SECTION 1 – GENERAL REQUIREMENTS

1.1 DEFINITIONS

A. Whenever used in these specifications the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1. **City** – The City of Tipton, represented by the City Council, having the authority of approval of the plans, specifications and acceptance of the final construction.
2. **Engineer** – City Engineer or representative to act on behalf of the City.
3. **Owner** – Person or firm having control of the development site, and management of the project.
4. **Contractor** – The person, firm or corporation with whom the developer has entered into an agreement for construction of the project.
5. **Project** – The total construction of which the work to be provided may be the whole or part.
6. **Work** – The entire completed construction or the various separately identified parts thereof required to be furnished.

1.2 WORK TO BE PERFORMED

A. The City Engineer, with consultation and input from Tipton Utilities, shall review and advise the Utility on all plans for the construction of water lines, sewage lines, and storm water lines proposed by a developer. If the City of Tipton does not employee a full-time City Engineer, the Utility may, at its discretion, hire an engineer of its choice to review and advise the Utility regarding all proposed plans and ensure all standards provided herein and applicable standards and requirements of the appropriate governmental jurisdictions are met. The cost to hire an engineer by the Utility to review and advise on developer construction plans shall be borne by the developer.

B. Work may not commence until the City Engineer or engineer working on behalf of the Utility concurs with the “final” plans of the developer.

C. Work to be performed shall be in accordance with the drawings and specifications concurred to by the City Engineer and Tipton Utilities. If the City of Tipton does not employ a full-time City Engineer, the Utility may, at its discretion, hire an engineer to inspect all construction work and ensure conformance with the “final” plans. The cost to hire an engineer by the

Utility to inspect and ensure conformance with the “final” plans shall be borne by the developer.

D. Prior to the commencement of work, developer shall post individual Performance Guarantees for the construction of water lines, sewage lines and/or storm lines as follows:

The developer shall be required to provide financial performance guarantee, by certified check, performance bond, or any irrevocable, unconditional, acceptable letter of credit issued by a financial institution acceptable to the Tipton Utility Board, that all water, sewer, and/or storm lines shall be completed in a timely manner. Bonds, checks, and letters are to be issued in the name of the City of Tipton. Said financial performance guarantee shall be conditioned upon the following:

1. The completion of water, sewage, and/or storm lines improvements and installations shall be within two (2) years from the commencement of work;
2. A penal sum shall be fixed and approved by the Tipton Utility Board equal to 100% of the total estimated current cost of all water, sewage and storm lines improvements and installations provided in the “final” plans;
3. Should the developer not complete the water, sewage, and/or storm lines improvements and installations as required within the stated two (2) year period, the Utility Board may approve an extension of time of up to two (2) additional years, granted at six (6) month intervals, for completion of the required water, sewage, and/or storm lines improvements and installations. Should the developer not complete the water, sewage, and/or storm lines improvements and installations as herein required within the two (2) year period or within any time extension approved by the Utility Board, the Utility Board may take the necessary steps to proceed with the completion of the water, sewage, and/or storm lines improvements and installations, making use of the certified check, performance bond or letter of credit.
4. The developer may request the release of the performance guarantee posted with the City of Tipton after the following requirements are met:

    a. the City Engineer or the Utility’s designated engineer certifies the water, sewage and/or storms lines were installed as shown on the “final” plans and in conformance with the standards herein and all applicable standards and

requirements of the appropriate governmental jurisdictions; and

b. the developer shall provide the Utility Board with two (2) sets of “mylar” as-built drawings and an electronic file showing all water, sewage, and/or storm lines improvements and installations; and

c. upon the receipt of a maintenance guarantee, the proper authority shall release the performance guarantee within sixty (60) days.

E. Prior to the release of the performance guarantee the developer shall be required to provide financial maintenance guarantee, by certified check or maintenance bond, that all public facility improvements and installations required under the provisions of this ordinance shall be maintained according to specifications cited herein. Bonds and checks are to be issued in the name of the City of Tipton. Said financial maintenance guarantee shall be conditioned upon the following:

1. The maintenance shall run and be in force for a period of three (3) years from the date of the performance guarantee.
2. A penal sum shall be fixed and approved by the Utility Board but **not** less than 15% of the total performance guarantee for the water, sewer, and/or storm lines performance guarantee for improvements and installations. The minimum maintenance guarantee to be posted shall be no less than $5,000.00.
3. Each water, sewer and/or storm lines improvement or installation shall be bonded individually, or have an individual certified check to cover the penal sum and, and shall not have the maintenance guarantee provided in combination with any other improvement or installation.
4. All maintenance bonds shall expire at the end of the three (3) year period for which they were established. Within 60 days of the expiration date, the City of Tipton shall return said expired maintenance bonds to the developer. In the case where a certified check has been posted as a maintenance guarantee, the developer shall, at the end of the three (3) year maintenance period, contact the City of Tipton in order to obtain the release of the maintenance guarantee. The City of Tipton shall return said maintenance guarantee to the developer within sixty (60) days. The maintenance guarantee for each water, sewer, and/or storm lines improvement or installation shall be handled separately and shall in no way be contingent on the completion of any of the other individual improvements and installations or their maintenance.

1.3 LOCAL LABOR AND MATERIAL

A. Whenever possible, the Contractor, his subcontractors, material men, or others who employ labor, shall employ such labor locally.

B. The Contractor shall purchase materials such as sand, cement, gravel, pipe, steel, lumber, etc., from local dealers wherever such local dealers' prices meet competitions; and where such materials meet the specifications.

1.4 SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction."

1.5 DISCOVERY OF HAZARDOUS MATERIAL

If, during the course of this work, the existence of hazardous material, including asbestos containing material, is observed in the work area, the Contractor shall immediately notify the Owner in writing. The Contractor shall not perform any work pertinent to the hazardous material prior to receipt of special instructions form the Owner and the City of Tipton. Asbestos containing material includes transite pipe.

1.6 EASEMENTS

A. The Developer will obtain right-of-way easements over and through certain private lands for the construction and rehabilitation. The width or limits of such rights-of-way will be defined by the City before the work or construction shall begin. If the methods of construction employed by the Contractor are such as to require the use of land beyond the limits obtained, he shall make his own agreements with the property owners affected for the use of such additional land.

B. In all such right-of-way easements, the Contractor shall be required to carefully remove the property owner's fences, or other obstacles to the construction procedure, and replace the same after the work is installed. The backfilling shall be to the grade of the existing ground level or to the grade as established by the property owner in the event the property owner permits the deposit of excess material upon such land.

C. The cost of all such restoration of property shall be included in this work.

1.7 OPERATIONS WITHIN RIGHT-OF-WAY

A. The contractor must stake right-of-way lines and maintain such stakes throughout the construction period. The contractor must also provide finished grade stakes throughout the sub-division for the duration of the construction period.

B. In public thoroughfares, all operations of the contractor, including those of temporary nature, must be confined within the applicable right-of-way limits after having obtained approval of the Town. If the methods of the construction employed by the Contractor are such as to require the use of land beyond the public thoroughfares, he shall make his own agreements with the property owners affected for the use of such additional.

1.8 PERMITS

A. The Developer will obtain permits which relate to the completed facilities. Permits obtained by the Developer include permits from the following:

1. Indiana Department of Environmental Management
2. Department of Natural Resources
3. Corps of Engineers
4. Indiana Department of Fire Prevention & Building Safety
5. Indiana Department of Transportation
6. Railroads
7. City of Tipton Tree Permit Request

B. The Contractor shall obtain permits which relate to construction procedures.

1. All necessary permits or licenses required from the State or County in connection with construction procedures under or along existing highways shall be obtained by and at the expense of the Contractor. The construction shall be performed by the Contractor in full accordance with any and all requirements of the State Highway Commission or County Road Commission, including those applying to barricades, watchmen, guarding, lighting, storage of supplies, equipment and excavated materials, method of backfilling, final grading, replacement of pavement or road surface, and all other conditions or requirements which may be stipulated by the State Highway Commission or County Road Commission, whether specifically shown on the drawings or mentioned in the specification.
2. The Contractor shall obtain all blasting permits required.

1.9 MAINTAINING TRAFFIC

A. Before closing any thoroughfare, the Contractor shall notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county or city.

B. The Contractor shall notify the City of his intention to close a particular street 72 hours in advance of the proposed closing. The Contractor shall place all proper detour signs and barricades prior to the actual street closing.

C. During the construction, the Contractor shall be responsible for maintaining and protecting the pedestrian and vehicular traffic at all times on all streets involved and providing access to all residential and commercial establishments adjacent to the construction area. The Contractor shall furnish and maintain signage, barricades, flares, etc., in accordance with Indiana Manual on Uniform Traffic Control Devices. The signage, barricades, etc., must be in good condition.

D. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Insofar as it is practicable, do not locate excavated material and spoil banks in such manner as to obstruct traffic. Keep the traveled way of all street, roads, and alleys clear and unobstructed insofar as is possible. Do not use streets, roads, or alleys for the storage of construction materials, equipment supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed, except when and where necessary, and then only upon due advance notice to the Engineer and for the shortest practicable period of time, consistent with efficient and expeditious construction. The Contractor shall be liable for any damage to persons or property resulting from his work.

E. Streets in which excavation has occurred shall be temporarily restored to receive traffic as soon as possible. Permission to close additional streets shall be denied the Contractor if, in the opinion of the City or the Engineer, the restoration on streets where excavation has occurred has not progressed satisfactorily.

1.10 WALKS AND PASSAGEWAYS

The Contractor, when required, shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise. Do not obstruct the sidewalks, gutters, or streets, or prevent in any manner the flow of water in streets. Use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter; exercising such precaution as may be directed by the Engineer. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.

1.11 WARNING LIGHTS AND ARROW BOARDS

The Contractor shall place sufficient warning lights and arrow boards on or near the work and keep them illuminated during periods of construction and reduced visibility (from twilight in the evening until sunrise) and shall be held responsible for any damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

1.12 UTILITIES

A. Temporary Removal: All existing utility systems which conflict with the construction of the work herein which can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the work may be done by the Contractor.

B. Permanent Relocation of Utilities: Water mains, storm sewer inlets, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light and traffic standards, cable ways, signals, and other utility appurtenances located in the public right-of-way which would permanently interfere with the proposed improvements will be moved by the utility involved and paid for by the Contractor.

C. Payment for Utilities: The Contractor shall make all necessary applications and arrangements and pay all fees and charges for electrical energy for power and light, a gas energy, water service, and telephone service require for the construction of this Contract during its entire progress. He shall provide and pay for all temporary wiring, switches, connections, and meters.

1.13 DUST, NOISE, AND EROSION CONTROL

Dust shall be minimized by use of water and deliquescent salts. Noise shall be minimized by use of properly constructed and maintained equipment provided with suitable mufflers, snubbers, and other sound attenuating devices and supports. Erosion shall be controlled in such manner that soil particles from the construction site are prevented from entering the public waters or from being deposited on neighboring property, streets, and highways.

1.14 SUBMITTALS – CERTIFICATE OF COMPLIANCE

The Contractor shall submit to the City a Certificate of Compliance from the manufacturer and/or supplier of each and every specified material or manufactured equipment item. The Certificate shall state that the material or the item of equipment to be furnished has been manufactured with materials in accordance with the applicable sections of all required codes, specifications, and standards as required by the specifications.

1.15 MANUFACTURER'S SERVICE TIME

A. When a lift station or other equipment is to be furnished by the Contractor and maintained by the City, service by the manufacturer is required to be furnished as part of the work and shall be at the Contractor's expense.

B. The service provided shall be by a qualified representative to check the completed installation, place the equipment in operation, and instruct the City's operators in the operation and maintenance procedures. Such services are to be for a period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.

C. The services shall further demonstrate to the City's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.16 GUARANTEE/WARRANTY

The Contractor shall provide a written or typed warranty for all equipment installed.

1.17 RECORD DRAWINGS

A. Contractor shall prepare or be responsible for preparation and submittal of one (1) set of half-size (11" x 17") record drawings, one (1) set of full size reproducible mylar drawings and one (1) set in an electronic file (compact disk, 3.5" disk, or electronic file transmission) utilizing AutoCAD (Release

14) or comparable computer-aided design software in “DWG” and/or “DFX” format.

B. Record drawings shall be a full set of drawings showing all details of the sewer construction project reflecting any changes from the approved drawings and showing accurate locations of manholes, structure, sewers, house/building services, utility crossings and other pertinent features.

C. Record drawings shall be certified to accuracy by a registered professional Engineer.

D. Record drawings shall be submitted to City Utility Superintendent within thirty (30) days after the completion of construction.

END OF SECTION 1

SECTION 2 – TEMPORARY EROSION AND DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item shall consist of temporary control measures as shown on the plans or as ordered by the Owner during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

B. Temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment, and material storage sites, waste areas, and temporary plant sites.

D. Erosion control design for crossing a legal drain shall be approved and constructed per the latest standards of the Tipton County Surveyor's Office.

1.2 SUBMITTALS

Submit Control Plans to Engineer for review and approval.

PART 2 – PRODUCTS

2.1 GRASS

Grass which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

2.2 MULCHES

Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

2.3 FERTILIZER

Fertilizer shall be a standard 10-10-2 commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

2.4 STRAW BALE DIKE

Straw bale dikes, as illustrated in Detail 1, Section B, Page 5, shall be used to prevent soil erosion at all stream or ditch crossings. Individual straw bale dike locations are indicated on the site plans.

2.5 SLOPE DRAINS

Where construction disturbs grassy slopes equal to or steeper than 3:1 the slope shall be protected with an erosion control mat as illustrated in Detail 2.A and 2.B as shown in Section B, Pages 6 and 7. Slope drains may be constructed of pipe, fiber mats, rubber, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

2.6 SILT FENCING

Silt fencing, as illustrated in Detail 3 as shown in Section B, Page 8 shall be used to prevent soil erosion at top of slope locations as indicated on the site plans.

2.7 OTHER

All other materials shall meet commercial grade standards and shall be approved by the Owner before being incorporated into the project.

PART 3 – EXECUTION

3.1 GENERAL

A. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

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

3.2 SCHEDULE

Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, construction, paving, and

structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.

3.3 AUTHORITY OF OWNER

The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

3.4 CONSTRUCTION DETAILS

A. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.

B. Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

C. The Owner will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor’s capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

D. In the event that temporary erosion and pollution control measures are required due to the Contractor’s negligence, carelessness, or failure to

install permanent controls as a part of the work as scheduled or are ordered by the Owner, such work shall be performed by the Contractor at his/her own expense.

E. The Owner may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

F. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

G. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.

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

END OF SECTION 2

SECTION 3 – EARTHWORK FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Specifications for the stripping of topsoil and vegetation, excavation, trenching, bedding, filling, backfilling, compaction, and related work in connection with the installation of water mains, gravity sanitary sewers, storm sewers, and force mains are included in this Section.

B. Definitions

1. Excavation: Removal of earth and rock to form a trench for the installation of a water main, gravity sanitary sewer, storm sewer, or force main.

2. Earth: Unconsolidated material in the crust of the Earth derived by weathering and erosion. Earth includes:

   a. Materials of both inorganic and organic origin;
   b. Boulders less than 1/3 cubic yard in volume, gravel, sand, silt, and clay;
   c. Materials which can be excavated with a backhoe, trenching machine, dragline, clamshell, bulldozer, highlift, or similar excavating equipment without the use of explosives, rock rippers, rock hammers, or jack hammers.

3. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes:

   a. Limestone, sandstone, dolomite, granite, marble, and lava;
   b. Boulders 1/3 cubic yard or more in volume;
   c. Materials which cannot be excavated by equipment which is used to remove earth overburden without the use of explosives, rock rippers, rock hammers, or jack hammers;
   d. Materials which cannot be excavated with a backhoe, trenching machine, dragline, clamshell, bulldozer, high-lift, or similar excavating equipment without the use of explosives, rock rippers, rock hammers or jack hammers.

4. Undercutting: Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.
5. Subgrade: Undisturbed bottom of a trench.

6. Bedding: Earth placed in trench to support pipe and conduit.
7. Backfill and Fill: Earth placed in trench from the top of bedding to finished grade, or to subbase of pavement.
8. Topsoil: Earth containing sufficient organic materials to support the growth of grass.

1.2 QUALITY ASSURANCE

A. The blasting supervisor shall have no less than five (5) years experience in explosive demolition and excavation. The blasting supervisor and crews shall have all appropriate licenses for the handling and use of explosives.

B. A Blasting Monitoring and Control Program shall be developed by the Contractor, and submitted to the Engineer, prior to the commencement of blasting operations.

1. The Blasting Monitoring and Control Program shall indicate the blasting area, the charge locations, number of explosive rounds at each charge location, the maximum charge per delay in pounds, and the maximum charge per round in pounds.

1.3 SUBMITTALS

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Materials test reports.
2. Blasting supervisor's experience record.
3. Blasting Monitoring & Control Program.
4. Storage procedures for explosives.

1.4 JOB CONDITIONS

A. All information given in the Contract Documents, including drawings relating to borings, materials encountered, and rock elevations, is from surveys performed by other consultants. Such information is furnished only for the information and convenience of the Contractor. The Engineer does not warrant or guarantee that the materials and conditions encountered during construction will be the same as indicated by the boring samples or by information shown on the drawings.

B. Existing storm sewers, sanitary sewers, water mains, gas mains, electric ducts, telephone ducts, steam mains and other underground structures, lines, and their house connections have been shown on the plans

according to the best available information. The exact location and protection of these facilities and structures, their support and maintenance in operation during construction (in cooperation with the proper authorities), is the responsibility of the Contractor in the performance of his contract.

