proportions for all concrete, unless otherwise specified, shall be selected preferably on the basis of field experience; but in the case where sufficient or suitable strength test data is not available; concrete shall be proportioned on the basis of laboratory trial mix design.

E. Measurement of Materials:

1. General Requirements:

a. Conform to ACI 304.

b. Beam or spring-less dial-type scale conforming to NBS “Specifications for Scales”.

c. Volumetric measurement of water shall be performed with an approved automatic valve.

2. Concrete Plant Scale Accuracy and Calibration Frequency:

a. The concrete plant scales shall be accurate to +0.4% of the capacity of the scale.

b. The scales shall be calibrated at intervals as specified in PART 3 - Testing, this Section.

3. Individual Batch Accuracy:

a. Cement: ±1.0%.

b. Water: ±1.0% by volume or weight.

c. Aggregates: ±2.0%.

d. Admixtures: ±3.0% by volume or weight.

e. Mixing and Delivery:

(1). Conform to ACI 304.

(2). Cement temperature, when added to mix, shall not exceed 170°F.

(3). Adjust the amount of mix water to compensate for the moisture content of the aggregates.

(4). Concrete Plant:

(a). Conform to “Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division Concrete Plant Manufacturers Bureau” and “Concrete Plant Standards of the Concrete Plant Manufacturers Bureau”.

(b). Charge with 5% to 10% of the mixing water both in advance and after the addition of aggregates and cement.

(c). Charge with remaining water uniformly with the other materials.

(d). Avoid charging in excess of manufacturer’s rating.

(e). Discharge mixed concrete completely prior to recharging.

(f). Mixing Time:

(1) Start immediately when all ingredients, except the last of the water, are in the mixer.
(2) Minimum mixing time shall conform to mixer manufacturer's instructions, but not be less than the following:

Capacity of Mixer Cubic Yards	Minimum Time of Mixing
1 or less	1 minute
2	1 minute, 15 seconds
3	1 minute, 30 seconds
4	1 minute, 45 seconds
5	2 minutes
6	2 minutes, 15 seconds

Add 15 seconds' mixing time for each additional cubic yard of concrete

(5). Mixing of Concrete at Plant off Jobsite:

(a). Mix concrete in central mixer or truck mixer. Transport in truck mixer turning at agitation speeds only.

(b). Water added to concrete having a slump below the specified minimum shall be at Contractor's risk. If the water added produces a slump greater than the specified maximum, the concrete will be rejected. If water is added, the concrete shall be remixed for a minimum of 25 revolutions.

(c). Water shall not be added after the truck has begun to discharge.

(d). Truck mixer shall conform to "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association.

(e). Ready-mixed concrete shall be produced and delivered conforming to ASTM C94 as applicable.

(f). Contractor shall furnish City/Engineer with a concrete delivery ticket for each load of concrete. The ticket shall have the following information recorded:

(1) Name of ready-mixed concrete batch plant.
(2) Serial number of ticket.
(3) Date and truck number.
(4) Name of contractor.
(5) Specific designation of the job (name and location).
(6) Mix number.
(7) Amount of concrete delivered (cu yd).
(8) Time mixer was loaded.
(9) Time of arrival at site.
(10) Time discharge started.
(11) Time completed delivery.
(12) Amount of water added by Contractor and his initials.
(13) Signature of ready-mix concrete representative.
(14) Type, name and volume of admixture.
(15) Type and brand of cement.
(16) Maximum size of aggregate.
(17) Free water on the aggregate.
(18) Indication that all materials are as previously certified or approved.
(19) The delivery ticket shall be supplemented by a computerized printout for each batch (from an automatic printing unit incorporated in the batching system) containing actual weights of all materials delivered including cement, water, and coarse and fine aggregate.

(6). Plant and truck mixer uniformity shall be tested according to ASTM C94. Frequency of tests shall be as specified in PART 3, this Section.

2.02 GROUT

A. Grout for Dry Packing:

1. Volume: 1 part Portland cement to 2 parts sand.

2. Keep water to a minimum as required for placing by the dry packing method.

3. Place after the mixed grout has been allowed to stand for 2 hours.

4. The sand and cement shall be as specified for concrete.

B. Flow able Non-Shrinking Grout:

1. Use unless otherwise indicated or specified.

2. Required for setting equipment recommended by the manufacturer to be set with non-shrinking grout and in other places indicated.

3. Grout shall conform to Corps of Engineers specification for Non-Shrink Grout, CRD-C621.

4. Grout shall be nonmetallic, as manufactured by one of the following:

a. L and M Construction Chemicals, Inc. - Crystex.

b. U. S. Grout Corporation - Five Star Grout.

c. Master Builder's Company - Masterflow 713 Grout.

d. Sauereisen Cements Company - Sauereisen F-100.

e. Cormix Construction Chemicals - Supreme Grout.

5. Prepare and place conforming to manufacturer's printed instructions.

6. For equipment bases, the concrete surfaces shall be sandblasted or roughened with a chipping hammer prior to grouting. The foundation plates shall be cleaned of any grease, oil, paint, primers, or epoxy coatings.

C. Grout for Bonding:

1. Proportion (by weight): 1-part cement to 1-1/2 parts sand.

2. Keep water to a minimum.

2.03 BONDING AGENT

A. Provide moisture-insensitive, epoxy-resin bonding agent as manufactured by one of the following:

1. A. C. Horn, Inc. - Epoxtite.

2. Euclid Chemical Company - Euco Epoxy.

3. Sika Chemical Company - Sikadur 32, Hi-Mod.

4. L&M Construction Chemicals, Inc. - Epobond.

2.04 CONCRETE ACCESSORIES

A. Water stops:

1. Serrated virgin polyvinyl chloride equal to one of the following:

a. Tamma Industries - Horn/Durajoint Type 3.

b. Vulcan Metal Products Company - Vulco 8013.

2. Plastic Water stop: Preformed plastic water stop as manufactured by SYNKO-FLEX Products Co., Houston, Texas.

B. Expansion Joints:

1. Expansion Joint Filler: Pre-molded cork of thickness indicated and conforming to ASTM D1752, Type III, self-expanding cork. Use at all locations unless indicated to be asphalt-impregnated fiber.

2. Expansion Joint Filler: Preformed asphalt-impregnated fiber of thickness indicated and conforming to ASTM D1751.

3. Bond Breaker: Polyethylene tape or other plastic tape as recommended by the sealant manufacturer for preventing sealant from adhering to joint filler materials or joint surfaces at the bottom of joint where such adhesion would result in sealant failure.

4. Sealant Backer Rod (closed cell, compatible with sealant):

a. Bostick Construction Products Division.

b. Chem-Calk - Backer Rod.

c. Dow Chemical Company - Ethafoam.

d. Hercules Foam Backer Rod.

e. Sonneborn Building Products - Sonofoam.

f. W. R. Meadows - Sealtight Backer Rod.

5. Joint Sealant:

a. Two-component polysulfide system as manufactured by one of the following:

(1) A. C. Horn, Inc. - Hornflex L.
(2) Pecora, Inc. - Synthacalk GC-2.

2.05 CURING AGENT

A. Liquid membrane-forming compound conforming to ASTM C309, Type 1. Curing agent shall be VOC compliant with a maximum of 3.5 lbs/gal (425 g/l) or less where area regulations are more stringent. ASTM C309, Type 2 shall be used as specified in PART 3 - Hot Weather Concreting, this Section.

PART 3 - EXECUTION

3.01 PREPARATION FOR CONCRETE PLACEMENT

A. Openings Through Concrete: Provide openings through concrete as indicated and for the proper installation of all equipment, piping, wiring, ductwork and similar items installed included in the Work.

B. Installation of Embedded Items:

1. Provide for accurate installation of embedded items included in the Work.

2. During cold weather, protect embedded items from moisture which may freeze, expand, and crack the concrete structure.

3. Grease or tape anchor bolt threads to protect from concrete splatter.

C. Installation of Joints:

1. Construction Joints:

a. Location:

(1) Joints shall be located as shown on the plans or standard drawings.

b. Preparation and Installation:

(1) Clean and break laitance or other foreign material from bonding surface.
(2) Tighten forms remaining in place (where applicable) to prevent seepage between forms and hardened concrete.
(3) Provide water stops and shear keys as indicated or specified and as required in any new construction joint requested by Contractor.

c. Water stops:

(1) Install conforming to manufacturer's standard installation instructions.
(2) All joints and splices of PVC water stop shall be 100% fused.

2. Expansion Joints:

a. Install filler, backer rod and sealant in strict conformance with manufacturer's written instructions.

b. Reinforcing shall not extend through expansion joints unless indicated otherwise.

c. Attach rigid joint filler to the face of the joint prior to placing adjacent concrete. The filler shall occupy the entire width of the joint.

d. Install sealant backer rod for sealant except where indicated to be omitted. Install bond breaker where indicated.

e. Clean joint surfaces immediately before application of sealant.

f. Install joint sealants to conform to ASTM C1193. Tool sealant to provide smooth, uniform bead with a slightly concave surface, eliminate air pockets, and insure sealant contact and adhesion with sides of joint.

g. Protect joints from moisture and ice during freezing.