PART 2 – PRODUCTS

2.1 BEDDING

A. Class I bedding shall be angular 6 to 12 mm (1/4 to ½ inch) graded stone, coral, slag, cinders, crushed stone or crushed shells.

B. Class II bedding shall be coarse sands and gravels with maximum particle size of 20 mm (3/4 inch). Class II bedding includes variously graded sands and gravels containing small percentage of fines generally granular and non-cohesive, either wet or dry. Soil types GW (well-graded gravel), SW (well-graded sand), and SP (pea gravel and/or crushed stone mixed with sand) are included in this class.

2.2 BACKFILL

A. General: Backfill shall be earth of such gradation and moisture content that the soil will compact to the specified density and remain stable. Unsuitable materials shall not be used.

B. Cover Material: Pipe cover material shall consist of durable particles ranging in size from fine to coarse (No. 200 to 1 inch) in size in a substantially uniform combination. Unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable. Bedding material may be used for cover material.

C. Granular Backfill – Special Backfill: Granular backfill, when indicated on the plans or as ordered by the Engineer, shall be used for backfilling providing it meets the following soils classified by the Unified Soils Classification System ASTM D-2487 or the Indiana State Highway Standard Specification Section 211 – Special Fill and Backfill (“B” Borrow).

Group Symbols	Typical Names
GW	Well-graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
SW	Well-graded sands and gravelly sands, little or no fines

SP	Poorly graded sands and gravelly sands, little or no fines

D. Gravel Backfill: When the material excavated from the trench is suitable for granular backfill, the Engineer reserves the right to order, in writing, the use of this excavated material in place of the granular backfill specified to be paid for as a separate pay item.

E. Suitable Excavated Materials as Backfill: Excavated material shall be used when earth backfill is specified on the plans or where granular backfill is not specifically specified, provided that such material consists of loam, clay, or other materials which, in the judgment of the Engineer, are suitable for backfilling. Unsuitable backfill or frozen backfill material shall not be used. Suitable backfill shall be the following soils, classified by the Unified Soil Classification System, ASTM D-2487:

Group Symbols	Typical Names
GW	Well-graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands and gravelly sands, little or no fines
SP	Poorly graded sands and gravelly sands, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays

F. Unsuitable Materials: Materials which are unsuitable for backfill include stones greater than 8 inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic, and the following soils, classified by the Unified Soil Classification System, ASTM D-2487:

Group Symbols	Typical Names
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
PT	Peat, muck, and other highly organic soils

G. Concrete Backfill: Concrete used for backfill around sewers, water mains, or other utility piping shall be Class B concrete.

H. Cellular Concrete: Lightweight cellular concrete may be used for filling of abandoned sewers as a grouting mixture for filling voids and as a substitute for backfill concrete in tunnels or casing pipes. The cellular concrete shall be produced by blending preformed foam with cement-sand grout slurry to produce a concrete having a fresh weight per cubic foot of not less than 75 pounds.

PART 3 – EXECUTION

3.1 EXISTING UTILITIES, STRUCTURES, AND PROPERTY

A. All poles, fences, sewer, gas, water or other pipes, wires, conduits and manholes, railroad tracks, buildings, structures and property along the routes of water mains, force mains, and sewers shall be supported and protected from damage by the Contractor.

B. Movable items such as mailboxes may be temporarily relocated during construction. Place movable items in their original location immediately after backfilling is completed, unless otherwise shown on the drawings. Replace movable items which are damaged during construction.

C. The Contractor shall proceed with caution in the excavation and preparation of trenches so that the exact location of underground utilities and structures, both known and unknown may be determined. The Contractor shall be responsible for the repair of utilities and structures when broken or otherwise damaged.

D. Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of underground structures, the Contractor shall make explorations and excavations for such purpose.

E. Wherever sewer, gas, water, or other pipes or conduits cross the trench, the Contractor shall support said pipes and conduits without damage to them and without interrupting this Contract. The manner of supporting such pipes, etc., shall be subject to the approval of the utility involved.

F. When utility lines that have to be removed or relocated are encountered within the areas of operations, the Contractor shall notify the Engineer in ample time for the necessary measure to be taken to prevent interruption of the service.

G. The Contractor shall so conduct the work that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the work unless he shall have first obtained the property owner's written consent thereto and shall have shown said written consent to the Engineer.

H. All excavated material shall be piled in a manner that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

I. All streets, alleys, pavements, parkways, and private property shall be thoroughly cleaned of all surplus materials, earth, and rubbish placed thereon by the Contractor.

3.2 CLEARING

A. Clear and remove logs, stumps, brush, vegetation, rubbish, and other perishable matter from the project site as required to perform work.

B. Do not remove or damage trees that do not interfere with the work. Completely remove trees required to be removed, including stumps and roots. Properly treat damaged trees which can be saved.

C. Debris from the tree removal, including trunk, branches, leaves, roots and stumps, shall not be buried or burned on the job site, but must be completely hauled away and disposed of at the Contractor's expense.

3.3 STRIPPING AND STOCKPILING OF TOPSOIL

A. Strip topsoil and vegetation from the excavated areas. Clean topsoil may be stockpiled for reuse as the upper 6 inches of the areas to be seeded.

B. Do not intermix grass, weeds, roots, root mat, brush, and stones larger than 3 inches with stockpiled topsoil. Dispose of root contaminated topsoil.

3.4 PAVEMENT AND WALK REMOVAL

A. Remove existing pavement and walks from the excavated areas. Remove excavated asphaltic and concrete materials from the job site as these materials are excavated.

B. The width of pavement removed along the normal trench for the installation of pipe and structures shall not exceed the width of the trench by more than 12 inches on each side of the trench when the amount of pavement removed is less than 75% of the total existing pavement width. Remove all existing pavement when the excavation requires the removal of 75% or more of the total existing pavement width.

C. Remove walks completely when excavation is along the length of a walk and requires the removal of part of the walk. Remove walks to existing joints in the walks when excavation crosses walks. If there are no joints in an existing walk, the width of walk removed shall not exceed the width of the trench by more than 12 inches on each side of the trench.

D. Use methods to remove pavement and walks that will assure the breaking or cutting of pavement and walks along straight lines. The face of the remaining pavement and walk surfaces shall be approximately vertical.

3.5 EXCAVATING

A. General: After stripping of topsoil and vegetation, perform excavations of every description regardless of material encountered within the grading limits of the project to lines and grades as indicated on the drawings or as otherwise specified.

1. Materials removed below the depths indicated without specific direction of the Engineer shall be replaced at no additional cost to the Owner, to the indicated excavation grade with satisfactory bedding materials placed and compacted.

B. Dewatering: Keep excavations free from water until the water mains, force mains, sewers, structures, and appurtenances to be constructed in

the excavations are completed and will safely withstand forces from water. Provide sufficient dewatering equipment and make satisfactory arrangements for the disposal of the water without undue interference with other work, damage to property, or damage to the environment.

1. Operate dewatering equipment ahead of pipe laying and keep the water level below the pipe invert until the pipe is secured by backfill.

C. Trenching: Trees, boulders, and other surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.

1. Do no open more than 100 feet of trench in advance of the installed pipe, unless otherwise directed or permitted by the Engineer. Excavate the trench within 6 inches of full depth for a distance of at least 30 feet in advance of the pipe laying, unless otherwise directed or permitted.
2. Contractor shall be responsible for the determination of the angle of repose of the soil in which the trenching is to be done. Excavate all slopes to at least the angle of repose except for areas where solid rock allows for line drilling or presplitting, or where shoring or trench box is to be used.
3. Sides, slopes, and faces of all excavations shall meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Give special attention to slopes which may be adversely affected by weather or moisture content.
4. Flatten the trench sides when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.
5. Shoring, sheeting, trench box, or other means shall be used to support sides of trenches in hard or compact soil when the trench is more than 5 feet in depth and 8 feet or more in length. Sides of trenches shall include embankments adjacent to trenches. In lieu of shoring, the sides of the trench above the 5-foot level may be sloped to preclude collapse, but shall not be steeper than a 1-foot rise to each ½-foot horizontal. Provide a bench of 4 feet minimum at the toe of the sloped portion of the trench wall when the outside diameter of the pipe to be installed is greater than 6 feet.
6. Use diversion ditches, dikes, or other suitable means to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Do no allow water to accumulate in an excavation. If possible, the grade should be away from the excavation.

7. Excavations shall be inspected by a competent Contractor's representative after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased, if necessary.
8. Do not store excavated or other material nearer than 4 feet from the edge of any excavation. Store and retain materials as to prevent materials from falling or sliding back into the excavation. Install substantial stop log or barricades when mobile equipment is utilized or allowed adjacent to excavations.
9. The width of trenches in earth for water main pipe, sewers, basin connections, house connections, and other drains up to and including 33 inches in internal diameter shall provide a clearance of not less than 8 inches or more than 10 inches on each side of the pipe. Trenches for pipe larger than 33 inches in internal diameter shall provide a clearance of not less than 10 inches or more than 14 inches on each side of the pipe.
10. The maximum clear width of trenches in earth for manholes shall be the greatest external width of the structure plus the space necessary for the construction and removal of the forms and construction of masonry work.
11. The design of the water main, force main, and/or sewer pipe and structures is predicated upon the width of trench specified in this Article. The Contractor shall be responsible for the provision and installation, at his own expense, of such remedial measures as may be directed by the Engineer, should the trench width limits specified in this Article be exceeded.
12. Test the air in excavations in locations where oxygen deficiency or gaseous conditions are possible. Establish controls to assure acceptable atmospheric conditions. Provide adequate ventilation and eliminate sources of ignition when flammable gases are present. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, and basket stretcher, shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
13. Provide walkways or bridges with guardrails where employees or equipment are required or permitted to cross over excavations.
14. Provide ladders where employees are required to be in trenches 4 feet deep or more. Ladders shall extend from the floor of the trench to at least 3 feet above the to of the excavation. Locate ladders to provide means of exit without more than 2 feet of lateral travel.
15. Provide adequate barriers and physically protect all remotely located excavations. Barricade or cover all wells, pits, shafts, and similar excavations. Backfill temporary wells, pits, shafts, and similar excavations upon completion of exploration and similar operations.

D. Quicksand: Carry on the work with utmost vigor and proceed with the work expeditiously when running sand, quicksand, or other bad or treacherous ground is encountered. Install bedding to support the pipe as directed by the Engineer.

E. Blasting: Removal of rock from the excavation may be facilitated by the use of controlled explosives.

1. Blasting supervision and Blasting Monitoring and Control Programs shall meet the requirements of this Section.
2. Storage procedures for explosives shall be developed by the Contractor and submitted to the Engineer before explosives are brought to the job site.

3.6 SHEETING

A. The Contractor shall be responsible for construction means, methods, techniques, and procedures, and for providing a safe place for the performance of the work by the Contractor, Subcontractors, suppliers and their employees, and for access use, work, or occupancy by all authorized persons.

B. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as “Safety and Health Regulations for Construction.”

C. Adequate supporting systems, such as sheeting, shoring, piling, cribbing, and bracing shall be furnished and installed by the Contractor as required to protect existing buildings, utilities, and property from damage during the progress of the work.

3.7 STORAGE AND REMOVAL OF EXCAVATED MATERIAL

A. Suitable excavated material required for filling and backfilling operations may be stockpiled in on-site locations as approved by the Engineer, until the material is ready to be placed.

B. Remove unsuitable materials from the job site as unsuitable materials are excavated. Remove surplus suitable materials from the job site, as trenches are backfilled.

3.8 TEMPORARY PLUGS

Prevent foreign matter from entering pipe while it is being installed. Do not place debris, tools, clothing, or other material in the pipe. Close the open ends of pipe

by watertight plugs when pipe laying is not in progress. Remove any earth or other material that enters pipe, lateral pipe, or appurtenances through any open pipe end. Remove earth and other materials at no additional cost to the Owner.

3.9 BACKFILLING WATER MAIN AND FORCE MAIN TRENCHES

A. Backfilling of water main and force main trenches shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.

B. Do not backfill trenches and excavation until all utilities have been inspected by the Owner's representative and until all underground utilities and piping systems are installed in accordance with the requirements of the specifications and the drawings. Required hydrostatic tests may be applied to the line either before or after the trench is backfilled, subject to the approval of the Engineer.

C. Place and tamp bedding and backfill in a manner which will not damage pipe coating, wrapping, or encasement.

D. Material from the trench subgrade to the centerline of the pipe shall be Class II bedding. Place bedding by hand or approved mechanical methods in layers of 8 inches loose depth. Compact bedding by hand tamping or with a power operated hand-vibrating compactor. Deposit bedding in the trench for its full width on each side of the pipe simultaneously.

E. Place pipe cover material from the centerline of the pipe to 12 inches over the pipe. Compact pipe cover material to the density required to allow backfill over the pipe cover material to be compacted to the density specified in this Article.

F. Do not use the following materials for backfill:

1. Unsuitable materials;
2. Frozen materials;
3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.

G. Trenches Requiring Special Backfill When Specified: Where the edge of the trench is 5 feet or less from the edge of the existing or proposed roadway pavement and trenches across roadways, driveways, utility crossing, or in areas to be paved or subjected to traffic, the trench shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as

determined in accordance with AASHTO T99, Method A. Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Do not compact backfill by puddling, unless permitted by the Engineer.

H. Trenches in State Highway Right-of-Way: Where excavation occurs within the right-of-way of a state highway, all areas within 12 feet of the pavement edge shall be backfilled with Grade “B Borrow” Special Backfill. All areas beyond 12 feet shall be backfilled in the manner specified in the following paragraph.

I. Trenches Not Requiring Special Backfill: Backfill trenches not requiring granular backfill with suitable excavated material. Place and compact backfill to produce an adequate foundation for the applicable paved or unpaved surface treatment. Fill and restore any settlement of the backfill. In paved areas, backfill shall be maintained to subbase elevation. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.

J. Trenches in Traveled Pavements: All cuts and trenches in paved streets or other paved areas shall be backfilled within suitable excavated material unless granular backfill is specifically indicated on the plans or ordered by the Engineer to within 12 inches of the street surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall maintain the trenches, added crushed stone and grading as necessary, until sufficient settlement has taken place and final restoration is made.

3.10 BACKFILLING SANITARY SEWER AND STORM SEWER TRENCHES

A. Do not backfill trenches and excavation until all utilities have been inspected by the Owner’s representative and until all underground utilities and piping systems are installed in accordance with the requirements of the specifications and the drawings.

B. Place and tamp bedding and backfill in a manner which will not damage pipe coating, wrapping, or encasement.

C. Bedding procedures for sanitary sewers and storm sewers shall be as specified in the Section for the applicable pipe material.

D. If bedding does not cover the pipe, place cover material from the top of bedding to 12 inches over the pipe. Compact pipe cover material to the

density required to allow backfill over the pipe cover material to be compacted to the density specified in this Article.

E. Do not use the following materials for backfill:

1. Unsuitable materials;
2. Frozen materials;
3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.

F. Trenches Requiring Special Backfill When Specified: Where the edge of the trench is 5 feet or less from the edge of the existing or proposed roadway pavement and trenches across roadways, driveways, utility crossing, or in areas to be paved or subjected to traffic, the trench shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as determined in accordance with AASHTO T99, Method A. Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Do not compact backfill by puddling, unless permitted by the Engineer.

G. Trenches in State Highway Right-of-Way: Where excavation occurs within the right-of-way of a state highway, all areas within 12 feet of the pavement edge shall be backfilled with Grade “B Borrow” Special Backfill. All areas beyond 12 feet shall be backfilled in the manner specified in the following paragraph.

H. Trenches Not Requiring Special Backfill: Backfill trenches not requiring granular backfill with suitable excavated material. Place and compact backfill to produce an adequate foundation for the applicable paved or unpaved surface treatment. Fill and restore any settlement of the backfill. In paved areas, backfill shall be maintained to subbase elevation. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.

I. Trenches in Traveled Pavements: All cuts and trenches in paved streets or other paved areas shall be backfilled within suitable excavated material unless granular backfill is specifically indicated on the plans or ordered by the Engineer to within 12 inches of the street surface. The remainder of the trench is to be filled with crushed stone and compacted in place, prior to opening the street to traffic. The Contractor shall maintain the trenches, added crushed stone and grading as necessary, until sufficient settlement has taken place and final restoration is made.

3.11 MAINTAINING TRAFFIC

A. Before closing any thoroughfare, the Contractor shall notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county or city, which notice shall be given not less than 72 hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare.

B. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Insofar as it is practicable, excavated material and spoil banks shall not be located in such manner as to obstruct traffic; and the traveled way of all streets, roads, and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the Engineer and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his work.

3.12 WALKS AND PASSAGEWAYS

The Contractor, when required, shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter; exercising such precaution as may be directed by the Engineer. All material excavated must be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.

3.13 WARNING LIGHTS

The Contractor shall place sufficient warning lights on or near the work and keep them illuminated during periods of reduced visibility (from twilight in the evening until sunrise) and will be held responsible for damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

3.14 CLEANUP AND MAINTENANCE

A. Cleanup the job site as backfilling is completed. Remove excess earth, rock, bedding, materials, and backfill materials. Remove unused piping materials, structure components, and appurtenances. Restore items moved, damaged, or destroyed during construction. Grade area to be restored. Leave backfill mounded over trenches which are not backfilled with Special Backfill. Cleanup and restoration specified in this paragraph shall be completed within 1,000 feet of excavation.

B. Restoration of grass, bushes, trees, and other plants shall be completed by the Contractor to original condition.

C. Restoration of pavement and walks shall conform to the City of Tipton's specifications for Paving and Surfacing. A temporary driving surface, such as crushed stone, shall be compacted in place in the trench area, as backfilling is complete. Cold-mix asphalt patching material may be used as a temporary driving surface at the Contractor's option or when specifically called for in the plans or specifications. Temporary pavement shall not be more than 1,000 feet behind the excavation. When no existing pavement remains after excavation, a temporary compacted aggregate surfacing may be provided instead of the permanent paving or a temporary cold-mix asphalt pavement. When the pavement is asphaltic concrete, placement of the asphaltic concrete surface course may be delayed until all other heavy construction is completed.

D. Maintain the job site until the work has been completed and accepted. Fill trenches which settle when settlement is visible. Restore items damaged by construction or improper restoration. Keep dust conditions to minimum by the use of water, salt, calcium chloride, oil, or other means.

END OF SECTION 3

SECTION 4 - WATER MAINS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and install pipe, fittings, valves, hydrants and appurtenances necessary to complete work shown or specified.

B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.

C. Definitions

1. Abbreviations

a. ANSI – American National Standards Institute
b. ASTM – American Society for Testing & Materials
c. AWWA – American Water Works Association

2. All pipe, fitting and valve sizes and references to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 QUALITY ASSURANCE

A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.

B. The Contractor shall test and disinfect water mains constructed under this Contract, as specified in this Section.

C. The Contractor shall collect samples of water from water mains constructed under this Contract, after the piping has been disinfected. Submit the samples to the applicable regulatory agency for bacteriological analysis. Collection and submittal of these samples shall meet the requirements of the applicable regulatory agency. If samples do not pass the requirements of the bacteriological analysis, the water main will be disinfected and sampled again. This procedure will be followed until the samples pass the analysis.

D. A performance test may be required by the Utilities Superintendent, at any time, for such crew installing water mains. The Contractor shall perform these tests at no additional cost to the Owner. When required by the

Utilities Superintendent, the Contractor shall test a given section of water main installed by a given crew. The section shall be a continuous section of water main which can be isolated by valves shown on the drawings. The contractor shall not install water mains in other sections until the first section has been successfully tested.

PART 2 – PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, hydrants and appurtenances shall be as shown on the drawing or as required by the manufacturers and ANSI/AWWA specifications. All pipe, fittings, valves, hydrants and appurtenances shall be new and unused.

2.2 BURIED WATER MAIN PIPE AND FITTINGS

A. Ductile Iron Water Mains

1. Pipe

a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51. Design and manufacture pipe for the pressure class listed plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturers and ANSI/AWWA specifications, shall be included. Minimum thickness class shall be as follows:

Size Range	Pressure Class
4” – 12”	350
14” – 20”	250

b. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA CAAA/A21.11. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte, or equal.

2. Fittings

a. Fittings shall be ductile iron. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA C110/A21.10. Compact or short body fittings 3 inches through 16 inches shall meet the requirements of ANSI/AWWA C153/A21.53. Design and manufacture fittings for a pressure rating of at least 150 psi.

b. Fitting joints shall be mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Thrust block all mechanical joints as indicated on the drawings or as required by the manufacturers and ANSI/AWWA specifications. Pipe connecting to restrained joint fittings shall be restrained as indicated on the drawings or as required by the manufacturers and ANSI/AWWA specifications.

3. Adapters

   a. Adapters from ductile iron water mains to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure class rating of 150 psi.
   b. Adapter ends connecting to ductile iron water mains shall be one of the following: plain end, push-on joint, mechanical joint or restrained push-on joint. Adapters with plain ends, push-on joints or mechanical joints may be used where restrained joints are not required. Adapters shall have restrained push-on joints where restrained joint piping is required, as indicated on the drawings. Mechanical joints and restrained push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte, or as approved by the Utilities Superintendent.
   c. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Line the inside surfaces of all pipe, fittings and adapters with single layer cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104.
5. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.
6. Nuts and Bolts

   a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
   b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

7. Polyethylene encasement for ductile iron water mains shall meet the requirements of ANSI/AWWA C105/A21.5. Install polyethylene encasement only when indicated on the drawings.

B. Polyvinyl Chloride Water Mains

1. Pipe

a. Polyvinyl chloride pipe shall meet the requirements of ANSI/AWWA C900, Class 150/DR18. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturers and ANSI/AWWA specifications, shall be included.
b. Polyvinyl chloride pipe shall have ductile-iron-pipe-equivalent outside diameter.
c. Pipe joints shall be push-on type and meet the requirements of ANSI/AWWA C900. Do not use solvent-cement joints.
d. Construction of water mains utilizing polyvinyl chloride pipe shall incorporate “tracing wire” the entire length of the water mains improvements or installations.

2. Fittings

a. Fittings shall be ductile iron and meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi.
b. Line the inside surfaces of fittings with dement mortar lining and bituminous seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of fittings with bituminous coating. Outside coating shall meet the requirements of ANSI/AWWA C110.
c. Fitting joints shall be mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
d. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.

3. Adapters

a. Adapters from polyvinyl chloride water mains to victaulic, flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.

b. Line the inside surfaces of adapters with a single cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of adapters with bituminous coating, complying with ANSI/AWWA C110.
c. Adapter ends connecting to polyvinyl chloride water mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
d. Adapter ends connecting to victaulic, flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Gaskets

a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of ANSI/AWWA C900.
b. Gaskets for mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11 and ASTM F477.

5. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.

2.3 PIPE AND FITTINGS SMALLER THAN 4-INCH

A. Pipe shall be Type K drawn copper and shall meet the requirements of ASTM B88.

B. Fittings and couplings shall be cast bronze and shall meet the requirements of ASTM B16.18. Construct and manufacture fittings and couplings for a pressure rating of 150 psi.

C. Unions shall be bronze and shall meet the requirements of ASTM B16.18. Design and manufacture unions for a pressure rating of 150 psi.

D. Flanges for connection of screwed joint pipe to flange joint valves or fittings shall be 125-16 cast iron, screwed companion flanges, complying with both ASTM A126 and ANSI B16.1.

E. Tape for screwed joints shall be teflon.

F. Gaskets for flange joints shall be 1/16-inch thick, full face and conform to ANSI/AWWA C111/A21.11. Gaskets shall be rubber or as approved by the Utilities Superintendent.

G. Bolts for flange joints shall be steel, heavy hexagon head machine bolts. Nuts shall be steel, semi-finished, heavy hexagon nuts. Nuts and bolts shall meet the requirements of ASTM A307 for Grade B and be zinc-coated alloy steel.

2.4 VALVES

A. Butterfly Valves

1. Butterfly valves and operators shall meet the requirements of AWWA Standard C504. Valves and operators shall be Class 150B.
2. Buried butterfly valves shall have mechanical joints. Mechanical joints shall meet the requirements of AWWA C111. Butterfly valves installed above ground or in structures shall have flange joints as specified in AWWA Standard C504. Nuts, bolts, and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be cadmium plated. Gaskets shall be full face and shall be red rubber, or equal.
3. Each buried butterfly valve shall have a manual operator and a 2-inch operating nut. Valve opening direction shall be consistent with operation of existing valves in the waterworks in which the valves are installed, unless otherwise directed by the Engineer.
4. Each butterfly valve installed above ground or in a structure shall have a manual operator and handwheel.

B. Gate Valves

1. Buried gate valves four inches and larger shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and have mechanical joint ends. Mechanical joints and joint accessories shall comply with ANSI/AWWA C111/A21.11. Valve opening direction shall be consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Utilities Superintendent.
2. Three-inch buried gate valves shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 OR C509; except, ends shall be screwed. Screwed ends shall conform to ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Utilities Superintendent.
3. Gate valves four inches and larger installed above ground or in structures shall be full ductile iron body, epoxy fusion bonded inside and out, outside screw and yoke gate valves. Valves shall correspond to ANSI/AWWA C500 or C509. Outside screw and

yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall be as specified in ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel. Gaskets shall be full face and rubber, or as approved by the Utilities Superintendent.

4. Gate valves smaller than four inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels. Valves shall meet the requirements of federal specifications WASTEWATER-V-54d for Class A, Type III Valves.

C. Buried valves two inch and smaller shall be curb stops. Curb stops shall meet the applicable requirements of ANSI/AWWA C800, ASTM B-62 for 85-5-5-5 composition bronze, and USAS B2.1. Curb stops shall be Mueller H-10283, Ford B11 Series, or as approved by the Utilities Superintendent.

D. Tapping Valves

1. Tapping valves shall comply with both ANSI/AWWA C500 OR C509 and have flange mechanical joint ends. Double disc gate valve gates, gate rings and body-seat rings shall be oversized to permit entry and exit of tapping machine cutters.
2. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue which fits a recess in the sleeve. Tongues shall meet the requirements of MSS SP-60. Resilient seated gate valves having a port diameter equal to or exceeding ¼ inch over nominal diameter shall not require a tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts, bolts and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel, and gaskets shall be rubber, or as approved by the Utilities Superintendent. Mechanical joints and accessories shall meet the requirements of ANSI/AWWA C111/A21.11. A full nominal diameter cutter shall be used for tapping. Tapping valves 14 inch and smaller shall be installed vertically. Tapping valves 16 inch and larger shall be installed horizontally and shall have bypass valves. Tapping valves installed horizontally shall have rollers and tracks. Valves 16 inch and larger shall have gear operators with enclosed gear cases suitable for buried service. Gear cases shall be extended type or totally enclosed type. Extended type gear cases shall have bolted side plates to cover stem and stuffing box.

E. Air and Vacuum Valves: Air and vacuum valves shall be as follows:

Size	Specification
½”	Apco No 141 WD, Val-Matic 100 DWS, or equal
1”	Apco No 142 WD, Val-Matic 101 DWS, or equal
2”	Apco No 144 WD, Val-Matic 102 DWS, or equal
3”	Apco No 146 WD, Val-Matic 103 DWS, or equal
4”	Apco No 1604/152, Val-Matic 104 DWS, or equal
6”	Apco No 1606/153, Val-Matic 106 DWS, or equal

2.5 VALVE BOXES

A. Valve boxes for butterfly valves and gate valves shall be cast iron. Valve boxes shall be two piece or three piece type. Each two piece box shall be complete with bottom section, top section and cover. Each three piece box shall be complete with base, center section, top section and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16th inch. Cast the word “WATER” in each valve box cover.

B. Valve boxes for curb stops shall be cast iron. Curb boxes shall be extension type. Each curb box shall be complete with foot piece, curb box and lid. Curb box shall be the following or as approved by the Utilities Superintendent:

Curb Stop Size	Foot Piece	Curb Box with Lid & Plug
½ “ and 5/8”	Mueller H-10390	Mueller H-10316
¾”	Mueller H-10391	Mueller H-10316
1”	Mueller H-10392	Mueller H-10316
1 1/4”	Mueller H-10393	Mueller H-10336
1 1/2”	Mueller H-10394	Mueller H-10336
2”	Mueller H-10395	Mueller H-10336

2.6 FIRE HYDRANTS

A. Fire hydrants shall be dry-barrel, compression shutoff, traffic model and comply with ANSI/AWWA C502. Main valve size shall be 5-1/4 inch. Inlets shall be 6-inch mechanical joint. Each hydrant shall have two 2-1/2 inch nozzles and one 4-½ inch pumper nozzle. Nozzle threads and hydrant opening direction shall be consistent with existing fire hydrants in the waterworks in which the fire hydrants are installed, unless otherwise directed by the Utilities Superintendent. Each hydrant shall be the proper length for the water main to which the hydrant is connected. Fire hydrant

coating shall meet the requirements of ANSI/AWWA C502. Paint color will be selected by the Utilities Superintendent. Hydrants shall be Model No. A423, as manufactured by Mueller Company or Waterous Pacer Hydrant WB67.

B. Fire Hydrant Placement – Fire Hydrants shall be placed no farther apart than 300 feet in all residential subdivisions, subdivision sections, and other residential areas in which dwelling density meets or exceeds three dwelling units per gross acre. Fire hydrants shall be placed no further apart than 300 feet in all Industrial, Business, and Commercial areas, and in all Industrial, Business, and Commercial uses. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the City of Tipton Fire Department. For residential uses with densities less than three dwelling units per gross acre, the requirements as established in Table No. III-B-A of the Uniform Fire Code shall apply. Where there is any ambiguity or dispute concerning the interpretation of this requirement, the decision of the Chief of the City of Tipton Fire Department shall prevail subject to appeal.

2.7 SPRINKLER SYSTEMS

Multi-family developments, duplexes, and hotels/motels shall be required to have sprinkler systems installed in the attics of said structure as approved by the Chief of the City of Tipton Fire Department. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the City of Tipton Fire Department. Where there is any ambiguity or dispute concerning the interpretation of this requirement, the decision of the Chief of the City of Tipton Fire Department shall prevail subject to approval.

2.8 TAPPING SLEEVES

A. Tapping sleeves shall be ductile iron split sleeves. Each sleeve shall have a branch connection with a flange end. The inside diameter of each branch shall be over-sized to permit entry and exit of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameters shown in ANSI/AWWA Standards.

B. Tapping sleeves for 4-inch through 16-inch pipe shall be mechanical joint type. Design and manufacture tapping sleeves for a working pressure of 200 psi.

C. Tapping sleeves for 18-inch and larger pipe shall be mechanical joint type. Design and manufacture tapping sleeves for a working pressure of 150 psi.

2.9 TAPPING ASSEMBLIES

Tapping assemblies for steel cylinder type prestressed concrete pressure pipe shall be specifically designed and manufactured for the tapped pipe. Design and manufacture assemblies for a working pressure of 150 psi. The inside diameter of the outlet branch shall be oversized to permit entry and exit of tapping machine cutters. Each outlet branch shall have a flange end with a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1.

2.10 TAPPING SADDLES

A. Design and manufacture tapping saddles for a working pressure of 200 psi. Saddle bodies shall be ductile iron. Saddle straps shall be corrosion resistant steel alloy. Saddle gaskets shall be positively confined O-ring gasket. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameter shown in ANSI/AWWA Standards.

B. Each saddle used for making a wet connection shall have a branch connection with a flange end. The inside diameter of each branch shall be oversized to permit entry and exist of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1.

C. Each saddle used for making a dry connection shall have a branch connection with a flange or mechanical joint end. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts and bolts for flange joints shall meet the requirements of ANSI/AWWA C110 and be zinc-coated alloy steel. Gaskets shall comply with ANSI/AWWA C110, be full face and rubber, or as approved by the Utilities Superintendent. Mechanical joints and accessories shall meet the requirements of ANSI/AWWA C111/A21.11.

D. Gaskets used to seal joints between saddle bodies and tapped pipes shall be O-ring type, circular in cross section, and made of natural or synthetic rubber with a Durometer Hardness of 70$\pm$ 5.

2.11 FLANGE-MECHANICAL JOINT ADAPTERS

Flange-mechanical joint adapters shall be Dresser Style 127, Smith-Blair Type 912 or as approved by the Utilities Superintendent.

2.12 AIR AND VACUUM VALVE CHAMBERS

A. Air and vacuum valve chambers shall be 4-foot diameter precast concrete manhole barrels with precast concrete flat slap tops. Precast manhole barrels shall meet the requirements of ASTM C478.

B. Air and vacuum valve chamber access frames and cover shall be Neenah R-1915-G or equal. Cast the word “WATER” in each cover.

PART 3 – EXECUTION

3.1 INSPECTION

Inspect water main pipe, fittings, valves, hydrants, and appurtenances prior to installation. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with undamaged and suitable products.

3.2 LAYING OF WATER MAINS

A. Other than the crossing of streets, all water mains are to be located out of streets and within the utility right-of-way space provided by the developer. All water mains shall be located within six (6) to eight (8) foot of the curb line. Deviations from these specifications require approval of the Water Superintendent.

B. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.

C. Lay and maintain pipe to the lines and grades shown on the drawings or to the minimum depth specified in this Article. Install fittings, valves and hydrants in the locations shown on the drawings.

D. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Utilities Superintendent.

E. Water mains shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Water mains crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the

sewer or force main. The 18-inch separation shall apply whether the water main is over or under the sewer or force main. Lay water mains at crossings of sewers and force mains so a full length of water main shall pass through or come in contact with any part of a sanitary sewer manhole.

F. All water mains should maintain a minimum depth of four (4) feet and a maximum depth of 4'-6" of cover. Cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation. At points of conflict, "fittings" shall be used to get proper clearance from the conflicting utility; for example, 45-degree fittings or other appropriate fittings.

G. Laying of water mains shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.

H. Shape the bottom of the trench to give uniform circumferential support of the lower quarter of each pipe.

I. Do no lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.

J. As each length of pipe is placed in a trench, joint the pipe being laid to the previously laid pipe. Bring the pipe to correct line and grade. Secure the pipe in place with bedding tamped under the pipe. Tamp bedding up to the centerline of the pipe.

K. Deflection from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.

L. Provide thrust restraint at horizontal and vertical deflection fittings and at tees, plugs, tapping sleeves and tapping saddles. Restraint shall be concrete thrust blocking or restrained joint piping.

M. Where concrete thrust blocking is used, cover the fitting to be blocked with visqueen or a heavy duty grease to prevent adherence of the concrete to the fitting.

N. Block the open end of the pipe at the close of each day's work to prevent contamination from dirt or rainwater and entry of any animal or foreign material.