3. Contraction Joints: As specified in this PART 3 -Finishing, this Section.

3.02 PLACING OF CONCRETE

A. Conventional Placing:

1. General Requirements:

a. Conform to ACI 304.

b. Bonding surfaces, including reinforcement, shall be clean, free of laitance and foreign materials.

c. Face horizontal bonding surfaces with 1-inch-thick coat of fresh “grout for bonding”. Wet all other surfaces.

d. Place concrete on properly prepared and unfrozen sub grade and only in dewatered excavation and forms.

e. Use forms for all concrete except where otherwise indicated or specified.

f. Do not place concrete that has partially hardened or has been contaminated by foreign materials.

g. Prevent mud or foreign materials from entering the concrete or forms during placement operations.

2. Conveying:

a. Convey concrete from the mixer and deposit in place by methods which will prevent the segregation or loss of materials.

b. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to provide a practically continuous flow of concrete at the delivery end.

c. Aluminum conveying equipment shall not be used.

3. Depositing:

a. Place concrete in continuous horizontal lifts not to exceed 2 feet, and place concrete against bulkheads and keyways at vertical joints.

b. Maximum free drop of concrete and grout for bonding shall be 5 feet, in walls 10 inches or less in thickness, with 1-foot additional drop allowed for each inch of wall thickness over 10 inches, with a maximum drop of 10 feet.

c. When moisture barrier is used, keep lapped joints closed and take precautions to avoid puncturing the barrier.

4. Consolidation of Concrete:

a. Consolidate concrete in conformance with ACI 309. Characteristics and application of concrete vibrators shall be as set forth in Table 5.1.4.

b. Provide an adequate number of vibrators of sufficient capacity to keep up with the maximum rate of concrete placement. Keep on hand adequate standby equipment in good operating condition.

c. Vibrate concrete only until the concrete is thoroughly consolidated and the voids filled, as evidenced by the leveled appearance of the concrete at the exposed surface and the embedment of the surface aggregate.

d. Insert internal vibrators vertically to the full depth of the layer being placed and into the previous layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete. Do not flow concrete from one location to another by use of a vibrator.

e. Consolidate concrete layer to full depth when using a surface vibrator. Use thinner layers or a more powerful vibrator if necessary to achieve complete consolidation.

f. Use form vibrators only where sections are too thin or where sections are inaccessible for internal vibrators.

5. Time Requirements:

a. Place concrete at a sufficient rate to assure that lifts below have not taken initial set before fresh concrete is deposited.

b. Place concrete within 45 minutes after mixing. This period may be extended to 1 hour and 30 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be re-tempered but shall be discarded.

6. Placing Concrete at Joints:

a. Bed horizontal joints with 1 inch of grout for bonding.

b. Take precautions to ensure tight, well-bonded construction joints with no air pockets or voids.

c. Take special precautions to avoid bending or displacing water stop while placing concrete around it.

d. Delay construction at a joint a minimum of 16 hours where placement is continued past joint, except where otherwise indicated.

3.03 FINISHING

A. Unformed Surfaces:

1. Screed Finish:

a. Use as first stage for all concrete finishes.

b. Use as final finish on surfaces that will be covered by additional concrete, grout placement, or mortar setting bed except as otherwise specified.

c. Immediately after screening, use a wood float, darby, or bullfloat to eliminate high and low spots and to embed large aggregate. This shall be done in a manner to produce even, uniform surfaces so that surface irregularities do not exceed 3/8 inch in 10 feet when used as final finish.

2. Floated Finish:

a. Use as second stage of broomed, troweled, or magnesium-troweled finish.

b. Float with mechanical float. Hand floating will be permitted only in areas inaccessible to mechanical float.

c. On surfaces not to receive troweled or magnesium-troweled finish, finish with wood or cork float after mechanical floating to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

3. Broomed Finish:

a. Use as final finish on all outdoor slabs including pavements and sidewalks.

b. After floated finish, draw a stiff bristle broom across the surface making uniform corrugations, perpendicular to the direction of traffic, not more than 1/16 inch deep.

4. Troweled Finish:

a. Use as final finish on all other unformed surfaces not otherwise indicated or specified.

b. Trowel with steel trowel, mechanical or hand, to obtain a smooth, dense finish. The final troweling shall be done after the concrete has become hard enough so that no mortar adheres to the edge of trowel and a ringing sound is produced as the trowel passes over the surface.

c. Do not trowel before surface water has evaporated or has been removed with a squeegee.

d. Finish to a true uniform surface so that surface irregularities do not exceed 1/8 inch in 10 feet, except at floor drains.

e. Do not add sand or cement to the floor surface.

5. Magnesium-Troweled Finish:

a. Perform as specified in PART 3 - Troweled Finish, this Section, except use a magnesium trowel by hand instead of a steel trowel to obtain a dense, but not slick, finish.

b. Use where floor will receive protective coating after curing.

6. Contraction Joints:

a. Locate as indicated.

b. Maintain true alignment with straightedge.

c. Joints shall be grooved except where sawed joints or preformed joints are indicated.

d. Grooved Joints:

(1) Perform during the finishing process.
(2) Width of groove shall not exceed ¼ inch.
(3) Depth of groove shall be at least 1 inch or ¼ of slab thickness.

e. Sawed Joints:

(1) Cut joints with power blade as soon as concrete surface is firm enough to resist tearing or damage by the blade and before random shrinkage cracks can occur. (Usually required 4 to 12 hours after finishing.)
(2) Make joints approximately 1/8-inch-wide with depth as indicated.
(3) Seal with the same type sealant specified for expansion joint sealant.

B. Formed Surfaces:

1. Repair surface defects as specified in PART 3 -Repair of Defective Surfaces, this Section.

C. Repair of Defective Surfaces:

1. Defined as any concrete surface showing misalignment, rock pockets, poor joints, holes from ties, voids, honeycomb, or any other defective area.

2. Repairing:

a. Repair as soon as forms have been removed.

b. Chip surface back to minimum depth of ½ inch, chip edges perpendicular to surface, pre-wet depression and brush with neat cement immediately before patching.

c. Patch surfaces using stiff mortar with same sand-cement radio as original concrete and with minimum water for placing. Blend with white cement to match concrete color.

d. Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.

e. Moist-cure for 3 days or use curing compound.

f. City/Engineer shall be notified of areas containing defects or where reinforcing Steel is exposed, prior to determination of repair method.

3.04 CURING

A. Cure all concrete by one of the following methods in accordance with ACI 308:

1. Leaving in forms for a minimum of 7 days. Keep formwork wet to prevent drying of concrete surfaces.

2. Use of saturated bats, soaker hoses, or sprinkler for a minimum of 7 days. Keep concrete continuously wet.

3. Using one coat of a liquid membrane forming compound conforming to ASTM C309, Type 1. Apply immediately after removal of forms (which have been continuously wet); or in case of a slab, after the concrete has been finished and is hardened sufficiently to walk-on.

4. Using polyethylene sheets applied in full contact with surfaces.

5. Curing of concrete during hot or cold weather shall conform to PART 3 - Hot Weather Concreting and Cold Weather Concreting, this Section.

3.05 HOT WEATHER CONCRETING

A. Follow the recommendations of ACI 305 if any of the following conditions occur:

1. When the temperature is 90°F or above.

2. When the temperature is likely to rise above 90°F within the 24-hour period after concrete placement.

3. When there is any combination of high air temperature, low relative humidity, and wind velocity, which would impair either concrete strength or quality.

B. Concrete shall have a maximum temperature of 85°F during placement.

C. Dampen sub grade and forms with cool water immediately prior to placement of concrete.

D. Protect freshly placed concrete immediately after placement so that the rate of evaporation as determined by ACI 305 (Figure 2.1.5) does not exceed 0.2 pound per square foot per hour.

E. Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.

F. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.

G. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water-saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After the 24-hour interval, continue curing using one of the following methods:

1. Moist curing for 6 days.

2. Application of one coat of curing compound conforming to ASTM C309, Type 2.

3. Application and maintenance of curing paper or heat-reflecting plastic sheets for 6 more days.

H. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing using one of the following methods:

1. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for 6 days.

2. Strip forms and apply curing compound conforming to ASTM C309, Type 2. Do not allow concrete surfaces to dry prior to application of curing compound.

3.06 COLD WEATHER CONCRETING

A. When the temperature is 40°F or is likely to fall below 40°F during the 24-hour period after concrete placement, follow the recommendations of ACI 306 to prevent loss of concrete strength or quality.