O. Lower pipe, fittings, valves and hydrants into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products,

coatings, or linings. Do no drop or dump pipe, fittings, valves or hydrants into the trench.

P. Water main designs that require crossing a county legal drain shall be approved and constructed per the latest standards of the Tipton County Surveyor's Office.

3.3 SETTING VALVES, VALVE BOXES AND FIRE HYDRANTS

A. Clean the interiors of valves and hydrants of foreign matter before installation. Tighten stuffing boxes. Inspect valves and hydrants in opened and closed positions to ensure all parts are in working condition.

B. Set valves and valve boxes plumb. Center valve boxes on the valves or valve operators. Locate valves outside the area of roads and streets where feasible. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet.

C. Set hydrants plumb with the pumper nozzle facing the street. The centerline of the outlet nozzles shall be at least 18 inches or at most 30 inches above finished grade at a hydrant. Install hydrant extensions where required to bring hydrant to proper elevation. Set each hydrant upon a slab of stone or concrete not less than 4 inches thick and 15 inches square. Wedge the side of each hydrant opposite the pipe connection against the undisturbed trench face to prevent the hydrant from blowing off the branch connection. Compact the backfill around each hydrant to finish grade. Furnish and install a gate valve and valve box in each hydrant branch connection. In the field, apply two coats of red polyurethane epoxy to the fire hydrants installed.

3.4 CONNECTING TO EXISTING MAINS

A. The Contractor shall locate and verify exact size of all existing mains, both horizontally and vertically. Additionally, allow adequate time, after location and prior to making new connections, for changes in the connection location and size. Backfill excavation immediately after main is located and measured.

B. Make each wet connection with a tapping valve and tapping sleeve. Install and hydrostatically test each tapping valve and tapping sleeve assembly prior to tapping existing water main. Inspect each tapping valve prior to tapping existing water main. Open and close tapping valves, and inspect tapping valves in opened and closed positions to ensure all parts are in working condition. Inspect each tapping valve immediately before connecting tapping machine to ensure the tapping valve is open. Install

watertight plug on the tapping valve outlet and backfill excavation if existing water main is not tapped within 48 hours after installing tapping valve and tapping sleeve or tapping saddle assembly. Install watertight plug on the tapping valve outlet and backfill excavation if new water main is not connected to tapping valve within 48 hours after making tap in existing water main.

C. Make each dry connection with fittings and valves indicated on the drawings. Furnish and install sleeves required to complete connections. All required pipe, fittings, valves, tools, and equipment shall be at the connection site prior to starting connection. Wash interior of new pipe, fittings, and valves with a solution containing 50 mg/1 of chlorine prior to making connection. Make connections at night and on weekends when required. The Owner will operate existing valves. Install sufficient water main and restrain joints so existing water mains can be up in service immediately after connection is completed. Inspect joints and eliminate leaks immediately after connection is completed and existing mains are put in service. Install watertight plugs on open ends of pipe and valves, and backfill excavation if new water main is not connected to dry connection within 48 hours after completing dry connection.

3.5 JOINTING

A. Ductile Iron Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be re moved from the bell and spigot end of each pipe.
2. For restrained push-on joints, move the loose retainer ring into position against the retainer bar on the spigot end of the pipe being installed. Loosely assemble the joint bolts and nuts.
3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4”	5º	18-1/2”
6”	5º	18-1/2”
8”	5º	18-1/2”
10”	5º	18-1/2”
12”	5º	18-1/2”

4. For restrained push-on joints, pull the nuts to a uniform tightness by hand or with a short wrench. Do not pull the spigot of the pipe being installed against the back of the bell of the receiving pipe. Engage at least a full nut on each bolt when joint deflection is required.

B. Polyvinyl Chloride Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer's requirements. Additionally, all joints must be free of all foreign material.
2. Deflect the pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe.

C. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4" thru 24"	¾"	75 to 90 ft.-lb.

3. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4"	8º - 18'	31"
6"	7º - 7'	27"
8"	5º - 21'	20"
10"	5º - 21'	20"
12"	5º - 21'	20"
14"	3º - 35'	13-1/2"
16"	3º - 35'	13-1/2"
18"	3º - 0'	11"
20"	3º - 0'	11"
24"	2º - 23'	9"

D. Shouldered Type Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. The tightening torque shall not exceed the limits recommended by the joint manufacturer.
3. Deflect pipe, fittings, adapters or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the joint manufacturer.

E. Threaded Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtighten joints.
3. Backing off made-up threaded joints to facilitate fit-up or alignment will not be permitted.

F. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtorque nuts and bolts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of at least 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall be at least the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

B. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings.

C. Mechanical Joint Rod Restraint

1. Mechanical joint rod restraint shall be from fitting to fitting.
2. The number of rods shall conform to the following table:

Pipe Size	Rod Size	Minimum No. of Rods
4”	¾”	2
6”	¾”	2
8”	¾”	4
10”	¾”	4
12”	¾”	6
14”	¾”	6
16”	¾”	8
18”	¾”	8
20”	¾”	10
24”	¾”	16

D. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings and valves.
2. Support piping by suitable saddle stands, concrete piers or hangers.
3. Locate supports where necessary, at least 8 feet on center.

3.7 AIR AND VACUUM VALVE CHAMBERS

A. Install air and vacuum valve chambers as indicated on the drawings.

B. Mortar for joints and plastering shall consist of one part Portland Cement and two parts fine sand. Lime may be added to the mortar used for brick work. Add lime in an amount of not more than 20% of the volume of cement. Complete fill joints between precast chamber sections. Joints shall be smooth and free from surplus mortar on the inside surface of the chamber. Plaster brick at the top of chambers with ½-inch of mortar.

C. Set frames and covers so the top of the cover will be flush with finished grade.

D. Vent air and vacuum valve outlets to the surface. Terminate vent outlets 3 feet above finished grade. Screen vents to prevent the entrance of insects. Paint air and vacuum valve vents yellow.

3.8 HYDROSTATIC TEST

A. Hydrostatic tests shall be performed on all water mains installed. The Contractor shall make arrangements with the Town Engineer and/or Town Representative for scheduling each test. Each test shall be performed on the day mutually agreed upon and in the presence of the Town Engineer and/or Town Representative

B. The Contractor shall furnish equipment, temporary piping, pumps, fittings, gauges, and operating personnel necessary to conduct the tests. Water for testing may be obtained from the Owner.

C. The water mains may be tested in sections between valves when there is one or more intermediary valves in a water main.

D. Test procedures shall meet the requirements of AWWA Standard C600.

E. Each section of water main shall be complete, and thrust blocks shall have been in place for not less than 10 days prior to being tested.

F. Expel all air from the water main test section during the filling of the main and prior to the application of test pressure. Tap the water main at high points, if necessary, to release all air from the water main. Plug taps after the test is successfully completed. Plugs shall be watertight.

G. Test water mains at a static pressure of 150 pounds per square inch over a period of not less than eight consecutive hours. The test will be considered successful when the pressure drop over the test period is 5 pounds per square inch or less. If the pressure drop exceeds 5 pounds per square inch, repair the leaks and repeat the test. Repair leaks and repeat the test until the pressure drop over the test period is 5 pounds per square inch or less.

3.9 FLUSHING

A. Flush water mains and fire hydrants prior to disinfection. Flush water mains with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

Pipe Size	Inside Diameter	Flow at a Velocity of 2.5 Feet per Second
½"	0.622"	2.4 gpm
¾"	0.824"	4.2 gpm
1"	1.05"	6.8 gpm
1 ¼"	1.38"	12 gpm
1 ½"	1.61"	16 gpm
2"	2.07"	27 gpm
2 ½"	2.47"	38 gpm
3"	3.07"	58 gpm
4"	4"	98 gpm
6"	6"	220 gpm
8"	8"	390 gpm
10"	10"	620 gpm
12"	12"	880 gpm
14"	14"	1,200 gpm
16"	16"	1,600 gpm
18"	18"	2,000 gpm
20"	20"	2,500 gpm
24"	24"	3,600 gpm

B. Flush water mains and hydrants until the water discharged is clear.

3.10 DISINFECTION

A. Disinfect all new and repaired water mains prior to placing them in service. Disinfect pipe, fittings, valves and hydrants with a chlorine solution containing 50 mg/1 ± 5 mg/l of available chlorine.

B. The chlorinating material shall be chlorine gas, calcium hypochlorite or sodium hypochlorite. Calcium hypochlorite shall have 70% available chlorine by weight, and sodium hypochlorite shall have 5.25% to 14.7% available chlorine. Placing chlorine tablets in the mains during construction is not an acceptable method of disinfection. The following table shows the quantity of chlorine or hypochlorite required to produce 50 mg/l of available chlorine per 100 feet of pipe.

			Pounds		Ounces		Quarts	
Pipe Size	Inside Diameter	Chlorine Gas	Cal. Hycl. (70%)	Cal. Hycl. (70%)	Sod. Hycl. (14.7%)	Sod. Hycl. (14.7%)	Sod. Hycl. (14.7%)	Sod. Hycl. (5.25%)
½"	0.622"	0.00066	0.00094	0.015	0.072	0.20	0.0022	0.0063
¾"	0.824"	0.0012	0.0017	0.026	0.13	0.35	0.0039	0.011
1"	1.05"	0.0019	0.0027	0.043	0.20	0.57	0.064	0.018
1¼"	1.38"	0.0032	0.0046	0.074	0.35	0.99	0.011	0.031

1½”	1.61”	0.0044	0.0063	0.10	0.48	1.3	0.015	0.042
2”	2.07”	0.0073	0.010	0.17	0.79	2.2	0.025	0.069
2½”	2.47”	0.010	0.015	0.24	1.1	3.2	0.035	0.099
3”	3.07”	0.016	0.023	0.37	1.7	4.9	0.055	0.15
4”	4”	0.027	0.039	0.62	3.0	8.3	0.093	0.26
6”	6”	0.061	1.187	1.4	6.7	19	0.21	0.58
8”	8”	0.11	0.16	2.5	12	33	0.37	1.0
10”	10”	0.17	0.24	3.9	19	52	0.58	1.6
12”	12”	0.24	0.35	5.6	27	75	0.83	2.3
14”	14”	0.33	0.48	7.6	36	100	1.1	3.2
16”	16”	0.44	0.62	10	47	130	1.5	4.1
18”	18”	0.55	0.79	13	60	170	1.9	5.2
20”	20”	0.68	0.97	16	74	210	2.3	6.5
24”	24”	0.98	1.4	22	110	300	3.3	9.3

C. Tap water mains where required to inject chlorine solution into all pipe, fittings, valves and hydrants installed and repaired. Inject chlorine solution into water mains. Leave the chlorine solution in the water mains for 24 hours or longer. Open and close valves in lines being disinfected several times during contact period. Following the contact period, flush the water mains with potable water until the chlorine residual is 1.0 mg/l or less.

D. Bacteriological Tests – The water main shall be tested for bacteriological quality after disinfection and final flushing. Two or more successive sets of bacteriologically satisfactory samples taken at 24-hour intervals must be recorded before the facilities are released for use. Bacteriological testing shall meet the requirements of the applicable regulatory agency. Disinfection shall be repeated if the piping is not bacteriologically acceptable. Repeat disinfection and testing until the mains are approved for service by the applicable regulatory agency.

E. Hose connections on fire hydrants shall not be used for collecting samples. Contact the applicable regulatory agency for sampling criteria and procedures.

F. The time for disinfection, bacteriological testing, and approval of the main for service shall be included in the contract time.

3.11 COMPLETION SCHEDULING

Complete water mains as they are installed. Test, flush, sterilize, and place in service each part of the water main which is complete and can be placed in service without preventing work to continue on uncompleted parts of the new water mains.

PART 4 – FIGURES

4.1 INDEX

FIGURE	DESCRIPTION
1	Water Main Installation Detail
2	Thrust Block Details
3	Restrained Joint Details
4	Steel Casing Detail
5	Connection to Existing Main
6	Gate Valve and Box
7	Fire Hydrant Details
8	¾ Water Meter and Pit Detail
9	Pavement Repair Details
10	Pavement Repair Details
11	Typical Commercial Water Service Diagram
12	1” Water Meter and Pit Detail
13	2” Water Meter and Pit Detail
14	2” Commercial – Industrial Water Meter Detail

END OF SECTION 4

SECTION 5 – STORM SEWERS

PART 1 – GENERAL

1.1 GENERAL

A. It is the policy of Tipton Utilities not to accept maintenance responsibility for perforated “surface drain” lines.

B. This section covers all work necessary for the construction of the storm sewer piping systems and related items complete, including catch basins and inlet drains, manholes, junction chambers, diversion chambers, outfall structures, and miscellaneous structures.

C. This section shall be used only when non-watertight joints will be allowed, and hydrostatic or air testing will not be required for storm sewers unless because of suspected leakage or other problems the City Engineer deems necessary.

D. This specification covers the following types of materials for storm sewers, culverts, underdrains, inlet drains, conduits, and miscellaneous applications:

1. Reinforced Concrete Pipe and Fittings
2. Polyvinyl Chloride Pipe (PVC)
3. PVC Composite Pipe
4. Corrugated Polyethylene Pipe

The following materials are recognized as “possible” alternatives under certain, extreme circumstances. However, cost or expense of installation is not considered an extreme circumstance. The Superintendent prior to installation must approve use of these materials.

5. Corrugated Metal Pipe
6. Structural Plate Arches
7. Aluminum or Aluminized Steel Pipe and Structural Plate
8. Multi-Plate Pipe and Pipe Arches

E. Sewer pipe shall be of the size shown on the drawings and shall meet all requirements of these specifications.

F. This specification requires project plans and construction specifications to be submitted to and approved by all appropriate regulatory agencies prior to beginning any work.

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 SUBMITTALS

Before construction and preferably before fabrication, the Contractor shall submit to the Town Engineer for approval Calculations on the thickness or strength class and drawings showing pipe lengths, joints, and other construction and installation details. All pipe furnished under this Contract shall be fabricated only in accordance with the drawings and these specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

The city and it's Engineer may, at their option, specify a material to be used on the drawings; and the developer or Contractor shall furnish and install the pipe material or materials specified and will only offer other equal materials.

2.2 REINFORCED CONCRETE PIPE AND FITTINGS

A. Reinforcing concrete pipe and fittings shall conform to ASTM C76, latest revision, for circular pipe and ASTM C507 for elliptical pipe.

B. Reinforcing concrete pipe and fittings for normal conditions shall be reinforced in accordance with ASTM C76, Class III, Wall B (minimum). Acceptance shall be on the basis of Subsection 4.1.1 of ASTM C76.

C. Circumferential reinforcing in circular pipe shall be required. No elliptical reinforcing or combination of elliptical and circumferential reinforcing or part circular reinforcing shall be permitted in circular pipe.

D. Concrete pipe shall be steam cured and shall not be shipped from point of manufacture for at least five days after having been cast.

E. Joints shall conform to the requirements of ASTM C443. Gaskets shall be of an oil resistant type having a maximum swell of 90% when tested in accordance with ASTM D471. Lubricant for jointing shall be approved by gasket manufacturer.

1. All rubber gasket similar to and equal to “Press-Seal” or “Tylox” conforming to ASTM Designation C443, latest revision. The gasket shall be attached to the spigot of the pipe and shall be the sole element depended upon to make the joint flexible and practically watertight.
2. Butyl mastic joint sealant in rope or trowel applied form specifically made for permanently sealing joints in tongue and groove concrete sewer pipe. The material shall adhere tightly to the pipe surface and form a tight, flexible joint. The material shall have been in use for at least five years. Test results and material specifications shall be submitted to the Town Engineer and shall have been approved prior to use on the project.

2.3 POLYVINYL CHLORIDE PIPE AND FITTINGS

Polyvinyl chloride (PVC) pipe and fittings shall comply with ASTM D 3034. Construction of storm sewers utilizing polyvinyl chloride (PVC) pipe shall incorporate “tracing wire” the entire length of the storm line improvements or installations.

2.4 CORRUGATED METAL PIPE AND PIPE ARCHES

A. The following specifications shall govern the manufacture of the corrugated steel pipe and pipe arches.

1. Specifications for Zinc Coated (galvanized) Steel Sheets (ASTM A444).
2. Manufacture of Corrugated Steel Culverts and Underdrains (AASHTO M-36).
3. Structural Plate for Pipe, Pipe Arches, and Arches (AASHTO M-167).
4. Bituminous Coated Corrugated Steel Pipe and Arches (AASHTO M-190).
5. Sheet Material (ASTM A525).

B. Bituminous Coated Welded Seam Helically Corrugated Steel Pipe: The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by ½-inch depth. Each pipe shall have two annular corrugations rolled in each end. After the ends are rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch as required by AASHTO M-190 for Type A coating.

C. Bituminous Coated and Paved Invert Welded Seam Helically Corrugated Steel Pipe

1. The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by ½-inch depth. Each pipe shall have two annular corrugations rolled in each end.
2. After the ends are rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch. In addition, bituminous material shall be applied to form a smooth pavement in the bottom 25% of pipe and in the bottom 40% of pipe arch as required by AASHTO M-190 for Type C coating.

D. Smooth Lined Welded Seam Helically Corrugated Steel Pipe

1. The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by ½-inch depth. Each pipe shall have two annular corrugations rolled in each end. Each pipe shall have two lifting lugs welded to the outside of the pipe.
2. After the ends are rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch as required by AASHTO M-190 for Type A coating. The pipe shall be centrifugally lined on the inside with bituminous material to form a smooth surface which fills the corrugations to a minimum thickness of 1/8 inch above the crests of the corrugations. The bituminous lining material shall meet the requirements of AASHTO M-190.