B. Minimum temperature for concrete as mixed shall be as indicated on lines 2, 3, and 4 of Table 1.4.1 of ACI 306. Maximum temperature for concrete as mixed shall be 10°F greater than the corresponding minimum temperature.

C. Place and maintain concrete so that its temperature is never less than the temperature indicated on line 1 of Table 1.4.1 of ACI 306. Maintain the required temperature for the time duration indicated on Table 1.4.2 of ACI 306.

D. Monitor temperature of concrete in place at corners or edges of formwork as applicable.

E. Air Heaters:

1. Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines.

2. Oil-or coke-burning salamanders will not be permitted.

3. Heaters shall be ultramatic portable heaters made by the Union Chill Mat Company or City/Engineer approved equal.

4. Personnel shall be present at all times to maintain safe, continuous operation of heating system.

F. Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces do not occur.

G. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen sub grade prior to concrete placement.

H. The maximum allowable temperature drop during the first 24-hour period after protection is discontinued shall be as indicated on line 5 of Table 1.4.1 of ACI 306.

I. Cure the concrete in accordance with Chapter 5 of ACI 306.

3.07 LOW-STRENGTH CONCRETE

A. Low-Strength Concrete:

1. Defined as either:

a. Concrete whose average, of any sets of three consecutive 28-day strength tests, is below the required 28-day strength.

b. Concrete whose individual 28-day strength test (average of two cylinders) is more than 500 psi below the required 28-day strength.

2. Should concrete meet either definition of low-strength concrete as a minimum, the Contractor shall take the following steps:

a. Increase the cement content. The increase shall be based on a statistical evaluation of the strength data, the design water-cement ratio, compressive strength curve, and acceptable mix-design literature as follows:

(1) If sufficient concrete has been furnished to accumulate 30 tests, these should be used to establish a new target average strength in accordance with ACI 318, Section 4.3.1.

(2) If less than 30 tests have been made, the new target average strength should be at least as great as the average strength used in the initial selection of the mix proportions. Increase the target average strength based on a statistical evaluation of the available strength data, the design water-cement ratio, compressive-strength curve, and acceptable mix-design literature. If the statistical average equals or exceeds the initial mix-design level, a further increase in the average level is required.

b. Remove and replace with acceptable concrete when the quality and location of the concrete is such that City/Engineer considers the strength or durability of the structure is impaired and so orders.

B. Potentially Low-Strength Concrete: Defined as concrete whose 7-day test (average of two cylinders) is less than 70% of the specified minimum 28-day compressive strength.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Concrete Seal Coat:

1. Apply to the ground surface immediately beneath all" on-grade" slabs and footings where indicated or specified.

2. Seal coat shall consist of a concrete slab of the thickness indicated but not less than 2 inches.

3. Accurately screed so that the top of the seal coat will not be higher than the bottom elevation of structural slabs or footings to be placed thereon.

4. Do not place seal coat until after all excavating in the area have been completed and all drain lines, conduits, and other items under the area are completed and properly backfilled and compacted.

B. Equipment Bases:

1. Construct equipment bases, pads, and foundations as indicated or, when not indicated, conforming to equipment manufacturer's requirements.

2. Reinforce conforming to typical detail unless otherwise indicated.

3. Equipment bases shall include concrete, reinforcing steel, form work as required, and anchor bolts. Place grout for equipment included in the Work.

4. Finish top area of bases between anchor bolts and forms with a troweled finish.

3.09 TESTING

A. Field Testing of Concrete Plant and Mixing Trucks:

1. The concrete plant shall be inspected and tested to ensure conformance with ACI 304 and the "Concrete Plant Standards of the Concrete Plant Manufacturers Bureau". The scales shall be calibrated at the initial setup and at 3-month intervals thereafter.

3. Mixing trucks shall be inspected and tested to ensure conformance with ACI 304 and "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau" of the National Ready-Mix Concrete Association. Tests shall be done at initial setup and every three months thereafter.

3. Submit test reports when requested.

B. Field Testing of Concrete and Making of Concrete Test Cylinders:

1. Contractor shall furnish on request test equipment, test cylinder molds, and certified personnel to perform all required field tests, make the required concrete test cylinders, and deliver test cylinders to the testing laboratory. The prescribed tests shall be made in the presence of or with the concurrence of the City.

2. Field testing personnel shall be on-site throughout placement of concrete.

3. Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172 except samples for slump, air and temperature tests shall be taken from the first portion of the batch discharge. Samples shall be taken at random and at the point of truck discharge.

a. Moisture content, ASTM C566. Perform this test a minimum of twice a day and adjust the amount of mix water to compensate for the moisture content of the aggregates.

b. Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each day's placement for each 100 cubic yards or fraction thereof.

c. Slump test conforming to ASTM C143. Perform tests on the first batch produced each day, for every 50 cubic yards or fraction thereafter, and with every set of test cylinders. Additional tests shall be run when directed by Engineer.

d. Air content test conforming to ASTM C231. Perform for first batch of day and with each set of test cylinders.

e. The batch of concrete being tested for slump or air content shall not be placed until acceptable results are obtained.

f. Discard concrete used for slump and air tests.

g. Perform concrete and air temperature tests for first batch of day and with each set of test cylinders. Additional readings shall be taken when directed by City/Engineer.

h. Any batch of concrete with slump or air content not in conformance with Specifications shall be rejected.

i. Furnish slump, air content, and temperature test results to the testing laboratory for inclusion in the cylinder rest reports.

C. Laboratory Testing of Aggregates and Concrete During Construction:

1. An independent testing laboratory will be selected and paid by the Developer/Owner to perform the required laboratory tests and statistical evaluations of aggregates and concrete being used in the Work.

2. Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing two cylinders at 7 days of age and two at 28 days of age.

3. Contractor shall have the right to observe all phases of concrete cylinder curing and testing. Should Contractor observe any deviations from the prescribed testing procedures that he considers detrimental to concrete strength test results, he shall immediately notify Developer/Owner in writing.

4. Contractor shall assist laboratory in obtaining Samples of fine and coarse aggregate for testing.

5. The Contractor shall make arrangements with the testing laboratory to receive copies of test reports. The cost of providing a maximum of two copies of each report to the Contractor will be paid by the Developer/Owner.

6. Should the test results indicate low strength concrete as defined in PART 3 –Low Strength Concrete, this Section, Contractor shall take immediate corrective action.

7. Should the statistical data indicate an excessive margin of safety, the concrete mix may be modified subject to City/Engineer’s approval.

8. Should the material tests taken during construction indicate nonconformance with the Specifications, the Contractor shall take immediately corrective action.

END OF SECTION 03300

SECTION 11151 – SUBMERSIBLE WASTEWATER PUMPING STATION

PART 1 – GENERAL

1.01 SUMMARY

A. This section covers furnishing and installing submersible wastewater pumping stations and related components for lift stations with a capacity less than one million gallons per day (1 MGD) or less than a size deemed appropriate by the City for a particular application. Future discharge to the proposed lift station shall be taken into account during design and shall be considered when determining the ultimate capacity of the proposed lift station.

B. Pumping stations shall be:

1. Capable of pumping raw wastewater and be of the duplex type.

2. Furnished complete and include pump casings, shafts, bearings, seals, lubrication, floor mounted discharge bases, piping assemblies, guide rails, anchor bolts, stainless steel bolts, submersible motors, controls, power cables, access hatch cover, standby power supply and all other parts and accessories indicated, specified or required for proper installation, operation and maintenance.

C. Related Work Specified Elsewhere:

1. Site Preparation and Earthwork: Section 02200.

2. Manholes and Wet Wells: Section 02605.

3. Pipe Installation and Testing: Section 02620.

4. Valves, Hydrants and Accessories: Section 02640.

5. Chain-Link Fences and Gates: Section 02831.

6. Concrete: SECTION 03300.

D. See details in the Standard Drawing Details.

1.02 REFERENCES

A. Applicable Standards:

1. American National Standards Institute (ANSI).

a. B16.1 -Cast Iron Pipe Flanges and Flanged Fittings.

b. 316 – Stainless Steel Round Bar.

2. American Society for Testing and Materials, (ASTM).

a. A-48 – Gray Iron Castings.

3. National Electrical Manufacturer's Association (NEMA).

a. NEMA Type 4 Enclosures.

b. NEMA Type 1 Enclosures.

4. Institute of Electrical and Electronics Engineers (IEEE).

5. Underwriters Laboratories.

a. UL-508 – Industrial Control Equipment.

b. UL-1008 – Transfer Switch Equipment.

6. National Electrical Code.

7. International Organization for Standardization.

8. National Fire Protection Association.

9. International Electrotechnical Commission.

B. Regulations

1. Missouri Department of Natural Resources

a. 10 CSR 60-11.010(3)(A) – Backflow Prevention Methods

b. 10 CSR 60-11.010(4) – Backflow Prevention Methods

1.03 SUBMITTALS

A. Submit as specified in accordance with the submittal section.

B. Shop drawings shall be submitted showing materials and assembly of all elements of the pumping station. In addition to pump and motor data to be submitted, descriptive literature shall clearly indicate all information necessary to evaluate conformance with specification requirements for all features of the pump station including valves. Complete

data for all electrical items, switches, enclosures, relays, motor starters and controls, and a drawing of the control panel layout and a schematic diagram of the control panel circuitry shall be included. Submittals shall include, but not be limited to, the following:

1. Equipment submittals as specified in accordance with the submittal section.

2. Standard performance curves for each pump model furnished. Curves shall cover range from shutoff to150% of design flow rate at the conditions specified, and shall be submitted for the following parameters as a function of pump capacity:

a. Total developed head.
b. Required brake horsepower.
c. Pump efficiency.
d. Required wire-to-water horsepower.
e. Minimum nameplate horsepower with 1.15 derating factor (excluding motor S.F.).
f. Required NPSH.
g. Minimum recommended submergence.

3. Provide two (2) sets of operation and maintenance manuals covering the pumps, generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

1.04 QUALITY ASSURANCE:

A. Factory Tests and Reports:

1. Perform tests on each pump in accordance with Hydraulic Institute Standards except as otherwise specified.

2. Statically balance pump impellers and dynamically balance all pump/motor units such that equipment vibration displaced (peak-to-peak) as measured at any point on the machine shall not exceed 5.0 mils for 1200 r.p.m. and 4.0 mils for 1800 r.p.m.

3. Submit results of factory tests.

4. Perform standard tests on all motors in accordance with IEEE.

1.05 FACTORY ASSEMBLY:

A. Pump/motor units shall be completely shop assembled and aligned prior to shipping.

B. After completion of the specified factory tests, pumps shall be prepared for shipment with the minimum amount of disassembly, and such that no field disassembly, cleaning, or flushing is required.

C. Any components removed for shipping shall be match-marked prior to removal and shipment.

D. Prepare all cast iron surfaces and provide manufacturer's standard paint system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Submersible Pumps – ITT Flygt

B. Standby Power Supply - Cummins

2.02 GENERAL REQUIREMENTS:

A. Provide totally sealed submersible electrically operated pumps capable of pumping raw unscreened sewage.

B. Pumps shall be capable of operating dry continuously for at least 24 hours without damage.

C. Pump controls shall be as indicated and as specified in this section.

D. Pump shall operate at or near maximum efficiency at operating conditions.

E. Pump head-capacity curve shall be continuously falling from shutoff head.

F. Pump discharge connection elbow and discharge piping shall be installed such that pump will automatically connect and seal to discharge connection elbow when lowered into place.

G. Pump shall be easily removable for inspection or service.

H. Provide guide rail system and pump rail guide bracket to raise or lower pump unit by lifting chain.

I. Guide entire weight of pump unit with a minimum of two stainless steel guide bars.

J. Seal interface of the pump and discharge elbow by O-ring, gaskets, or metal to metal contact.

K. Pumps shall be capable of pumping 3-inch diameter non-compressible solids.

L. All equipment to be installed inside the wetwell shall be explosion-proof rated for use in Class I, Division 2, Group C and D areas.

M. Pumping station equipment shall be installed in a concrete wetwell.

2.03 DESIGN REQUIREMENTS Design requirements will be determined by Engineer. The following requirement, at a minimum, shall be established for each pump and provided to the City for review and approval prior to ordering of any equipment. The City shall review all information submitted in a timely manner.

A. Number of Pumps (2 min.)

B. Design Capacity

C. Design Heads: Minimum, ft.
Rated, ft. (at Design Capacity)
Shutoff, ft. (minimum)

D. Maximum Motor Speed, rpm (not to exceed 1800 rpm)

E. Minimum Efficiency at rating Point, %

F. Brake horsepower

G. Wire to Water Horsepower

H. Minimum Nameplate Motor Horsepower: Nameplate horsepower, regardless of service factor, shall be at least 115 percent of the maximum load imposed by the driven equipment.

I. Maximum Depth of Water in Wet well, ft.

J. Minimum Depth of Water in Wet well, ft.

K. Minimum Discharge Elbow Outlet Size, In.

2.04 PUMP MATERIAL AND CONSTRUCITON

A. Construct motor housing, pump casing and major pump components of cast iron conforming to ASTM A48.

B. Provide bolts, nuts and washers of AISI Series 300 stainless steel

C. Impeller:
1. Cast iron, ASTM A48, Class 35B.
2. Semi-open multi-vane, back-swept, non-clog design.
3. Vane shall be hardened to RC 45 and be capable of handling solids, fibrous materials, rags, wipes and other material found in wastewater.
4. Secured to shaft with pinned fasteners to prevent slipping in either direction.
5. Balanced statically and dynamically to eliminate vibration and minimize hydraulic end thrust.

6. Casting shall not have been repaired by plugging, welding or other means.
7. Renewable wear rings shall be provided on the impeller. Rings shall be positively locked in place.

D. Shaft:
1. AISI Type 416 of 420 Stainless Steel
2. Ample diameter to assure first critical speed will occur at not less than 150% of rated pump speed.

E. Bearings:
1. Minimum B-10 life of 50,000 hours.
2. Pump shaft to rotate on two (upper and lower) permanently lubricated bearing without end movement.

F. Shaft Seal:
1. Two mechanical seals arranged in tandem in an oil chamber for lubrication.
2. Each interface shall be held in contact by an independent spring system designed to withstand maximum suction submergence.
3. Each seal shall contain one stationary ring and one positively driven rotating ring.
4. Shall be made of tungsten carbide at all points.
5. Shall require neither maintenance nor adjustments.
6. Shall be easily inspected and replaceable.
7. Shall not be damaged if the pumps are run unsubmerged for extended periods of time of in a dry pit installation.
8. Shall be relappable and shall be able to be reconditioned.

G. Oil Chamber:
1. Oil chamber shall contain a moisture sensor, an inspection plug and vert plug.

H. Mating Surface Seals:
1. All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is required.
2. The use of elliptical O-rings, gaskets or seals requiring specific fastener torque to obtain and maintain seal compression and watertightness will not be acceptable.

I. Coating:
1. All iron and steel parts which will submerged or in contact with pumped liquid after installation shall be coated.
2. Prepare surfaces in accordance with SSPC-SP5.
3. Minimum 10 mils dry film thickness
4. Primer: Koppers “200HB Epoxy”, Tnemec “20-1255 Pota-Pox”, Valspar “78-D-7 Tank Lining Epoxy” or equal.
5. Finish Coat: Koppers “200HB Epoxy”, Tnemec “20-2000 Pota-Pox”, Valspar “78-W-3 Tank Lining Epoxy” or equal.
6. Provide at least one (1) quart of the finish material for field touch-up painting.

2.05 PUMP ACCESSORIES

A. Pump Discharge Base:
   1. Material: Cast Iron, ASTM A48, Class 30 or higher
   2. Furnished by pump manufacturer for each pumping unit installation.
   3. Base shall be sufficiently rigid to firmly support the guide rails, discharge piping and pumping unit under all operation conditions.
   4. Base shall be provided with integral support legs suitable for bolting to the floor of the wetwell with stainless steel anchor bolts.
   5. Face of the inlet flange shall be perpendicular to the station floor and make contact with the face of the pump discharge nozzle flange.
   6. Designed to automatically connect to the pump discharge without bolts.
   7. Diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125.
   8. Pump and motor assembly shall be automatically connected to and supported by the discharge base and guide rails such that the unit can be removed from the wetwell and replaced without the need for operating personnel to enter the wetwell.

B. Guide Rail Sliding Bracket:
   1. Each pumping unit shall be provided with an integral, self-aligning guide rail sliding bracket.
   2. Bracket shall be designed to obtain a wedging action between flange faces as final alignment of the p[ump occurs in the connected position.
   3. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions.

C. Guide Rails:
   1. Schedule 40 stainless steel pipe.
   2. Type 316 stainless steel, including rails, brackets and anchor bolts.
   3. Shall not support any portion of the pump weight.
   4. Provide a minimum of two guide rails.
   5. Size shall be 2-inch minimum.
   6. Shall extend to the top of wetwell at the access hatch cover.

D. Lifting Cable:
   1. Provide one stainless-steel cable for each pump.
   2. Designed to raise and lower pump with additional safety factor for overcoming force of pump hand-ups.
   3. Provide hook for cable when not in use.
   4. Provide one portable hoist assembly for removal of pumps. Hoist shall be electrically operated and have mounting plate/socket cast into top of concrete slab.

E. Cable Holder:
   1. Provide stainless-steel grip holders for pump and control cables.
   2. Cables shall be easily adjusted to pumping level without splices.
   3. Provide continuous cables from exterior junction box to pumps and level controls.