2.5 CORRUGATED METAL PIPE COUPLINGS

Bituminous Coated Pipe Couplings: Coupling bands shall be the same base metal and spelter coating as the pipe. Bands shall be 0.064-inch thick and 10 ½ inches wide. Bands shall be bituminous coated and shall have two corrugations 7-5/8 inches center to center. Bands 12-inch diameter through 30-inch diameter shall be one-piece, and 36-inch diameter through 96-inch diameter shall be two-piece. Band laps 12-inch diameter through 48-inch diameter shall be joined by one galvanized bar, bolt, and strap connector. Band laps 54-inch diameter through 96-inch diameter shall be joined by two galvanized bar, bolt, and strap connectors.

2.6 ALLUMINUM OR ALUMINIZED STEEL CORRUGATED PIPE AND STRUCTURAL PLATES

A. Aluminum Alloy Structural Plate

1. Aluminum alloy plates and fasteners intended for use in the construction of structural plate pipe and pipe arch for storm sewers shall meet the applicable requirements of AASHTO M-219. The plate shall be fabricated from aluminum alloy 5052 H141. The chemical composition of the plates shall conform to ASTM B209 alloy 5052.
2. The corrugations shall have a pitch of 9 inches plus or minus 3/8 inch and depth of 2-1/2 inches plus or minus 1/8 inch. The inside crown radius of the corrugations shall be not less than 2 inches.
3. The structural plate pipe or arches shall be assembled in accordance with the manufacturer's erection instructions and in accordance with the drawings.

B. Aluminized Steel Pipe and Arches

1. Aluminized coated corrugated steel pipe and pipe arch intended for use in the construction of storm sewers shall meet the applicable requirements of AASHTO M-36. Sheet material shall meet the latest revision of ASTM A525 and AASHTO M-274. The coils from which the pipe is produced shall be coated with 1.0 ounce per square foot of commercially pure aluminum.
2. Pipe shall be furnished circular or as a pipe-arch shape as required and shall be fabricated with helical corrugations and a continuous welded seam extending from end to end of each length of pipe.
3. Each end of each pipe with the welded seam shall have two annular corrugations reformed to permit joining with hugger bands.
4. Coupling bands shall be hugger bands.

2.7 MULTI-PLATE PIPE AND PIPE ARCHES

A. Multi-plate pipe and pipe arch structures shall be in accordance with AASHTO M-167. They shall be made with steel sections with corrugations 6 inches wide by 2 inches deep running at right angles to the section.

B. Bolts and nuts shall be special heat-treated galvanized ¾-inch diameter bolts in accordance with ASTM specifications.

C. Multi-plate pipe and pipe arch structures shall be designed in accordance with the manufacturer's design criteria and in accordance with the drawings.

D. Detailed instructions regarding erection shall be furnished by the manufacturer.

2.8 PVC COMPOSITE PIPE AND FITTINGS

ABS or PVC composite pipe and fittings shall conform to ASTM D 2680, Latest Revision.

2.9 CORRUGATED POLYETHYLENE PIPE AND FITTINGS

Corrugated polyethylene pipe and fittings shall be high density polyethylene and shall conform to ASTM D 3350, with a minimum cell classification of PE 334413.

2.10 MANHOLES AND OTHER STRUCTURES

A. Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to requirements of ASTM Specification C478, latest revision. For ease of maintenance, manholes and similar structures shall be located either in the roadway, street or within six (6) to eight (8) feet of the curb line within the utility right-of-way space.

B. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:

1. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C150, ACI 301, and ACI 318. Concrete for precast manhole sections shall be 3000 psi concrete. Monolithic manholes shall use 4000 psi concrete. Ready-mix concrete shall conform to ASTM C94, Alternate 2. Maximum size of aggregate shall be ¾ inch. Slump shall be between 2 and 5 inches.
2. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
3. Reinforcing steel shall conform to ASTM A615, Grade 60 deformed bars, or ASTM A616 Grade 60 deformed bars.
4. Mortar Materials:

    a. Sand – ASTM Designation C144, passing a No 8 sieve.
    b. Cement – ASTM Designation C150, Type 1.
    c. Water – shall be potable.

5. The manufacturer shall provide openings for sewers entering and leaving the manhole. Any additional openings needed to be made in the field shall be made by drilling holes at least ½ inch in diameter with a maximum spacing of 3 inches.
6. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Castings shall have a total weight of not less than 355 pounds and shall conform to the

design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch bolts, nuts, and washer.

7. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements.
8. Any other special manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall be constructed as detailed on the drawings.

2.11 CATCH BASINS AND DRAIN INLETS

Cast iron or ductile iron frames and gratings for catch basins and drain inlets shall be as shown on the drawings. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blow holes, shrinkage, cold shuts, and all defects and shall conform to ASTM A48 Class No. 30-B. During construction, precautionary measures such as adequate screening of grates shall be maintained to deter earth and other materials from entering the drains.

PART 3 - EXECUTION

3.1 INSPECTION AND REJECTION OF PIPE

A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Town Engineer. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.

B. Prior to being lowered into the trench, each pipe shall be carefully inspected and those not meeting the specifications shall be rejected and at once removed from the work.

C. The Town Engineer shall have the right to cut cores from such pieces of the concrete pipe as he desires for such inspection and tests as he may wish to apply.

D. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.

E. The Town Engineer shall also have the right to take samples of concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.

F. Any pipe which has been damaged after delivery will be rejected and replaced solely at the Contractor's expense.

3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the Town Engineer approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

3.3 NOTICE TO ENGINEER

The Town Engineer shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

3.4 LAYING PIPE

A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and shall be removed immediately from the site of the work.

B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.

C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.

D. Practically watertight work is required, and the Contractor shall construct the sewer with the type of joint specified.

E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.

F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the

recommendations of the manufacturer on particular type of joint and the directions of the Town Engineer. All joint work shall be done by experienced workmen.

G. All pipe shall be bedded as described in this specification under Pipe Bedding. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.

H. Each length of pipe shall be mechanically pulled "home" with a winch or come-along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place.

I. The Contractor shall use laser beam equipment, surveying instruments, or other proven techniques to maintain accurate alignment and grade.

J. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.

3.5 PIPE BEDDING AND HAUNCHING

A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.

B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.

1. When Angular 60 to 12 mm (1/4 to ½-inch) clean graded stone, slag or crushed stone material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. If Class I material is used for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe

to avoid loss of side support through migration of Class II haunching material in the bedding.

2. Take care with coarse sands and gravels and maximum size 20 mm (3/4-inch) material, to provide a uniformly compacted bedding. Excavate the bedding material or place it to a point above the pipe bottom, determining such point by the depth of loose material resulting in the preparation of the bedding and the amount of compaction that will be required to bring the material to grade. Use hand or mechanical tamping to compact the bedding material to a minimum 85% Standard Proctor Density.
3. Slightly damp material will generally result in maximum compaction with a minimum of effort. If water is added to improve compaction or if water exists in the trench, take care to avoid saturation of Class II material, which could result in additional stability problems. Check grade of bedding after compaction.

C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.

D. The rigid pipe, such as concrete, or ductile iron, backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.

E. For flexible pipe, corrugated metal pipe, the placement of embedment material or haunching around the pipe must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. If crushed stone, pea gravel, or graded gravel or sand is used to backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe, it shall be hand placed. If fine sand, silt, or clayey gravels are used for initial backfilling over the pipe, the material shall be hand placed in 6- to 8-inch layers and hand compacted on both sides of the pipe to an elevation 12 inches (300 mm) over the top of the pipe. Care should be taken so not to compact directly over the pipe.

F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.

G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation

shall be made on “unit cost” projects only, and as prescribed under basis for payment.

3.6 CONCRETE CRADLE (CLASS “A” BEDDING)

Concrete cradles shall be constructed of Class “B” concrete and of the design shown on the detailed drawings.

3.7 MANHOLES AND OTHER STRUCTURES

A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:

1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:

    a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.
    b. The joint shall consist of a flat rubber gasket attached to the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation 443, latest revision.

2. Openings in manhole sections for sewer connections shall be cut at the point of manufacture and shall be circular or horseshoe shaped with grooved or roughened surfaces to improve mortar bond. Any additional holes cut in the field shall be accomplished in a manner approved by the Town Engineer.
3. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet. Manhole bases shall be cast on a minimum of 6 inches of compacted crushed stone.
4. Manhole channels or inverts shall be preformed and poured with Class “B” concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.
5. Manhole frames and lids shall weigh not less than 355 pounds and be of good quality cast iron, conforming to ASTM Designation A48 and as shown on Detail #2 on the Standard Detail Sheet. Unless specifically designated otherwise, manhole castings shall be the non-locking type. All manhole frames shall be cast or drilled with three holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch bolts, nuts, and washers. The joint between the casting frame and cone section shall be fully mortared or gasketed and coated with a coal

tar epoxy coating upon reaching its final set to become a watertight joint.

6. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. Steps shall be placed as shown on the drawings.

3.8 FINAL SEWER CLEANING

A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by the Town Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

B. Upon the Town Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

PART 4 – FIGURES

4.1 INDEX

Figure	Description
ST-1	Standard Storm Sewer Manhole Detail
ST-2	Type I Storm Sewer Manhole Detail
ST-3	Straight Curb Inlet Casting Type 1
ST-4	Straight Curb Inlet Casting Type 2
ST-5	Rolled Curb Inlet Casting Type 3
ST-6	Beehive Curb Inlet Casting Type 4
ST-7	Flat Curb Inlet Casting Type 5
ST-8	Inlet Structure Type 1A
ST-9	Inlet Structure Type 1B
ST-10	Catch Basin Structure Type CA

END OF SECTION 5

SECTION 6 – GRAVITY SANITARY SEWERS

PART 1 – GENERAL

1.1 GENERAL

A. For ease of maintenance, manholes and similar structures associated with sanitary sewers shall be located either in the roadway, street or within six (6) to eight (8) feet of the curb line within the utility right-of-way space.

B. This section covers all work necessary for the installation of gravity sanitary sewers and related items complete, including manholes, junction chambers, diversion chambers, house services, and miscellaneous concrete structures.

C. Sewer pipe shall be the size shown on the drawings and shall meet all requirements of these specifications.

D. If a material type is shown on the drawings, that material shall be used in the installation unless otherwise noted in the specifications.

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 SUBMITTALS

Before construction and preferably before fabrication, the Contractor shall submit to the Engineer for approval calculations on the thickness or strength class and drawings showing pipe lengths, joints, and other construction and installation details. All pipe furnished under this Contract shall be fabricated only in accordance with the drawings and these specifications.

1.4 QUALITY ASSURANCE

A. Performance Tests: The Contractor shall test all gravity sewers constructed under the Contract. The Contractor shall constantly check horizontal and vertical alignment. Testing for vertical deflection in the case of non-rigid pipe and sewer watertightness testing in the case of all gravity sewers and hydrostatic testing of ductile iron pipe shall be as specified in this Section.

B. Line and Grade Requirements: The Contractor shall provide assurance to the Engineer or the Engineer's representative that the sewer is laid accurately to the required line and grade as shown on the drawings. The Contractor shall utilize a laser beam instrument to lay and check the alignment and grade between manholes. Before proceeding with the next section of sewer, the last section shall be checked for proper line and grade. Variations from a uniform line and grade as shown on the drawings and described below shall be cause for the line to be rejected.

1. Variance from established line and grade shall not be greater than 1/32 of an inch per inch of pipe diameter and not to exceed ½ inch, provided that such variation does not result in a level or reverse sloping invert; provided also that the variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 1/64 inch per inch of pipe diameter or ½ inch maximum.

C. Test Sections

1. Initial Performance Test: An initial performance and leakage test will be performed on the first sections of sanitary sewer constructed of approximately 600 feet in length of each size and type sewer material installed. No additional sewer pipe shall be installed until the first section of sewer of each size and type of sewer material has satisfactorily passed the test for line and grade and the leakage test.
2. Subsequent Performance Testing: After the initial performance test and leakage test and as work progresses, the Engineer may designate additional sections for testing as conditions in his opinion warrant. If a review of the Contractor's workmanship leads the Engineer to question whether or not the tolerances and standards specified are being met, the Engineer reserves the right to select other locations and lengths to be tested. The Engineer shall notify the Contractor of the location where a test is to be required not later than 15 days after the sewer installation has been completed. Unless otherwise authorized, the Contractor shall arrange to commence the test within 15 days after the sewer has been installed or 15 days after receiving notification by the Engineer, whichever date is later.
3. Final Performance Testing for Acceptance: Before acceptance and final payment for all new sanitary sewers, the Contractor and the Engineer or the Engineer's representative shall check all sewers, even if previously checked, for accurate alignment and grade. Also, all sanitary sewers shall be tested as specified in Articles 3.10 through 3.14 of this Section for watertightness. The program of

testing whether by infiltration, exfiltration, airtesting, or vacuum testing shall be determined by the Engineer.

1.5 LENGTH OF OPEN TRENCH

Except by permission of the Engineer, not more than 450 feet of trench shall be opened at any one time. Not more than 30 feet of trench may be opened in advance of the completed pipe laying operation, and not more than one street crossing may be obstructed by the same trench at any one time.

1.6 RELATION TO WATER MAINS

A. Sewers must be laid at least 10 feet horizontally from any existing or proposed water main. The distance is to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation. Special conditions 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 inches above the top of the sewer. It may be necessary to install 150 psi water main pipe and joints as sewer pipe for the congested areas.

B. Whenever the sewer crosses a water main, it should be laid at least 18 inches below the main, or the water main should be relaid with fittings to cross over the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.

C. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling. Maximum distance between sewer pipe joints and water pipe shall be provided where vertical separation is a problem.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sewers 15 Inches or Smaller

1. Sewers 15 inches in diameter or smaller shall be PVC composite pipe, polyvinyl chloride pipe, or ductile iron pipe.
2. PVC Composite Sewer Pipe and Fittings: PVC composite sewer pipe and fittings shall conform to ASTM D2680, latest revision.
3. Polyvinyl Chloride Pipe and Fittings

a. Polyvinyl chloride pipe and fittings shall conform to ASTM D3034 SDR 35, Type PSM, latest revision.
b. Maximum diameter of PVC sewer pipe to be used is 15 inches.
c. Construction of sanitary sewers utilizing polyvinyl chloride pipe shall incorporate “tracing wire” the entire length of the sewer lines improvements or installations.

4. Ductile Iron Pipe and Fittings: Ductile iron pipe and fittings shall conform to the requirements of ANSI/ASTM A746, Ductile Iron Gravity Sewer Pipe.

a. Thickness class requirements of ductile iron pipe to be sued in conveyance of sanitary sewage by gravity shall be minimum thickness of Class 350 unless otherwise noted for standard length pipe.
b. Outside surfaces of the pipe and fittings shall be bituminous coated complying with ANSI/AWWA A21.51/C151 and ANSI/AWWA A2110/C110.
c. Inside surfaces of all pipe, fittings and adapters shall be lined with cement mortar and a bituminous seal coat. Cement mortar lining and bituminous seal coat shall meet the requirements of ANSI/AWWA A21.4/C104.
d. Ductile iron pipe and fittings shall be push-on type conforming to ANSI A21.11 (AWWA C111), latest revision. Fittings shall be ductile iron and shall comply with ANSI Specification A21.10, latest revision, with mechanical joints for 150 psi working pressure.

5. Joints for PVC Sewer Pipe

a. Joints on PVC sewer pipe shall be the integral bell type gasketed joint designed so that when assembled the elastromeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with manufacturer’s requirements. The joint shall comply with the physical requirements of ASTM D3213, and the gasket shall be the only element depended upon to make the joint flexible and watertight.
b. All PVC Pipe entering a manhole shall have a manhole waterstop gasket as supplied by the manufacturer firmly clamped around the pipe at the manhole. If flexible entry type manhole system is used, the waterstop gasket is not required.

B. Fittings

1. Fittings such as wyes, tees, and bends shall be made in such a manner as will provide strength and watertightness at least equal to the class of the adjacent main line pipe to which they are jointed and shall conform to all other requirements specified for pipe of corresponding class and internal diameter. Joints shall be of the same type as used on the adjoining pipe.
2. Fabricated branches for wyes and tees shall be securely attached to the wall of the pipe in a watertight manner and shall be flush with the inside surface of the pipe. The branches shall have their axes perpendicular to the longitudinal axis of the pipe. Wye branches shall have their axes approximately 60 degrees for clay pipe and 45 degrees for concrete pipe from the longitudinal axis of the pipe, measured from the bell end. Pipe reinforcement shall not be interrupted beyond a radial distance of 3 inches outside of the fitting.

C. Manholes and Other Structures: Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to requirements of ASTM Specification C478, latest revision.

1. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:

   a. Concrete for precast manhole sections shall be 3000 psi concrete. Monolithic manholes shall use 4000 psi concrete. Ready-mix concrete shall conform to ASTM C94 Alternate 2. Maximum size of aggregate shall be 1-1/2 inches. Slump shall be between 2 and 4 inches.
   b. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
   c. Reinforcing steel shall conform to ASTM A615, Grade 40 deformed bars, or ASTM A616, Grade 40 deformed bars.
   d. Mortar Materials:

      (1) Sand – ASTM Designation C144, passing a No 8 sieve.
      (2) Cement – ASTM Designation C150, Type 1.
      (3) Water – shall be potable.

   e. All joints shall be fully sealed and waterproofed. Rubber gaskets for precast concrete manhole sections shall meet the requirements of ASTM C443. The gasket shall be the

sole element depended upon to make the joint flexible and watertight.

f. The manufacturer of the precast manholes shall provide core-drilled openings to produce a smooth, uniform, cylindrical hole of the proper size to accommodate a resilient connector meeting the requirements of ASTM C 923 for all sewers entering and leaving the manhole. The resilient connectors shall be either Press-Seal Gasket Corp., which provides PSX gasket or Press Wedge II; or similar flexible manhole sleeves furnished by Kor-N-Seal by NPG Systems, Inc.; or equal.

g. Precast manhole sections shall be steam cured and shall not be shipped from the point of manufacture for at least five days after having been cast. The exterior surface of each section shall be thoroughly coated with a coal tar epoxy type coating as manufactured by TNEMEC Co, Tnemec-46H413 Hi-Build Tneme-Tar; or approved equal by the Engineer. Final dry mils thickness shall be a minimum of 12 mils. Monolithic concrete manholes and other concrete structures shall be cured for a minimum of seven days and then coated in the field with a coal tar epoxy type coating as mentioned above.

h. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Castings shall have a total weight of not less than 380 pounds and shall conform to the design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section to provide a water tight-fit with three 3/8-inch stainless steel bolts and expansion shields. Unless specifically designated otherwise, manhole castings shall be the non-locking type.

i. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements. Manhole steps manufactured by M.A. Industries, Inc., PS-1-PF, Clay & Bailey Mfg. Co., or equal, are acceptable.

j. Any other special manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall be constructed as detailed on the drawings.

k. The Contractor may, at his option, furnish and install a combination precast concrete base and first section with precut openings for services. Detailed drawings shall be submitted to the Engineer prior to manufacture.

l. Precast manhole sections shall have a lifting eye cast into the wall for lifting the section. Lifting holes through the precast section will not be allowed.

D. Grease Trap: Grease trap tank shall be constructed of 6000 psi concrete. All tank joints shall be sealed watertight with butyl rubber extrudible preformed gasket material. All outside riser ring surfaces shall be waterproofed 1/8" with trowelable grade butyl rubber back plaster.

PART 3 – EXECUTION

3.1 INSPECTION AND REJECTION OF PIPE

A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.

B. Prior to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and at once removed from the work.

C. The Town or its representatives shall have the right to cut cores from such pieces of the concrete pipe as he desires for such inspection and test as he may wish to apply.

D. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.

E. The Town or its representatives shall also have the right to take samples of concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.

F. Any pipe which has been damaged after delivery will be rejected and replaced solely at the Contractor's expense.

3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the Engineer approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

3.3 NOTICE TO ENGINEER

The Utility Superintendent shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

3.4 LAYING PIPE

A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and shall be removed immediately from the site of the work.

B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.

C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.

D. Practically watertight work is required, and the Contractor shall construct the sewer with the type of joint specified.

E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.

F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the recommendations of the manufacturer on particular type of joint and the directions of the Town Engineer. All joint work shall be done by experienced workmen.

G. PVC (polyvinyl chloride) gravity sewer pipe and fittings, ASTM Designation D3034 SDR 35, shall be installed in accordance with the directions contained in ASTM Designation D2321. Only materials classified as Class I will be acceptable for bedding, haunching, and initial backfill of the pipe placed and compacted in accordance with ASTM D2321.

H. Joints on PVC pipe shall be the integral bell type gasketed joint designed so that when assembled the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in

accordance with the manufacturer's recommendations. The gasket shall be the only element depended upon to make the joint flexible and watertight.

I. All PVC pipe entering a manhole shall have manhole waterstop gasket as supplied by the manufacturer firmly clamped around the pipe. If flexible entry type manhole system is used, the waterstop gasket is not required.

J. All PVC pipe shall have a deflection test performed by the Contractor in the presence of the Engineer or his representative.

K. All pipe shall be bedded as described in this specification under Pipe Bedding. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.

L. Each length of pipe shall be mechanically pulled "home" with a winch or come-along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place. Pushing the pipe home shall be done by means of a block and push bar. Use of hydraulic excavating equipment as the means of pushing or moving the pipe to grade will not be permitted.

M. The Contractor shall use laser beam equipment to maintain accurate alignment and grade. A qualified operator shall handle the equipment during the course of construction. If bending of the laser beam due to air temperature variations or dust in the air is apparent "within the pipe" units, a fan shall be provided to circulate the air. However, air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. Survey instruments may be used for checking alignment and grade if questions arise about the accuracy of the work

N. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall not be perforated to allow passage of water into the installed pipeline to prevent flotation of the pipeline. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any open end of unplugged branch must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.

O. The Contractor shall conduct a leakage test as described in Sewer Tests of the specification on the first section of sewer of each size and type sewer material installed. No additional sewer pipe shall be installed until the first reach of sewer of each size and each type sewer material has satisfactorily passed the leakage test.

P. The Contractor shall prevent all ground water and surface water from entering the existing sewer system during construction of a new sewer or force main extension.

Q. Sanitary sewer designs that require crossing a county legal drain shall be approved and constructed per the latest standards of the Tipton County Surveyor's Office.

3.5 PIPE BEDDING AND HAUNCHING

A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.

B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.

1. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding.

C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.

D. For rigid pipe, such as concrete or ductile iron, backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.

E. For flexible pipe such as PVC, the placement of embedment material, consisting of bedding, haunching, and initial backfill, must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Class I material, as defined in specification Section 02222, Article 2.01, paragraph A, shall be used as embedment material for flexible pipe. Bedding thickness shall be as specified in paragraph C of this Section. The haunching material (the material from the bedding to the pipe springline) and initial backfill (the material from the pipe springline to a plane 12-inches over the to of pipe),

shall be hand placed. Care must be taken to not cause damage by compacting the material directly over the pipe.

F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.

G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation shall be made on "unit cost" projects only, and as prescribed under basis for payment.

3.6 MANHOLES AND OTHER STRUCTURES

A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:

1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:

    a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.
    b. The joint shall consist of a round rubber gasket confined in a groove in the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation 443, latest revision and a flexible butyl rubber joint sealant between joints.

2. Openings in manhole sections for sewer connections shall be core-drilled at the point of manufacture and shall be done to produce a smooth, uniform, cylindrical hole of proper size to accommodate a resilient connector meeting requirements of ASTM C923. The resilient connectors shall be either Press-Seal Gasket Corp., PSX Gasket or Press-Wedge II; or similar flexible manhole sleeves furnished by Kor-N-Seal by NPC Systems, Inc.; or equal.
3. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet, or monolithic base and first section combination. Manhole bases shall be cast or placed on a minimum of 6 inches of compacted crushed stone.
4. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.

5. Monolithic concrete manholes, junction chambers, and other cast-in-place concrete structures shall be cured for a minimum of seven days. The exterior surfaces shall then be coated thoroughly with a coal tar epoxy type coating as manufactured by TNEMEC Co., Tneme-46H413 Hi-Build Tneme-Tar; or approved equal by the Engineer. Coating shall be 12 mil minimum dry film thickness. Each joint of precast concrete manhole sections, lifting holes, and holes left by the removal of cores shall be fully mortared and shall be coated with a 12 mil minimum dry film thickness of coal tar epoxy as specified upon reaching its final set.
6. Any additional holes cut in the field shall be drilled with a core-drill or in a manner approved by the Engineer.
7. Manhole frames and lids shall weigh not less than 400 pounds and be of good quality cast iron, conforming to ASTM Designation A48. Unless specifically designated otherwise, manhole castings shall be the non-locking type. All manhole frames shall be cast or drilled with three holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch stainless steel bolts, nuts, and washers. The joint between the casting frame and cone section shall be sealed with a pliable butyl rubber and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.
8. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. Steps shall be placed as shown on the drawings.

3.7 HOUSE/BUILDING SERVICES

A. The Contractor shall install 6-inch diameter house/building service sewer shall be installed as shown on the Standard Detail Sheet. The house/building service shall extend from a “wye” or “tee” fitting in the main sewer line to the property line or easement line, unless stated otherwise.

B. The Contractor shall contact the individual property owners for the preferred location of the house/building service to best suit the property owner’s needs. If the Contractor is unable to contact the property owner in advance of laying the main sewer by or across the property, the Contractor shall so notify the town Engineer in writing.

C. Fittings for house/building service connections on a main line sewer 15 inches in diameter or smaller shall be tees or 45-degree wyes and shall be of the same material as the main line sewer, unless otherwise approved by the Town Engineer.

D. House/building services and connections on main line sewers greater than 15 inches in diameter shall be of a type that will maintain the structural

integrity of the main line sewer and provide a watertight connection. Intrusion of house/building services into the flow way of the main line sewer should not be permitted.

E. Six-inch lateral pipe shall connect to the main line sewer at an angle of 15 degrees to 45 degrees from the spring line and shall include the necessary bends and straight pipe sections to reach the property line at the elevations specified. A pipe stopper or a bell cap shall be placed on/in the last bell. This stopper or bell cap should be compatible with the type of infiltration/exfiltration test performed on the sewer.

F. The Contractor shall furnish and use the proper fittings, couplings, and adapters suited to make the transition between different pipe materials which will maintain the structural integrity and the watertightness of the entire sewer system.

G. At the discretion of the town Utility Superintendent, when and where he feels that improper installation practices are suspected, or questionable bedding materials and methods are employed, or where the installations are severe, the Contractor will have to perform deflection testing on the 6-inch house laterals as specified in Article 3.9.

H. Backfill around fittings and lateral pipe shall be carefully placed and compacted to prevent damage from backfill settlement and shall be installed in same manner as described for sewer installation.

I. The Contractor shall mark the end of each house lateral with a 5/8-inch steel rod 5 feet long placed vertically over the end of the lateral. The rod shall be painted green and left sticking above the existing ground not more than 1 inch.

J. The Contractor shall keep accurate horizontal and vertical location measurements of each house/building service installed. The location of all house/building services shall be shown on record drawings as noted in Section 1.17 Record Drawings. The accuracy of the measurements shall be the Contractor's responsibility.

3.8 STUBS, CONNECTIONS, BULKHEADS, AND MISCELLANEOUS ITEMS OF WORK

A. Where special junction chambers are to be constructed or where existing sewers carrying sanitary sewage are encountered, the Contactor shall provide and maintain temporary connections to prevent a nuisance. All such temporary connections, pumping, and diversion shall be included in the price bid for this work.

B. Where called for shop connections and stubs for future sewer connections shall be provided.

C. New sewer connections to existing manholes shall be neatly made by cutting a hole in the existing structure, concreting the sewer in place, and providing a watertight connection.

D. The Contractor shall not connect any existing sewers or house/building services prior to the completion of the exfiltration/infiltration tests, air tests, and acceptance of the sewer without the written permission of the Engineer.

3.9 VERTICAL DEFLECTION TESTING

For PVC pipe, the entire length of installed mainline pipe shall be tested for acceptance with an approved go-no-go mandrel under the observation of the Engineer. The testing shall be conducted after the final backfill has been in place for at least 30 days. No pipe shall exceed a deflection of 5%. The deflection test shall be run using a mandrel having a diameter equal to 95% of the inside diameter of the pipe in accordance with ASTM D-3034 Appendixes. The pipe shall be measured in compliance with ASTM D-2122. All pipe exceeding the allowable deflection shall be replaced, repaired, and retested.

3.10 INFILTRATION LIMITS

A. Maximum infiltration/exfiltration limits for all new sanitary sewers shall not exceed 200 gallons per inch of diameter per mile of pipe per 24 hours. This standard is for the overall project and includes all manholes and house service connections. All sections of the sewer shall be tested, and any sections not meeting this infiltration standard shall be repaired and retested.

B. The Contractor shall note the special provision under Article 3.04, paragraph 0, that the first section of sewer of each size and type of sewer shall be given a satisfactory leakage test before proceeding with any additional construction.

3.11 SEWER WATERTIGHTNESS TESTING

A. Tests for watertightness shall be conducted on all installed sewers in the presence of and in the manner accepted by the Engineer. The Contractor shall furnish and install all equipment necessary for the sewer tests.

B. Watertightness tests shall be conducted on short sections of the sewer as soon as the manholes have been constructed and the backfilling completed.

C. Where the section tested is in excess of the allowable limits, the Contractor shall correct the construction of the sewer so that the section tested is within the allowable limit. All methods and materials used in the repair shall be approved by the Engineer.

D. The program of testing shall fit the conditions as determined by the Engineer using Air Test for Leakage. When ductile iron pipe with push-on type joints are used for sewer construction, a hydrostatic pressure test shall be performed.

1. The Air Test for Leakage

   a. The air test for leakage shall be used to test sewer watertightness on all sewer pipe unless otherwise noted.
   b. The ends of the sewer section being tested shall be sealed and property blocked. The seal at one end shall have an orifice through which to pass air into the pipe. An air supply shall be connected to the orifice at one end of the section. The air supply line will contain an off-on gas valve and a pressure gauge having a range from 0 to 25 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of the nearest $\pm$ 0.1 psi. The seals at each manhole shall be properly blocked to prevent displacement while the line is under pressure.

2. Procedure for Conducting a Low Pressure Air Test

   a. Clean pipe to be tested by propelling a snug fitting inflated ball through the pipe by water pressure or other adequate method. This step is important because it not only flushes out construction debris, but the water used to flush the ball through the pipe dampens the pipe wall. The rate of air loss through pipe wall permeation can be significant on dry pipes.
   b. Plug all pipe outlets with pneumatic plugs having a sealing length equal to or greater than the diameter of the pipe to be tested. The pneumatic plug shall be able to resist internal testing pressures without requiring external bracing.
   c. The groundwater level surrounding the section of sewer under testing shall be determined by one of the procedures previously outlined in paragraph D(1). If the groundwater table is above the pipe, then test pressures shall be increased by the corresponding increment (e.g., if the groundwater table is above the lowest crown of the pipe,

the air pressure should be increased 0.43 times each foot of water.)

d. Once the pipe outlet plugs are securely in place, pressurized air is introduced to the system. The air shall be fed through a single control panel with three individual hose connections as follows:

(1) from control panel to pneumatic plugs for inflation in sewer pipe;
(2) from control panel to sealed line for introducing the pressurized air;
(3) from sealed line to control panel; This line will enable continuous monitoring of the air pressure rise in the sealed line.

e. The air shall be introduced slowly to the section of pipe under evaluation until the internal air pressure is raised to 4.0 psig greater than the hydrostatic pressure head created by the existence of groundwater that is over the pipe section.

f. A minimum of two minutes shall be provided for the air pressure to stabilize to conditions within the pipe. (This stabilization period is necessary for variations in temperature to adjust to the interior pipe conditions.) Air may be added slowly to maintain a pressure to 3.5 to 4.0 psig for at least two minutes.

g. After the stabilization period, when the pressure reaches exactly 3.5 psig, the stopwatch shall be started; and when the pressure reaches 2.5 psig, it is stopped. The portion of the line being tested shall be acceptable if the time in minutes for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than the time shown in the following table:

Pipe Diameter (Inches)	Time (Minutes)
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

h. In areas where the groundwater is above the top of the pipe, the test pressures shall be increased by 0.433 per foot of groundwater (e.g., if the groundwater is 11-1/2 feet, the 3.5 to 2.5 pressure drop will be increased by 5 psi; the time then will be measured for a pressure drop from 8.5 psi to 7.5 psi.)

3. Safety Precautions During Air Test

a. The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

b. As a safety precaution, pressurizing equipment should include a regulator set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.12 HYDROSTATIC TESTING

A. A hydrostatic test on ductile iron pipe with push-on type joints has two purposes: one is to set the gaskets in place, and the other is to provide a leakage test.

B. Said test shall include all ductile iron sewer pipe with push-on type joints installed by the Contractor in this Contract. The Contractor shall make arrangements with the Engineer for scheduling the test after the sewer pipe has been accepted as being ready for testing. The test shall be performed in the presence of the Engineer on the day mutually agreed upon.

C. Water for testing may be obtained from the Owner. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test.

D. Hydrostatic test on ductile iron pipe with push-on type joints installed as gravity sewers and siphons shall be in accordance with the following provisions:

1. The ends of the sewer section being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The benchwall shall be formed in the manhole after the test section has been approved.
3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water. All air shall be expelled from the pipe.
4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
5. The system shall be tested in conformance with Section 13 of AWWA Specifications 600, at 50 pounds per square inch over a period of not less than one hour. The system will not be acceptable until all leaks have been repaired.
6. Hydrostatic test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. Inasmuch as a force of 2500 pounds is exerted on an 8-inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.

E. A hydrostatic test on ductile iron pipe with push-on type joints installed as force main shall be in accordance with Article 3.12, paragraph D., with the following exception:

1. The force main shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.

3.13 MANHOLE VACUUM TESTING

A. A vacuum test shall be conducted by the Contractor on all manholes to ensure watertightness and manhole integrity.

B. The equipment required to conduct a vacuum test on manholes includes inflatable pipe plugs, test head, vacuum pump, flexible air hose, and a vacuum gage. The test equipment shall be capable of drawing a vacuum of 10-inch Hg. The equipment shall be designed specifically for the purpose of testing manholes and shall be as manufactured by P.A. Glazier, Inc., Worchester, Massachusetts 10002, or equal.