F. Access Hatch Cover:
   1. Fabricated aluminum hatch suitable for a live load of 150 pounds per square foot with stainless steel accessories.
   2. Spring loaded to minimize opening effort.
   3. Automatic latching mechanism shall prevent the hatch from closing unintentionally.
   4. Double leaf type construction of structural shales and reinforced diamond patten checkered plate.
   5. Structural shapes and plates shall have a minimum thickness of ¼ inch.
   6. Hatch cover shall be set in concrete top. All aluminum surfaces to be in contact with concrete shall be given a heavy coat of coal tar paint.
   7. Sized by pump manufacturer.
   8. Provided with OSHA approved fall protection.

2.06 ELECTRIC MOTORS

A. Each pump shall be driven by an air-cooled, totally submerged, electric motor furnished by the pump manufacturer.
B. Each motor shall be rated 480 volts, 60 Hz, 3-phase and be capable of using a variable frequency drive (VFD) system.
C. The stator housing shall be air-filled, watertight casing.
D. Motor shall be moisture resistant, Class H, 155°C and shall be NEMA MG1 Part 31 for continuous duty at 40°C ambient temperature.
E. Each motor driving a pump shall have a nameplate rating of at least 1.15 times the maximum horsepower required by the pump and shall provide a margin of safety against motor overheating in the variable frequency drive application.
F. Motor bearing shall be antifriction, permanently lubricated type. The lower bearing shall be fixed to carry the pump thrust and the upper bearing free to move axially. The bearing shall have a calculated AFBMA L10 Life Rating of 50,000 hours when operating at maximum operating head. Maximum shaft runout at the mechanical seals shall not exceed 2 mils at any point in the operating head range.
G. Each motor shall be provided with a special cable suitable for submersible pump applications.
H. Cable size shall conform to NEC requirements.
I. The cable entry water seal design shall be such that a specific fastener torque is not required to ensure a watertight and submersible seal. The use of epoxies, silicones or other secondary sealing systems will not be acceptable.
J. Capable of continuous unsubmerged operation under full pump load condition without exceeding the temperature rise limitations for the motor insulation system.
K. Stator shall incorporate thermal switches in series to monitor the temperature of each phase winding. Thermal switches shall open, stop the motor and activate an alarm at the temperature not greater than 140°C.
L. A float leakage sensor shall be provided to detect water in the stator chamber. When activated, the leakage sensor shall stop the motor and activate an alarm.
M. Three additional pump/motor tags shall be provided for each motor/pump unit.

2.07 SEQUENCE OF OPERATION

A. The pump control system shall be designed to operate with four float switches in a Pump off, lead, lag and high water alarm modes. With the pumps off, and the flow into the wetwell causes the water level to rise, the “lead” float switch will close and the controller will start the lead pump. The lead pump will continue to operate, even after the level drops and the “lead” float switch opens, until the “off” float opens and the controller stops the lead pump.

B. When the “off” and “lead” floats are closed and the lead pump is operating, if the wet well level continues to rise and the “lag” float closes, the controller will start the lag pump. Should a pump fail to start, the controller shall activate an alarm condition. The lead and lag pumps will continue to operate, even after the level drops and the “lead” and “lag” floats open, until the “off” float opens and the controller stops the lead and lag pumps.

C. The controller shall automatically alternate the “lead” from pump to pump after each pump operation cycle.

D. If the lead and lag pumps are operating and the wet well level continues to rise and closes the “high level” float, the high water alarm light will illuminate, flashing on/off, the alarm horn will sound and the controller shall activate an alarm condition. The alarm light and horn will remain in operation until the level drops and the “high level” float opens. The alarm horn may be silenced by depressing the “Push to Silence” switch.

E. A time delay shall be programmed into the controller to prevent both the lead and lag pump from starting at the same time. Should a power failure occur and the “off”, “lead” and “lag” floats are closed, when the power is restored, the lag pump will start approximately 10 seconds later. This delay will occur anytime both pumps receive a start signal simultaneously.

2.08 CONTROL PANEL

A. Provide the electrical control panel, motor starters, lead pump alternator and pump controls. Controls shall include indicting lights for pump run and moisture detection.

B. Prefabricated Exterior Control Panel Design Requirements:
   1. Furnished by Pump Manufacturer.
   2. NEMA Type 4X enclosure with gasketed hinged door, padlock hasp, screw-type door clamps and padlock. A nameplate shall be permanently affixed to the panel and include the pump model number, voltage, phase, hertz, ampere rating and horsepower rating
   3. Interior steel mounting panel.
   4. Sized to house motor starters, relays, alternators, etc.
   5. Mount on Unistrut rack that is sized adequate to hold the pump disconnect switches, automatic transfer switch and the common control panel.
   6. Watertight termination fittings for all pipes and conduits entering enclosures.

7. Interior of box insulated with 1-inch thick noncombustable Styrofoam board insulation with foil facing.
8. Chromolox 150-watt (minimum) Type S strip heater and a Chromalox W(-90 thermostat wired to power supply terminal block through a 5-A cartridge type fuse.
9. HAND-OFF-AUTO switch for each pump.
10. Run time meters for each pump calibrated in one-hundredth hour increments.
11. Pump run indicator light for each pump on panel exterior.
12. Pump failure indicator light for each pump on panel exterior.
13. TVSS surge protection.
14. Alarm system, including audible horn and visible flashing red light.
15. An automatic alternator with manual switch shall be provided to change the sequence of operation at the end of each pumping cycle. The manual switch shall allow for either pump to be selected as lead pump or for automatic alternation.
16. In the event that either pump is out of service, the alternator shall be bypassed.
17. 120-volt GFI single phase service receptacle mounted to the panel in NEMA 4X enclosure.
18. Provided with power surge (lightning) arrestor.
19. Provided with phase protection.

C. Alarm System
1. Alarm system shall be activated in cases of power failure, pump failure, high water level and all available generator alarms.
2. Contractor shall furnish 5 alarm contacts (pump 1 fail, pump 2 fail, high water level, power outage and generator fail) for connection to ShoMe Electric monitoring system.
3. Alarm beacon shall be vaportight with a ¾ inch bottom hub, red globe, guard, 60 watt bulb and shall be mounted on top of the control enclosure with a ¾ inch hub.
4. The horn, light and connection to ShowMe Electric monitoring system shall be powered by a battery backup in case of power failure.

2.09 EMERGENCY OPERATION

A. All pump stations shall provide overflow protection by means of a riser from the force main with a camlock quick connector and appropriate valving to hook up portable pumps.
1. The diameter of the quick connect coupling shall be designated by the City.
2. Riser assembly shall be housed in a concrete vault. Riser assembly shall include a plug type shutoff valve and check valve.
3. Access to the assembly shall be through an aluminum hatch cover cast into the top slab. Hatch cover shall be provided by the pump manufacturer and meet requirements covered in Section 2.05(F).
4. All valves, piping and fittings shall be field painted. Field painting shall consist of a minimum of two coats of epoxy enamel paint. Color to be selected by the City.

B. Wet Well shall be provided with a 4” PVC drop pipe that extends to 12” above wet well floor. The pipe shall extend above the top of the wet well and shall include a tee, threaded plug and camlock quick coupling connector.
C. Pumping stations shall be provided with standby power by one of the following methods:
   1. Connection to two independent public utility sources, or;
   2. Provide power generating equipment.

2.10 AUTOMATIC TRANSFER SWITCH

A. Shall be manufactured by Cummins.

B. Transfer switch shall be double throw, electrically and mechanically interlocked, and mechanically held in the source 1 and 2 positions.

C. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

D. Transfer switches designated “3-pole” shall have a full current-rated neutral bar with lugs.

E. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plugs, to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

F. Terminals shall be pressure type and appropriate for all field wiring. Terminal arrangement and cabinet space must be such that feeder conductors can enter from the top, side, or bottom of the switch, at the installer’s discretion.

G. All enclosures shall be NEMA 3R, third-party certified for compliance to NEMA ICS6 and UL 508, unless otherwise indicated:
   1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA 70, (NEC 2017), regardless of the direction from which the conduit enters the enclosure.
   2. Exterior cabinet doors shall provide complete protection for the systems internal components. Doors must have permanently mounted key type latches. Bolted covers or doors are not acceptable.
   3. Transfer switch shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.
      a. Transfer switches located outdoors shall be supplied in NEMA type 3R (IEC IP34) dust proof and rain proof enclosures.

H. Comply with requirements for Level 1 equipment according to NFPA 110.

I. Indicated current ratings:
   1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
   2. Main contacts shall be rated for 600 VAC minimum.
   3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).

J. Manual Switch Operation: The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical but must be coordinated with control function.

K. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

L. Features:
   1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
   2. All transfer switch sensing shall be configurable from an operator panel or from Windows 7 or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
   3. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
   4. The control system shall be designed and prototype tested for operation in ambient temperatures from -40 degrees C to +60 degrees C (-40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
   5. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
   6. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.

M. Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric

display for detailed system information. Panel display and indicating lamps shall include permanent labels.

1. The indicator panel LEDs shall display:
   a. Which source the load is connected to (Source 1 or Source 2).
   b. Which source or sources are available.
   c. When switch is not set for automatic operation, because the control is disabled.
   d. When the switch is in test/exercise mode.
2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
   a. Activate pre-programmed test sequence.
   b. Override programmed delays, and immediately go to the next operation.
   c. Reset the control by clearing any faults.
   d. Test all of the LEDs by lighting them simultaneously.
3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
   a. AC voltage for all phases, normal and emergency
   b. Source status: connected or not connected.
   c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.

4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
   a. Set nominal voltage and frequency for the transfer switch.
   b. Adjust voltage and frequency sensor operation set points.
   c. Set up time clock functions
   d. Set up load sequence functions
   e. Enable or disable control functions including program transition.
   f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history.

N. Control Functions: Functions managed by the control shall include:
   1. Software adjustable time delays:
      a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec).
      b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec).
      c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec).
      d. Engine cool down: 0 to 30 minutes (default 10 min).
      e. Programmed transition: 0 to 60 seconds (default 3 sec).
   2. Undervoltage sensing: Three-phase normal, three-phase emergency source.
      a. Pickup: 85 to 98% of nominal voltage (default 90%).
      b. Dropout: 75 to 98% of nominal voltage (default 90%).
      c. Dropout time delay: 0.1 to 1.0 seconds (default 0.5 sec).
      d. Accurate to within +/- 1% of nominal voltage.

3. Over-voltage sensing: three-phase normal, three-phase emergency source.
    a. Pickup: 95 to 99% of dropout setting (default 95%)
    b. Dropout: 105 to 135% of nominal voltage (default 110%).
    c. Dropout time delay: 0.5 to 120 seconds (default 3 sec).
    d. Accurate to within +/- 1% of nominal voltage
4. Over/Under frequency sensing:
    a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
    b. Dropout: +/-1% beyond pickup (default 1%).
    c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec).
    d. Accurate to within +/- 0.2%
5. Voltage imbalance sensing:
    a. Dropout: 2 to 10% (default 4%)
    b. Pickup: 90% of dropout
    c. Time delay: 2.0 to 20 seconds (default 5 sec)
6. Phase rotation sensing:
    a. Time delay: 100 msec.
7. Loss of single-phase detection:
    a. Time delay: 100 msec.

O. Control features shall include:
1. Programmable genset exerciser: A field-programmable control shall periodically start the generator, transfer the load to generator for a preset time, then re-transfer and shut down the generator after a preset cool-down period.Push-button programming control shall have a selection of eight different schedules for exercising generator, with or without load.
2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.

4. Transfer Override Switch: Overrides automatic re-transfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light to indicate override status.

P. Control Interface:
1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. The transfer switch shall be provided with a network communication card and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.
3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

Q. Engine Starting Contacts:
   1. One isolated and normally closed, and one isolated and normally open; rated 10A at 32 VDC minimum.

2.11 STANDBY ELECTRIC GENERATOR SYSTEM

A. General Characteristics: The generator set will be of the latest commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and as specified herein. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local codes and regulations. All equipment shall be new and of current production of a national firm that manufactures the generator and controls, portable cords and plugs, switchgear, and assemblies the generator sets as a complete and coordinated system. There will be one source responsibility for warranty, parts, and service through a local representative with factory-trained service men.

B. Manufacturer's Responsibilities: The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set.

C. Testing: To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
   1. Design Prototype Tests: Components of the emergency system, such as the engine/generator set, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and pre-production models, which will not be sold, shall have been used for the following tests.
   2. Maximum power (kW)
   3. Maximum motor starting (kVA) at 25% instantaneous voltage dip.
   4. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-22.40 and 16.40.
   5. Governor speed regulation under steady-state and transient response.
   6. Voltage regulation and generator transient response.
   7. Fuel consumption at 1/4, 1/2, 3/4, and full load.
   8. Harmonic analysis, voltage waveform deviation and telephone influence factor.
   9. Single-phase short circuit tests.
   10. Alternator cooling air flow.
   11. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
   12. Endurance testing.

D. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
   1. Single-step load pickup.

2. Transient and steady - state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated Power at 0.8 PF
6. Maximum Power.
7. Upon request, arrangements to either witness this test will be made, or a certified test record will be sent prior to shipment.

E. Warranty & Maintenance
1. The generator set shall be guaranteed against defective material and workmanship in accordance with the manufacturer's published warranty for five (5) years from date of startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall be regularly engaged in a maintenance contract program to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions, adjustment to the generator, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and proper functioning of all systems.

F. Material and Operating Characteristics:
1. The generator set shall be Cummins with a UC3E alternator or equal model as manufactured by Cummins. It shall provide 125% of the maximum KW demand when operating at 277/480 volts, 0.89 power factor. The generator set shall be capable of this rating while operating in an ambient condition of 105°F (87.2°C) and 3300 feet above sea level.
2. The generator set shall be natural gas.
3. Vibration isolators shall be provided between the engine-generator and heavy-duty steel base.
4. Engine: The engine shall deliver the minimum bhp at a governed speed of 1800 rpm. The engine shall be equipped with the following:
   a. An isochronous governor capable of +.25% steady-state frequency.
   b. 12-volt positive engagement solenoid shift-starting motor.
   c. 15-ampere minimum automatic battery charging alternator with solid-state voltage regulation.

   d. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick and oil drain.
   e. Dry-type replaceable air cleaner elements for normal applications.
5. The engine shall have a minimum of 6 cylinders and be liquid-cooled by a unit mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H_20 static pressure on the fan in an ambient temperature up to 122°F/50°C.

6. Generator: The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-1.65) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL-1-24092. Temperature rise of the rotor and stator shall be limited to NEMA Class H ratings. The

   excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within ±2% at any constant load from 0% to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability, and volts-per-hertz, operations; and be protected from the environment by conformal coating.
   a. The generator set shall meet the transient performance requirements of ISO 8528-5, level G-2.
   b. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 1-phase symmetrical short circuit without the addition of separate current support devices.
   c. The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
7. Controller: Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated on the generator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -40°C to 85°C. Relays will only be acceptable in high-current circuits.
8. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include the following features.
   a. Fused DC circuit
   b. Complete 2-wire start/stop control, which can operate on closure of a remote contact.
   c. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
   d. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
   e. Cranking cycler with 15-second ON and OFF cranking periods.
   f. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
   g. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.
   h. Engine cooldown timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.
   i. 3-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine

shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

j. Alarm horn with silencer switch per NFPA 110.

9. Standard indicating lights to signal the following shall be included:
   a. Overcrank (red).
   b. High Engine Temperature (red).
   c. Overspeed (red).
   d. Low Oil Pressure (red).
   e. Auxiliary Fault (red).
   f. Low Water Temperature (red).
   g. Air Damper (red).
10. Test button for indicating lights.
11. Terminals shall be provided for each indicating light above, plus additional terminals for common fault and common pre-alarm.
12. Accessories: Line circuit breaker of 200 amperes, 200 amps sensor, 3 poles, 600 volt rated, UL molded case type, generator mounted.
    a. A re-setable line current sensing circuit breaker with inverse time versus current response shall be furnished, which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. A field current-sensing breaker will not be acceptable.
    b. Weather protective enclosure shall be constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color, with a level 2 sound attenuated enclosure for 70 db(A) @ 7 meters. Side panels will be lockable and easily removed for servicing.
    c. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
    d. 12-volt lead-antimony battery(ies) capable of delivering the manufacturer's recommended minimum cold-cranking amps required at 0°F per SAE Standard J-537 shall be supplied.
    e. 10-ampere automatic float and equalize battery charger with ±10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
    f. The engine exhaust silencer shall be coated to be temperature and rust resistant, rated for critical application. The silencer will reduce total engine exhaust noise by 25-35 dB(A), residential grade muffler.
    g. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
    h. Two flexible fuel lines rated 300°F and 100 psi ending in pipe thread.

2.12 VENTILATION

A. Pump station wet well shall be provided with adequate ventilation. Ventilation piping shall be a minimum 4-inch diameter stainless-steel or aluminum threaded pipe and provided with ¼-inch screen mesh.

2.13 STATION GROUNDS

A. Fencing:
   1. A chain-link fence shall be provided around the pump station in accordance with Section 02831.
   2. The fence shall have a fabric height of six feet and be provided with three barbed wire strands above the top of the fabric.
   3. The fence shall be provided with a 12-foot wide double-leaf gate with locking system.
   4. All fencing and gates shall be grounded in accordance with the Standard Details.

B. Valve Vault:
   1. A suitable valve vault shall be provided to house a plug valve and check valve from the discharge of each pump. Check valve shall be located between the plug valve and the pump. Valves shall be placed only in horizontal pipe runs. Valves shall not be located in the wet well.
   2. Check valves shall be used in all pump discharge piping and be as specified in other sections of this specification.
   3. Plug valves shall be used in all pump discharge piping and be as specified in other sections of this specification .
   4. Valve vault shall be constructed of concrete and be provided with an aluminum access hatch cover of similar design and manufacture of the hatch cover provided for the wet well. Access hatch cover shall be of single leaf and be a minimum of 30 inches by 36 inches.
   5. Provide drain connecting vault to wet well. Provide a shut off valve in the drain piping between the vault and wetwell. Shut off valve shall be provided with a valve box and extension stem.
   6. All valves, piping and fittings shall be field painted. Field painting shall consist of a minimum of two coats of epoxy enamel paint. Color to be selected by the City.

C. Gravel Surfacing:
   1. Crushed rock: Gradation of ¾-inch to 1-inch sizes.
   2. The area inside the fence shall be provided with a minimum of 4 inches of gravel surfacing on 6 mil polyethylene sheeting placed over entire enclosed area. Polyethylene sheeting shall be provided with 3-one inch holes per square yard.
   3. Treat soil with soil sterilant prior to sheeting application.

D. Outside Lighting:
   1. An outside weatherproof pole mounted light shall be provided.
   2. Light shall be of the LED type with electric eye (photo cell) for dusk to dawn operation.

E. Access Road:
1. Pump station shall be provided with an asphalt or concrete access road.
2. The access road shall be a minimum of 12 feet in width and extend from the pump station gate to the adjacent street pavement.
3. Access road shall be constructed with a minimum of 4” thick base rock, 7” minimum thickness of black base and 1-1/2” of asphalt surface, (or concrete equivalent).
4. Access road shall have a turn-around provided at the pumping station.

F. Water Supply:
1. Provide metered water supply to pumping station with a ¾” freeze proof yard hydrant with a non-potable water sign within perimeter fence. Provide an appropriate backflow preventer as per Paragraph 2.06.A.1, Page 02640-5 in this document.

G. Power Feed:
1. An above ground fused disconnect switch shall be provided for the main power feed.

H. Minimum Retention:
1. A storage capacity for 2-hour retention of the peak hourly flow shall be provided.

I. Flood Protection :
1. Pumping station structures along with the electrical and mechanical equipment shall be protected from damage by not less than the 100-year flood elevation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pumping Station:
1. All work shall conform to manufacturer’s recommendations.
2. Make all electrical and control connections.
3. Provide all necessary lubrication for initial start-up, testing and as required for final acceptance.
4. Provide a complete unit with all materials, components and adjustments as required for successful operation.
5. Installation, start-up and setting of all equipment and associated construction shall conform to manufacturer’s recommendations.
6. Do not place grout for pump discharge bases until pumps are completely aligned.
7. Install pipe and appurtenance supports to minimize stresses on pump nozzles.
8. Electrical junction boxes are not permitted inside wet well.
9. The equipment manufacturer shall furnish the services of a qualified factory-trained field service representative to inspect the installation and perform startup operations. Field service representative shall also provide for a minimum of four (4) hours to train and instruct the City’s personnel in the operation and maintenance of the pumps and controls.
10. Field Testing:

a. Demonstrate that each pump is capable of pumping the specified flow at rated head through pumping tests of not less than five minutes for each pump.

11. Submit a written test report to Contractor with one copy to the City in a letter form stating operations performed and results obtained for each unit.
12. Submit wet well exfiltration tests results to the City as specified for Wet Well Testing in the Pipe Installation and Testing Section.

B. Automatic Transfer Switch:
   1. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
   2. Connections:
      a. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
      b. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
      c. Ground equipment according to 2017 NEC.
   3. Source quality control:
      a. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
      b. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
      c. Factory shall perform dielectric strength test complying with NEMA ICS 1.
   4. Field quality control:
      a. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
      b. Manufacturer’s representative shall perform tests and inspections and prepare test reports.
      c. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
         - Perform recommended installation tests as recommended in manufacturer’s installation and service manuals.
         - After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
         - Simulate power failures of normal source to automatic transfer switch and of emergency source with normal source available.
         - Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
         - Verify time-delay settings.
         - Verify that the transfer switch is accurately metering AC voltage and current (when provided).
         - Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
   5. Demonstration:
      a. After generator set installation, the generator and transfer switch supplier shall

conduct a complete operation, basic maintenance and emergency service seminar covering generator set and transfer switch equipment for up to five (5) people employed by the City.

b. Seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided and emergency operation procedures.

c. Class duration shall be at least 4 hours in length and include practical operation with the installed equipment.

6. Service and Support:
   a. The manufacturer shall supply the City with a complete set of the service and maintenance library required to support the product.
   b. The manufacturer shall provide a five year (5) extended warranty (parts and labor).

C. Standby Electric Generator
   1. System:
      a. All equipment shall be installed in strict compliance with the manufacturer's instructions. On completion of the installation, startup and training shall be performed by a factory-trained service representative to insure compliance with the specifications.
      b. Contractor shall test all gas piping from the customer side of gas meter to the generator set prior to startup.
   2. Site Tests: An installation check, startup and pumping station load test shall be performed by the manufacturer's service representative. The City's Public Works Staff shall be notified of the time and date of the site test. The test shall include:
      a. Fuel, lubrication oil and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
      b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include block heaters, battery charger, generator strip heaters, remote annunciator, etc.
      c. Startup under test mode to check for exhaust leaks, cooling sir flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency and phase rotation.
      d. Engine coolant temperature, oil pressure and battery charger level, along with generator voltage, amperes and frequency shall be monitored throughout the test. An external load bank shall be connected to the system in sufficient pumping station load is not available to load the generator to the nameplate kW rating

D. Submit a written test report to Contractor with one copy to the City in a letter form stating operations performed and results obtained for each unit.

E. Wet well hydrostatic tests as specified for Manhole Water Testing in the Pipe Installation and Testing Section.

END OF SECTION 11151

SECTION 12000 – RIGHT-OF-WAY TECHNICAL SPECIFICATIONS

PART 1 – GENERAL REQUIREMENTS

1.01 SUMMARY OF WORK

A. Work Covered by These Specifications:

1. The work covered by these specifications shall consist of any and all utility work performed or to be performed in, under, or through rights-of-way, streets, or alleys, including but not limited to water supply, sanitary sewer, storm sewer, telephone, fiber optic cable, gas pipelines, electrical conduit or conductors, cable television lines, and telecommunication facilities. It is to include repair of street cuts, required final grading, and seeding or sodding. No street cut shall be accomplished without approval from the Public Works Director.
2. Public Right-of-Way shall be reserved for public water, sanitary sewer and storm sewer piping. Private utilities (telephone, fiber optic cable, gas, electrical conduit, cable tv and telecommunication facilities) shall be located in utilities easements outside of Public Right-of-Way.

B. Work Sequence:

1. Private Utility Installers shall schedule his work to allow emergency vehicle access to public and private property at all times. Private drives and public streets and alleys shall be opened for use at the end of each workday.

C. Coordination with Work by Others:

1. Private Utility Installers shall cooperate with City employees or others who may be working in the area of this Work. They shall strive to coordinate their Work to not interfere with the work of others unnecessarily. They will not be required to interrupt the progress of their operations materially to assure such coordination.

1.02 REFERENCES

A. Applicable Standards;

1. American Society for Testing and Materials (ASTM);

a. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.

b. D1556 – Density and Unit Weight of Soil in Place by Sand-Cone Method.

c. D2167 - Density and Unit Weight of Soil in Place by the Rubber Balloon

Method.

d. D6938 – Density and Water Content of Soil and Soil-aggregate in by Nuclear Methods, (Shallow Depth).

2. Department of Transportation, Public Service Commission;

a. Part 192 – Transportation of natural and Other Gas by Pipeline.

3. Missouri Standard Specifications for Highway Construction;

1.03 EXISTING ABOVE GROUND AND UNDERGROUND INSTALLATION AND STRUCTURES

A. General:

1. Utility poles, pipe lines and other existing above ground and underground installations and structures in the vicinity of the Work are to be indicated on the plans according to the best information available to the Private Utility Installer and City.

2. Private Utility Installer shall make every effort to protect such installations and structures. They shall contact the owners of such installations and structures and prospect in advance of trench excavation.

3. Damage to existing above ground and underground installation or structures caused by the Private Utility Installer shall be repaired by the Private Utility Installer as directed by the owner of such installation or structure. The owner of such installation or structure shall be notified immediately of any such damage and repairs made as soon as possible to keep the interruption of service to a minimum. The Private Utility Installer shall bear any costs assessed because of such repairs and shall hold the City and the Engineer harmless.