C. The procedure for conducting an air test on manholes shall be in accordance with the following procedure:

1. Each manhole shall be tested immediately after assembly and prior to setting the casting or backfilling around the structure.
2. All lift holes shall be plugged with non-shrink grout.
3. All pipes entering the manhole shall be securely plugged and adequately braced against the inside of the manhole to prevent being drawn out of the pipe.
4. The test head shall be placed on the inside of the cone section and sealed with an inflatable seal.
5. A vacuum of 10 inches of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than the following:

Manhole Size	Minimum Test Time
48”	60 seconds
60”	75 seconds
72”	90 seconds

3.14 CLOSED CIRCUIT TELEVISION INSPECTION

A. The sections of sewers which do not pass the watertightness tests as specified in Article 3.12, Sewer Tests, shall be inspected by closed circuit television and shall be repaired as directed by the Engineer.

B. The Contractor shall furnish a qualified television technician, a trained supervisor, and sufficient personnel to perform all the work required in the inspection operation.

C. The Contractor shall furnish spare cameras and related equipment to prevent delays due to equipment breakdowns. Cameras shall be equipped with remote-control focusing devices, remote-control devices to adjust the light intensity, and enough cable shall be furnished to inspect 1,000 linear feet of sewer in a continuous operation. One cameral shall be small enough to pass through a 6-inch opening.

D. The Contractor shall clean the sewer, where required, one section at a time. After the sewer is cleaned, the television camera shall be attached to end of a rod or line so that it can be pulled through the pipe line. The camera shall trail a line of steel cable which will be attached to a winch of sufficient size to be able to pull back or retrieve the camera whenever necessary.

E. The camera shall transmit a continuous image to the television monitor. This image shall be clear and sharp enough to enable those viewing the monitor to be able to easily see the interior condition of the pipe line being inspected.

F. For each television inspection unit being used, the Contractor shall provide a mobile air-conditioned viewing room large enough to accommodate at least three people for the purpose of viewing the monitor while the inspection is in progress. Minimum size of the monitors shall be 17 inches, measured diagonally across the viewing screen. Electrical power to operate the equipment shall be provided by the Contractor.

G. The Contractor shall furnish all equipment required for making a continuous video tape of the view which appears on the monitor.

H. The Engineer or his representative shall be present at all times during television inspection of the sewers and will indicate to the Contractor whatever data may be required to be logged and prepared for record purposes. The Contractor shall prepare and furnish to the Owner not less than two copies of the complete record, video tape, and report of all inspection work done.

I. The cost of this work (should it become necessary) shall be included as part of the bid, and no additional compensation will be made to the Contractor.

3.15 RECORD DRAWINGS

A. The Contractor shall prepare or be responsible for the preparation and submittal of record drawings as described in Section 01001, Article 1.17.

B. Record drawings shall be certified to accuracy by a registered professional Engineer.

PART 4 – FIGURES

4.1 STANDARD DETAILS

Figure	Description
S-1	Standard Sanitary Manhole Detail
S-2	Standard Sanitary Manhole Spacer Ring Detail
S-3	Standard Sanitary Manhole Frame and Cover Details
S-4	Force Main Discharge Detail
S-5	Sewer Pipe Bedding Detail

S-6	Concrete Encasement Detail
S-7	Drop Pipe Details
S-8	Alternate Drop Pipe Details
S-9	Jacking and Boring Detail
S-10	House/Building Service Detail – 1
S-11	House/Building Service Connection Detail – 2
S-12	House/Building Service Bedding Detail
S-13	House/Building Service Clean-out Detail
S-14	Grease Trap Detail

END OF SECTION 6

SECTION 7 – FORCE MAINS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Specifications for force main pipe, fittings, valves, and appurtenances are included in this Section.

B. Definitions: All pipe, fitting and valve size, and all reference to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.

1. AWWA, where used in these specifications, shall mean American Water Works Association.
2. ANSI, where used in these specifications, shall mean American National Standard Institute.
3. ASTM, where used in these specifications, shall mean American Society for Testing & Materials.

C. These specifications cover the following types of material:

1. Ductile Iron.
2. Polyvinyl Chloride (PVC).

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 RELATION TO WATER MAINS

A. Sanitary force mains must be laid at least 10 feet horizontally from any existing or proposed water main. The distance to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation.

B. Whenever the force main crosses a water main, it should be laid to provide a minimum vertical distance of 18 inches between the outside of the force main and the outside of the water main. The force main can be either above or below the water main.

PART 2 – PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, and appurtenances shall be as shown on the drawings and specified in this Section. All pipe, fittings, valves, and appurtenances shall be new and unused.

2.2 DUCTILE IRON PIPE

A. Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151) and the additional requirements specified herein. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness pressure class shall be class 150.

1. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Fast, Lok-Tyte, or equal.
2. Mark each length of pipe. Marking shall include pipe class, casting period, manufacturer's name or trademark and year of manufacture. Marking shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151).

B. Lining and Coating: Outside surfaces of the pipe and fittings shall be bituminous coated complying with ANSI/AWWA A21.51/C151 and ANSI/AWWA A21.10/C110.

2.3 PVC PIPE

A. Polyvinyl Chloride (PVC) Force Mains

1. Pipe

a. Polyvinyl chloride pipe shall meet the requirements of AWWA Standard C900. The color of the pipe shall be blue. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. The dimension ratio shall not be greater than 18.
b. Polyvinyl chloride pipe shall have cast-iron-pipe-equivalent outside diameter.

c. Pipe joints shall be push-on type. Joints shall meet the requirements of AWWA Standard C900. Do not use solvent-cement joints.
d. Mark each length of pipe. Markings shall meet the requirements of AWWA Standard C900.
e. Construction of force mains utilizing polyvinyl chloride pipe shall incorporate “tracing wire” the entire length of the force mains improvements or installations.

2. The inside surface of the pipe for pipe 4 inches and larger shall be mechanically grit blasted to white metal and then lined with a virgin polyethylene material having a nominal thickness of 40 mils or a two-component coal tar epoxy compound (Duraline) having a nominal thickness of 45 mils.
3. The linings shall have a minimum dry film thickness of 40 to 45 mils. The thickness shall generally equal or exceed 40 to 45 mils throughout the pipe, except at the ends where the thickness may taper for a distance of 4 inches to a minimum 10 mils thickness.

2.4 FITTINGS

A. Fittings shall be ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi.

1. Fitting joints shall be restrained mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be used instead of thrust blocking. Restrained joints shall be Lok-Fast, TR Flex, Lok-Ring, or equal. Pipe connecting to restrained joint fittings shall also have restrained joints as indicated on the drawings and specified in this Section.
2. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.

2.5 ADAPTERS

A. Adapters from polyvinyl chloride force mains to victaulic or flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.

B. Line the inside surfaces of adapters with cement mortar lining and bituminous seal coating. Cement mortar lining and bituminous seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat

outside surfaces of adapters with bituminous coating. Outside coating shall meet the requirements of ANSI/AWWA C110.

C. Adapter ends connecting to polyvinyl chloride force mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.

D. Adapter ends connecting to victaulic or flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

E. Adapters from ductile iron force mains to victaulic or flange joint valves or fittings shall be cast iron or ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design manufacture adapters for a pressure rating of 150 psi.

1. Adapter ends connecting to ductile iron force mains shall have plain ends, push-on joints, mechanical joints, or restrained push-on joints. Adapters with plain ends, push-on joints, or mechanical joints may be used where restrained joints are not required. Adapters shall have restrained push-on joints where restrained joint piping is required as indicated on the drawings and specified in this Section. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Fast, Lok-Tyte, or equal.
2. Adapter ends connecting to victaulic or flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.
3. Gaskets

    a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of AWWA Standard C900.
    b. Gaskets for mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11

4. Nuts and bolts for mechanical joints shall be high strength, heat treated, cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.

F. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA A21.11/C111.

G. Nuts and bolts for mechanical joints shall be high strength, heat treated, cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA A21.11/C111.

1. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

H. Polyethylene encasement for ductile iron force mains, when specifically called for on the drawings, shall meet the requirements of ANSI Specification A21.5 (AWWA Standard C105).

2.6 VALVES AND VALVE BOXES

A. Eccentric Type Plug Valves: Plug valves shall be nonlubricated eccentric type with resilient faced plugs having mechanical joint or flanged ends.

1. Port areas of 4-inch to 20-inch valves shall be at least 80% of full pipe area. Port area for 24-inch and larger valves shall be at least 70% of full pipe area.
2. Valve seats, valve plug stem sleeves and plug stem bushings shall be fabricated of materials which are corrosion and abrasive resistant. The corrosion resistance shall be such that exposure over a period of five years to domestic wastewater, industrial wastewater, domestic sludges or industrial sludges containing sulfuric acid, hydrochloric acid, acetic acid, mineral oils, vegetable oils, polymers, esters or acetones shall not result in sufficient corrosion to interfere with the serviceability of the plug valve.
3. Seals shall be capable of being replaced while the line and valve remain in service, if under submerged conditions, thereby eliminating the need to take process units out of service.
4. All exposed nuts, bolts, springs, and washers shall be plated with corrosion resistant material. Means of actuation shall be by lever, gear actuator, tee wrench, extension stem, or floor stand, as indicated.
5. All plug valves shall be equipped with an underground operator.
6. Plug valves 10-inch and larger shall be equipped with gear actuators. All gearing shall be enclosed and lubricated with seals provided on all shafts to prevent entry of dirt and fluid into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator shall clearly indicate valve positions, and an adjustable stop shall be provided to set closing torque. Valve stop shall be positive and shall not move due to repeated operation of the valve.
7. Valves shall be DeZurik Series 100, Homestead Ballcentric, Dresser Style 800 X-Centric, or equal.

B. Gate Valves: Buried gate valves 4-inch and larger shall be full iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 and shall have mechanical joint ends. Mechanical joints and joint accessories shall meet

the requirements of ANSI/AWWA A21.11/C111. Valve opening direction shall be consistent with operation of existing valves in the utility in which the valves are installed, unless otherwise directed by the Engineer.

1. Three-inch buried gate valves shall be iron body, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500, except ends shall be screwed. Screwed ends shall meet the requirements of ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the utility in which the valves are installed, unless otherwise directed by the Engineer.
2. Gate valves 4-inch and larger installed above ground or in structures shall be iron body, outside screw, and yoke gate valves. Valves shall meet the requirements of ANSI/AWWA C500, except those parts of ANSI/AWWA C500 only applicable to non-rising stem gate valves and wrench nuts. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be cadmium plated. Gaskets shall be full face and shall be velumoid, or equal.
3. Gate valves smaller than 4-inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels. Valves shall meet the requirements of federal Specification WW-V-54d for Class A, Type III valves.

C. Valve boxes for plug valves and gate valves shall be cast iron. Valve boxes shall be two piece or three piece type. Each two piece box shall be complete with bottom section, top section, and cover. Each three piece box shall be complete with base, center section, top section and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16 inch. Valve box cover shall be blank with no wording.

2.7 SEWAGE AIR AND VACUUM VALVES

Sewage combination air and vacuum valves shall be as follows:

Size	Specification
2” x 1”	Apco No. 401 SC, Val-Matic Co. No. 301 BWA, or equal
2” x 2”	Apco No. 402 SC, Val-Matic Co. No. 302 BWA, or equal
3” x 3”	Apco No. 403 SC, Val-Matic Co. No. 303 BWA, or equal

2.8 AIR AND VACUUM VALVE CHAMBERS

A. Air and vacuum valve chambers shall be 4-foot diameter precast concrete manhole barrels with precast concrete flat slab tops. Precast manhole barrels shall meet the requirements of ASTM C478.

B. Air and vacuum valve chamber access frames and cover shall be Neenah R-1915-G, or equal. Cast the word “SEWER” in each cover.

2.9 BURIED INDICATING TAPE

A. Metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines to be placed along the entire length of PVC force main. The tape shall have a 3-inch-minimum width, color coded for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read “CAUTION, BURIED FORCE MAIN BELOW” or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

B. The tape shall have a minimum strength of 1500 psi lengthwise and 150 psi crosswise, with a maximum 350 percent elongation. The tape shall be able to be detected with a metal detector when the tape is buried up to 3 feet deep.

PART 3 – EXECUTION

3.1 HANDLING AND CUTTING PIPE

A. Pipe and fittings shall be handled carefully to avoid cracking or abrasion of the pipe coating.

B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.

D. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose. All cut ends shall be examined for possible cracks caused by cutting.

3.2 INSTALLATION OF PIPING

A. All piping shall be installed to accurate lines and grades and shall be supported, guided, or anchored as shown, as specified, or as necessary.

B. Restrained joints shall be provided at vertical and horizontal deflection points, tees and crosses, or as directed by the Engineer.

C. All piping installations shall be done in a neat and workmanlike manner.

D. Install identification/location tape over all new non-metallic force main piping. See specification section 02558 “Identification/Location Tape” for material and installation requirements.

3.3 LAYING PIPE AND FITTINGS

A. No defective pipe or fitting shall be placed in the work, and any piece found to be defective after having been placed shall be removed and replaced by a second piece and at the expense of the Contractor.

B. Every pipe and fitting shall be cleaned of all debris, dirt, and other foreign material before being laid, and shall be kept clean until accepted in the completed work.

C. When bell and spigot pipe is laid, the bell of the pipe shall be cleaned of tar or other obstruction and wiped out before the clean spigot of the next pipe is inserted into it. The new pipe shall then be shoved home firmly against the back of the bell and securely held until the joint has been completed.

3.4 PIPE BEDDING AND HAUNCHING

A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.

B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.

1. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. If

Class I material is sued for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe to avoid loss of side support through migration of Class II haunching material into the bedding.

C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.

D. The rigid pipe, such as concrete or ductile iron, backfill between the bedding material and a plane 12-inches (300 mm) over the to of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.

E. For flexible pipe such as PVC, the placement of embedment material, consisting of bedding, haunching, and initial backfill, must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Crushed stone shall be used to backfill between the bedding material and a plane 12-inches over the top of pipe, and shall be hand placed. Care must be taken to not cause damage by compacting the material directly over the pipe.

F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.

G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6-inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation shall be made on “unit cost” projects only, and as prescribed under basis for payment.

3.5 JOINTING

A. Polyvinyl Chloride (PVC) Push-On Joints

1. Clean the bell and spigot of the pipe sections being joined. Wipe the outside of each spigot and inside of each bell clean of all dirt and other foreign matter. Wipe each bell and spigot dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Seat a gasket in the bell of the receiving pipe. Thoroughly lubricate the spigot end of the pipe being installed. Use the lubricant furnished by the pipe manufacturer. Center the spigot end of the pipe being installed in the bell of the receiving pipe. Support the

pipe being installed so the pipe being installed is jointed along the centerline of the receiving pipe. Push or pull the pipe being installed home. After jointing, check the gasket to ensure the gasket has not pushed out of its seat and the gasket is uniformly compressed around the pipe.

3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe manufacturer.

B. Mechanical Joints

1. Remove lumps, blisters, and excess bituminous coating from the bell and spigot end of each iron pipe, fittings, and valve. Wire brush the outside of each iron pipe or fitting spigot and inside of each bell. Wipe each bell, spigot, and ring gland clean of all dirt, oil, grease, and other foreign matter. Wipe each bell, spigot, and ring gland dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Brush each spigot and gasket with soapy water. Slip a ring gland followed by a gasket over the spigot. Center the end of the pipe, fitting, or valve being installed on the end of the receiving pipe, fitting, or valve. Support the pipe, fitting or valve being installed so the pipe, fitting, or valve being installed is jointed along the centerline of the receiving pipe, fitting, or valve. Push or pull the pipe, fitting, or valve being installed home. Push the gasket into position. Move the gland into position against the face of the gasket. Loosely assemble the joint bolts and nuts. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4” thru 24”	¾”	75 to 90 ft.-lb.

3. Deflect pipe, fittings, or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4”	8º-18’	31”
6”	7º-7’	27”
8”	5º-21’	20”
10”	5º-21’	20”

C. Flange Joints

1. Remove antirust coating from machined surfaces. Clean joint surfaces of the pipe, fittings, and valves being joined. Wipe surfaces clean of all dirt, oil, grease, and other foreign matter. Wipe surfaces dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Align the flange of the pipe, fitting, or valve being installed with the flange of the receiving pipe, fitting or valve. Support the pipe, fittings, and valves being joined so the flanges are properly aligned. Lubricate bolts and nuts with a graphite and oil mixture prior to installation of bolts and nuts. Install gasket between the flanges. Loosely assemble bolts and nuts. Check gasket to ensure the gasket is in proper position. Evenly tighten bolts and nuts. Tighten bolts and nuts so the joint will not leak. Do not overtorque bolts and nuts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of not less than 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings to be restrained and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall not be less than the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

B. Restrained Joint Piping: Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restrained shall not be less than that indicated on the drawings.

C. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings, and valves at the lines and grades indicated on the drawings and without strain upon pipe, fittings, and valves.
2. Support exposed piping by suitable saddle stands, concrete piers, or hangers.
3. Locate supports where necessary and not less than 8 feet on center.

3.7 HYDROSTATIC TEST

A. A leakage test must be successfully performed on the new force main in accordance with the following provisions:

1. Said test shall include all force main in this contract as shown on the drawings. The Contractor shall make arrangements with the Engineer for scheduling the test after the piping has been accepted as being ready for testing. All concrete thrust blocks shall have been in place for a period of at least ten days prior to the test. The test shall be performed on the day mutually agreed upon and in the presence of the Engineer.
2. Water for testing will be obtained by the Contractor at his cost. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test. The system shall be tested in conformance with Section 13 of AWWA Specification C600 at the static pressure of 100 pounds per square inch over a period of not less than eight consecutive hours. The system will not be acceptable until all leaks have been repaired to the satisfaction of the Engineer.
3. At the option of the Contractor, the force main may be tested in sections approximately 500 feet in length (subject to the approval of the Engineer); and upon satisfactory completion of the leakage test, the trench shall be backfilled as specified.
4. During the filling of the pipe and before the application of the specified test pressure, all air shall be expelled from the pipe line, if necessary, by means of taps at points of highest elevation; and after completion of the test, the taps shall be tightly plugged, unless otherwise specified.