1.04 TRAFFIC CONTROL AND SAFETY

A. Maintenance of Traffic:

1. The Private Utility Installer shall conduct their work as to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways or walks, whether public or private, the Private Utility Installer shall at their own expense provide and maintain suitable and safe bridges, detours or other temporary expedients for the accommodations of public and private travel, and shall give reasonable notice to the owners of private drives before interfering with them. Prior to interfering with the public travel in any way, the Private Utility Installer shall notify the Public Works Department with information as to the extent of the interference and the length of time of such interference to permit review and approval by the Public Works Department.

B. Barricades and Lights:

1. All streets, roads, highways and other public thoroughfares, which are closed to traffic, shall be protected by means of effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or street on each side of the blocked sections.

2. All open trenches and other excavations in Public Right-of-Way shall be provided with suitable barriers, signs and lights to the extent that adequate protection is provided to the public. Obstructions, such as material piles and equipment, shall be provided with similar warning signs and lights. All barricades and obstructions shall be illuminated by means of warning lights at night. All lights used for this purpose shall be kept illuminated from sunset to sunrise. Materials stored upon or alongside public streets shall be so placed, and the work at all times shall be so conducted, as to cause the minimum obstructions and inconvenience to the traveling public.

3. All barricades, signs, lights and other protective devices shall be installed and maintained in conformity with the latest edition of the Manual of Uniform Traffic Control Devices and applicable statutory requirements, and where within rights-of-way, as required by the authority having jurisdiction there over.

PART 2 – EXCAVATION, TRENCHING, AND BACKFILL

2.01 GENERAL

A. This specification covers excavation and trenching and backfilling work in Public Right-of-Way and shall include the necessary clearing, grubbing and preparation of the site, removal of improvements; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of sub grades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.

B. Excavation, trenching and backfilling work shall be performed in a safe and proper manner, with suitable precautions being taken against hazards of every kind. Excavation shall provide adequate working space and clearance for the work to be performed therein.

C. No backfill, fill or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill, fill, or embankments.

2.02 REMOVAL OF WATER

A. The Private Utility Installer shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during sub grade preparation and

continually thereafter until the pipeline to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.

B. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches, to the greatest extent practicable without causing damage to adjacent property.

2.03 TRENCH EXCAVATION

A. Trench excavation for private utilities crossing Public Right-of-Way shall comply with the following requirements.

B. Alignment and Grade-Natural Gas Pipelines:

1. Natural gas pipelines shall be located in utility easements and laid in a straight alignment parallel or perpendicular to the street centerline to the greatest extent possible. Natural gas transmission lines shall be placed at depths specified by DOT/MPSC Part 192.

2. Non-metallic lines shall be buried with metallic locator wires or tape, which will permit accurate location of said lines from the surface with normal magnetic locator devices.

3. Any line passing under a City street shall be buried at a minimum of 36” below the street surface and 24” below flow line of storm drains.

C. Alignment and Grade-Telecommunications Lines:

1. Telecommunication lines shall be located in utility easements and laid in a straight alignment parallel to, or perpendicular to, the street centerline to the greatest extent possible. Local service lines shall be buried a minimum of 24”. Trunk lines and fiber optic lines shall be buried at a minimum depth of 36”. Any line passing under a City street shall be buried at a minimum of 36” below the street surface. Placement must be a minimum of 24” below flow line of storm water structure and natural flow line.

D. Alignment and Grade-Underground Electric Transmission Lines:

1. Electric transmission lines buried in the City rights-of-way shall be laid in a straight alignment parallel to, or perpendicular to, the street centerline to the extent possible. Electric transmission lines shall be buried at a minimum depth of 36”.

2.04 BACKFILL

A. Ordinary Backfill:

1. There shall be no ordinary backfill in this Work.

B. Compacted Backfill in unimproved areas:

1. 90% compaction will be required in Public Right-of-ways except under roadways, driveways and sidewalks. The average density of the trench backfill shall be 90% of maximum density. Material shall be placed in lifts as required for adequate compaction with variations in lift thickness depending on soil and on method of compaction. Completed backfill shall have no less than 90% density, excluding the top few inches to be used as seedbed or for bedding sod.

C. Compacted Backfill in improved areas:

1. 95% compaction will be required under streets, driveways, and walkways. Backfill material shall be granular in accordance with requirements in Section 02200.

2. Placement of material and compaction for 95% compacted backfill shall be as described above for 90% compacted backfill except a minimum of 95% of maximum density must be maintained throughout the backfill.

D. Standard Compaction and Field Density Tests:

1. Wherever the terms “% of Maximum Density” or “Optimum Moisture” are used, Maximum Density and Optimum Moisture shall be determined by the Standard Compaction Test as defined by ASTM D698.

2. Field Density Test: Field density shall be obtained using the sand cone method (ASTM D1556), by the balloon method (ASTM D2167), or nuclear density gauge (ASTM D 698). The calculated density obtained in this test is divided by the Maximum Density as determined by the Standard Compaction Test to determine the percent compaction obtained.

3. Private Utility Installer will, through services of an independent laboratory, test all backfill at intervals as required to verify conformance with specified density relationships. A copy of all test results shall be provided to the City.

E. Responsibility of Private Utility Installer for Backfill Settlement:

1. Where either 90% or 95% compaction is called for, the Private Utility Installer shall be responsible financially, and otherwise, for a period of one year after completion of work, for;

(a). all settlement of trench and other backfill which may occur from time of original backfilling,

(b). the refilling and repair of all backfill settlement and the repair or replacement to the original or a better condition of all pavement, top surfacing, driveways, walks, surface structures, utilities, drainage facilities, and sod which have been

damaged as a result of backfill settlement or which have been removed or destroyed in connection with backfill replacement operations, and
(c). all damage claims or court actions against the City for any damage directly or indirectly caused by backfill settlement.

4 The Private Utility Installer shall make, or cause to be made, all necessary backfill replacements, and repairs or replacements appurtenant thereto, within thirty days after notification by the Engineer or City.

PART 3 – RESTORATION OF SURFACE

3.01 GENERAL

A. The Private Utility Installer shall restore all surfaces equal to or better than its original condition unless otherwise specified. Restoration includes pavement, sidewalks, curb/gutter, lawns, etc.

3.02 SEEDING, FERTILIZING AND MULCHING

A. Seeding and fertilizing is required where any utility excavation crosses Public Right-of-Way. The Private Utility Installer, at his option, may provide sod as specified herein in lieu of seeding in any or all areas required to be seeded. See Section 02930 for details of requirements.

3.03 STREET, DRIVEWAY, ALLEY AND SIDEWALK REPAIRS

A. All materials used shall conform to the City's Constructions Specifications and the latest edition of MoDOT's Standard Specifications for Highway Construction.

a. Black Base Course shall comply with Section 401 Plant Mix Bituminous Base or Section 403 Asphaltic Concrete Pavement, Type SP190 or Type SP250.

b. Surface Course shall comply with Section 401, Type BP-2 or Section 403, Type SP125.

c. Tack Coats shall comply with Section 407.

d. Any Prime Coat required shall comply with Section 408

B. All pavements are to be saw-cut prior to removal. Repairs to streets, driveways, and alleys disturbed by work in City right-of-way are to be made as follows:

1. New pavement shall have a width of at least 24" greater (12" each side) than the trench width. Each repair area in concrete or asphalt streets shall be cut on all sides for the full depth of the pavement with a concrete saw. The material shall be removed so

that no damage occurs to the surrounding pavement. If any damage occurs to the surrounding pavement, then the damaged areas will also be removed and replaced.

2. For concrete pavements, see Section 03300 in this document and details in the Standard Drawing Details. Concrete shall meet Missouri Standard Specifications for Highway Construction for Pavement Concrete Section 501, and shall have a maximum slump of 4 inches and a minimum compressive strength of 4000 psi at 28 days.

3. For asphalted concrete pavements, the asphalt thickness of the repair shall be at least 6” or equal to thickness of adjacent existing pavement, (whichever is greater), over a minimum of 4” of compacted base rock. The stone base (MoDOT Type I), shall be compacted to 95% of Maximum Dry Density. Replace the pavement with hot-mix asphalt and compact thoroughly in lifts not to exceed 2” each. See Section 02512 in this document and details in the Standard Drawing Details.

4. The top of all pavement repairs shall be flush with the existing pavement.

5.Curbs and gutters to be replaced as required to match existing shape and material. Curbs and gutters are to be constructed as per Section 02525 in this document).

4. Sidewalks shall be replaced over the entire width and to the nearest joints. The concrete thickness shall be at least 4” placed over a 4” thick rolled stone base or to existing if thicker. Concrete used for sidewalk repair shall be equivalent to MoDOT Class B-1 concrete, 4000 psi and shall have a maximum slump of 4”. Sidewalk construction shall be as per Section 02525 in this document.

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END OF SECTION 12000