END OF SECTION 7

SECTION 8 – LANDSCAPING FOR UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Furnish and install topsoil, fertilizer, seed, mulch, sod, trees, bushes, ornamental plants, fencing, mailboxes, planters, and related items necessary to complete work shown or specified.

B. The Contractor shall repair or replace lawn areas, trees, and ornamental plants damaged or destroyed during construction of the work included in this Contract, unless otherwise shown on the drawings. The Contractor shall repair or replace fences, mailboxes, planters, and other items damaged or destroyed during construction of the work included in this Contract, unless otherwise shown on the drawings.

C. Lawn areas include grassed areas which are cut and maintained on a routine basis. Lawn areas include lawns at homes and businesses and grass shoulders of streets, roads, and highways.

D. Replacement of underbrush in fields and woods, along farm fences and roads, and in similar areas is not required, unless otherwise shown on the drawings.

1.2 JOB CONDITIONS

A. Seed between February 15 and June 1 and between August 15 and November 1. Do not sow seed during adverse weather conditions. Do not broadcast seed during high wind. Do not sow seed when the moisture content of the soil is too low or too high for seed germination.

B. Plant trees and ornamental plants during the proper time and under the proper conditions for the particular tree or plant.

PART 2 – PRODUCTS

2.1 LAWN PRODUCTS

A. Limestone: Limestone shall be agricultural grade with a minimum total neutralizing power of 90. At least 40% of the limestone shall pass a No. 100 sieve, and at least 90% shall pass a No. 8 sieve.

B. Fertilizer: Fertilizer shall be 12-12-12 grade.

C. Seed:

1. Seed mix shall be as follows:

Seed Description	Percent By Weight
Kentucky Blue Grass (Poa prateusis)	35 to 40
Kentucky 31 Fecuse (Festuca arundinacea var. KY 31)	30 to 35
Perennial Rye (lolium multiflorm)	30 to 35

2. Seed shall not contain more than 5% inert matter. Seed shall not contain objectional weeds.

D. Mulch: Mulch shall be straw, grass, hay, pine needles, or wood fiber. Straw shall be threshed straw of cereal grain such as oats, wheat, barley, rye, and rice. Mulch shall not contain objectional weed seeds or other material that might be detrimental to the planting being established.

E. Asphalt Adhesive: Asphalt adhesive shall be emulsified asphalt. Adhesive shall meet the requirements of ASTM D977 for Grade SS-1.

2.2 SOD

Provide strongly rooted sod, not less than two years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of Kentucky Bluegrass (Poa pratensis).

2.3 TOP SOIL

A. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 1 inch in any dimension, and other extraneous or toxic matter harmful to plant growth.

B. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.4 FENCE AND OTHER PRODUCTS

Replacement fence, mailboxes, planters, and other items shall be new and unused. Fence, mailboxes, planters, and other items shall be the same type as the items removed. Fence, mailboxes, planters, and other items shall be of equal quality to the items removed when the items removed were new.

PART 3 – EXECUTION

3.1 GRADING

Fine grade all non-paved areas disturbed during construction. Areas shall be smooth and uniform. Finish elevations and grades shall be the same as elevations and grades prior to construction, unless otherwise shown on the drawings.

3.2 PREPARATION OF PLANTING SOIL

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. “Schedule of Planting Soil Mixture Requirements” is attached at end of this section.

D. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

E. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

1. Mix lime with dry soil prior to mixing fertilizer.
2. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before apply planting soil and tilling.

3.3 SEEDING

A. Loosen the seed bed, if not loose, to a depth of from 1 to 2 inches below finished grade.

B. Seeds and fertilizers can be sown with standard agricultural drills. Grass seeds may be sown broadcast or with a special seeder attachment on agricultural drills, but shall not be covered with more than ½-inch of soil, whether drilled or raked in. If not covered by the drill, all uncovered seed shall, immediately after sowing, be slightly raked or harrowed to cover the seed.

C. Apply fertilizer in the amount of 20 pounds per 1,000 square feet.

D. Sow grass seed at the rate of not less than four pounds per 1,000 square feet.

E. Apply adequate mulching material following seeding and fertilizing.

F. Keep seeded and fertilized areas adequately watered until germination of all seed is completed and uniform grass cover is accomplished.

3.4 PREPARATION OF SODDED AREAS

A. Prior to preparation of areas to be sodded, remove existing grass, vegetation, and turf. Dispose of such material outside of Owner's property. Do not turn over any removed material into the soil being prepared for sodding.

B. Loosen subgrade of areas to be sodded to a minimum depth of 4 inches. Remove stones over 1-1/2 inch in any dimension and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

C. Place 4 inches of topsoil to be sodded.

1. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.
2. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
3. Allow for sod thickness in areas to be sodded.

D. Grade areas to be sodded to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

E. Moisten prepared areas to be sodded before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

F. Restore areas to be sodded to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.5 SODDING

A. Sod areas indicated on drawings to be sodded.

B. Loosen the surface to a depth of 1 to 2 inches and rake area before sod is placed. Remove clods, lumps, boulders, and debris.

C. Apply limestone at a rate of 25 pounds per 1,000 square feet. Apply fertilizer at a rate of 10 pounds per 1,000 square feet.

D. Lay sod strips by hand. Fit sod to surrounding grade and fixed objects. Butt sod strips together so there are no open joints. Tamp or roll sod after initial watering. The sod shall have a smooth even surface after tamping and rolling.

E. Stake or peg sod when the sodded area has a slope of less than 4 feet horizontal to 1 foot vertical.

F. Lay sod within 24 hours from time of stripping. Do not plant dormant sod if ground is frozen

3.6 PLANTING, MAINTENANCE, AND REMOVAL OF TREES ON PUBLIC RIGHT-OF-WAY

A. The planting, maintenance and/or removal of all trees must conform to Ordinance No. 2003-07 as approved or amended by the Tipton City Council. Therein, street trees are defined as trees, shrubs, bushes and all other woody vegetation on land lying between property lines on either side of all streets, highways, avenues or ways, or which overhand any streets, highways, avenues, alleys, sidewalks, or ways within the City. All work on street trees shall comply with the Ordinance.

B. If a developer wishes to excavate near or plant, prune, or remove a tree in the public right-of-way the City of Tipton requires the developer to contact the Community Forest Manager/Street Commissioner, and file a Tree Permit Request, before work commences.

C. A copy of the Ordinance, permit and other guidelines regarding Ordinance No. 2003-07 can be procured at the Tipton City Offices. The document is entitled Tree Care.

D. Plant trees in the proper manner for the particular tree being planted or consult the Tree Care document.

E. Keep trees properly watered until growth is assured.

3.7 ALL OTHER TREES AND OTHER PLANTS

A. All other trees and plants should be planted in the proper manner for the plant being planted.

B. Keep trees and plants properly watered until growth is assured.

3.8 FENCING AND OTHER RESTORATION

A. Locate fences, mailboxes, planters, and other items in the same location that the item had been prior to construction. Erect wire and board fences plumb and on straight lines. Set mailboxes, posts, poles, and similar items plumb. Restore planters and similar items to the same shape the items had been prior to construction.

B. Wire fences shall have the proper tension for the type of wire fence restored. Other fences and items shall be properly erected or constructed.

3.9 CLEAN-UP

Clean up the job site following landscaping. Remove rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable condition.

END OF SECTION 8

SECTION 9 – CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and place plain and reinforced concrete and do related work necessary to complete work shown or specified.

B. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1. Following is a partial list of American Concrete Institute publications which are applicable to concrete construction:

a. ACI 318 Building Code Requirements for Reinforced Concrete.
b. ACI 211.1 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
c. ACI 211.2 Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.
d. ACI 347 Recommended Practice for Concrete Formwork.
e. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
f. ACI 308 Recommended Practice for Curing Concrete
g. ACI 306 Recommended Practice for Cold Weather Concreting.
h. ACI 305 Recommended Practice for Hot Weather Concreting.
i. ACI 304 Recommended Practice for Measuring, Mixing, and Placing Concrete.
j. ACI 503.1 Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive.
k. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

1.2 QUALITY ASSURANCE

A. Testing Laboratory Services: The Contractor shall employ and pay for the services of an independent testing laboratory to perform specific services and necessary tests as outlined below:

1. Tests: Establish each proposed design mix prior to placing the first concrete at the job site. Make a set of four test cylinders for each proposed mix. Break one cylinder from each set at seven days. Break the remaining cylinders at 28 days. A mix will be considered satisfactory if the average strength of three 28-day breaks equals or exceeds the specified 28-day strength. Adjust the design mix and repeat the test procedure if the average strength of three 28-day breaks is less than the specified 28-day strength.

B. Tolerances: Finish concrete shall meet the following tolerances:

1. Variations from Plumb: ± ¼-inch per 10 feet but not more than 1 inch
2. Variations from Level or Indicated Grade: ± ¼-inch per 10 feet but not more than ½ inch
3. Variations from Horizontal: ± ¼-inch per 10 feet but not more than ½ inch
4. Variations in Size and Locations of Openings or Sleeves: ± ¼-inch
5. Variation in Steps Flight of Stairs:

    a. Riser: ± 1/8-inch
    b. Tread: ± ¼-inch

6. Variation in Steps Consecutive Steps:

    a. Riser: ± 1/16-inch
    b. Tread: ± 1/8-inch

7. Reinforcing Steel Placement: ± 3/8-inch

1.3 SUBMITTALS

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.
2. Certified copies of test reports of concrete mixes required by the applicable standards.
3. Shop and placing drawings, bending diagrams, and mill test reports for reinforcing steel bars for cast-in-place concrete structures.

4. Samples of waterstops, vapor barrier, and perimeter insulation.
5. For concrete restoration and repair work, submit complete description of proposed method of repair, including sequence of work, dimensions, method of surface preparation, protection of existing structures and materials.
6. Sample and test reports of fly ash.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged or unsuitable products from the job site. Replace damaged products with undamaged products. Replace unsuitable products with suitable products.

1.5 JOB CONDITIONS

A. Follow methods outlined in ACI 306 if concrete is to be placed when the atmospheric temperature is expected to be less than 40ºF.

B. Calcium chloride will not be considered for approval as an accelerating admixture during cold weather construction.

C. Follow methods outlined in ACI 305 if concrete is to be placed when the atmospheric temperature is expected to exceed 90ºF.

D. Manufacturer's recommendations shall be strictly followed in regard to atmospheric temperature limitations during application of epoxy or acrylic polymer modified concrete materials.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C 150, ACI 301, and ACI 318. Cement shall be Type 1 for normal use, Type 1A where air-entrainment is desired, or Type III or Type IIIA where high early strength is desired and authorized by the Engineer. Blended hydraulic cements which meet the requirements of ASTM Specification C-595 Type 1-P Portland-pozzolan cement may be used where a more watertight concrete is required. Fly ash may also be used as a partial cement replacement for Types 1 or 1A.

B. Aggregate

1. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of ¾ inch, except in mass concrete the maximum size may be 1-1/2 inches.
2. Lightweight fine and coarse aggregates shall meet the requirements of ASTM Specification C 330.
3. Insulating fine and coarse aggregates shall meet the requirements of ASTM Specification C 332.

C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. A maximum of 500 mg/L of chloride ion may be present in the water.

D. Admixtures

1. Air-entraining admixtures shall meet the requirements of ASTM Specification C 260.
2. Water-reducing and retarding admixtures shall meet the requirements of ASTM Specification C 494, Type A or Type D, except that they shall contain no chlorides, shall be non-toxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification.
3. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 6%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.

E. Reinforcement

1. Reinforcing steel shall meet the requirements of ASTM Specification A 615, Grade 60.
2. Welded wire fabric or wire mesh shall meet the requirements of ASTM A 185.

F. Joint Filler

1. Preformed expansion joint filler shall be chosen to suit the job requirements as follows:

a. Type A: Asphalt filler for unsealed expansion or isolation joints in sidewalks, driveways, floor slabs on-grade, and elsewhere as indicated on the drawings. Filler shall meet the requirements of ASTM Specification D994.

(1) Sealtight asphalt expansion joint filler, as manufactured by W.R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.

b. Type B: Self-expanding cork filler for standard or waterproof sealed expansion joints in walls, slabs, and elsewhere as indicated on the drawings. Sealing shall be installed in accordance with the details shown on the drawings. Filler shall meet the requirements of ASTM Specification D1752, Type III

(1) Sealtight self-expanding cork expansion joint filler as manufactured by W.R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.

2. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D1190.

a. Sealtight No. 164, as manufactured by W.R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.

G. Waterstops shall meet the requirements of Corps of Engineers CRD-C572. Waterstops shall be of the configurations as shown on the standard detail drawings or as specified.

H. Curing Compounds: Curing compounds shall meet the requirements of ASTM Specification C 309, Type I.

I. Epoxy Adhesive and Grout

1. Epoxy adhesive and grout shall be epoxy-resin systems meeting the requirements of ASTM C 881 and the additional requirements herein.
2. The proper type, grade, and class (ASTM C 881) shall be chosen to suit the job requirements as follows:

a. Type
(1) I – For bonding hardened concrete and other materials to hardened concrete and setting anchor bolts and reinforcing bars in hardened concrete.

(2) II – For bonding freshly mixed concrete to hardened concrete.
(3) III – For bonding skid resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concrete.

b. Grade

(1) 1 – For crack injection and spray application, light viscosity.
(2) 2 – For brush application, medium viscosity.
(3) 3 – For trowel or caulking gun application, non-sagging heavy viscosity for filling voids and gaps.

c. Class

(1) A – For use below 40ºF.
(2) B - For use between 40ºF and 60ºF.
(3) C – For use above 60ºF.

d. Color: All epoxy adhesives and grouts shall be concrete gray or clear if they will be visible on the final concrete surface.

3. The epoxy material shall consist of a two-component system conforming to the following requirements:

a. Properties of mixed components shall meet the following requirements:

(1) Solids content: 100% by weight
(2) Pot life: 30 minutes (minimum) @ 75ºF
(3) Contact time: 2 hours @ 75ºF
(4) Tack free time: 4 hours minimum @ 75ºF

b. Properties of cured material shall meet the following requirements:

(1) Neat Binder

(a) Tensile Strength ASTM D-638: 3200 psi minimum @ 14 days, 75ºF cure
(b) Tensile Elongation ASTM D-638 (Modified): 1% minimum @ 14 days, 75ºF cure
(c) Compressive Strength ASTM D-695: 12,000 psi minimum @ 14 days, 75ºF

(d) Compressive Modulus: 400,000 psi minimum 28 days, 75ºF
(e) Water Absorption: 1% by weight, maximum 14 days 75ºF cure 24 hours immersion

(2) Grout: One part Binder to three-and-quarter parts Aggregate by loose volume

(a) Compressive Strength ASTM C-109 (Modified) (2" Cubes): 12,000 psi minimum @ 28 days, 75ºF cure
(b) Compressive Modulus (Modified): 1,250,000 psi minimum @ 28 days, 75ºF cure

c. Aggregate shall meet the requirements of the resin manufacturer.
d. Chemical acceptance for SPI Classification –2- ('A' Component).

(1) The cured system shall meet the requirements of the U.S. Department of Agriculture for use in food processing plants.
(2) The cured system shall meet the requirements of U.S. Government regulations requiring water extractables of less than 0.5 MG per square inch of exposed surface for potable water containers. Tests for water extractable shall meet the requirements of Environmental Control Administration of the U.S. Public Health Service.

e. The following epoxy manufacturers' products, or equal products, will be considered for approval:

(1) SIKADUR as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
(2) EPOTOX as manufactured by Toch Division, Carboline, St. Louis, Missouri.
(3) SONOBOND as manufactured by Sonneborn – Contech, Minneapolis, Minnesota.
(4) PROBOND as manufactured by Protex Industries, Denver, Colorado.

J. Modified Concrete

1. Polymer Modified Concrete: The purpose of this specification is to describe a two-component, polymer-modified, cementitious, fast-

setting, trowel grade, structural repair mortar. This system shall be used on horizontal, vertical, and overhead surfaces, on grade, above and below grade on concrete and mortar.

a. The polymer-modified cementitious system shall consist of a factory preproportioned two-component system whose components conform to the following requirements:

(1) Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. This acrylic copolymer shall have the following properties:

(a) Ph: 4.5 – 6.5
(b) Minimum Film Forming Temperature: Approx. 68ºF
(c) Tear Strength: Approx. 990-1420 psi
(d) Elongation at Break: 500-900%
(e) Particle Size Range: Less than 0.1 micron

(2) Component B shall be a blend of selected Portland cements, specially graded aggregates, organic accelerator, and admixtures for controlling setting time, water reducers for workability, and a corrosion inhibitor.

(3) The component ratio A:B shall be as required by the manufacturer. The system shall not contain chlorides, nitrates, added gypsum, added lime, or high alumina cements. The system shall be noncombustible, either before or after cure.

(4) Typical properties of mixed components:

(a) Application Time (working time): 15 min. after combining components
(b) Finishing Time: 20-60 min. after combining components
(c) Color: Concrete Gray

(5) Typical properties of cured material:

(a) Abrasion Resistance: 6 times that of controlled concrete
(b) Bond Strength (Pull off Method): 100% concrete substrate failure
(c) Modulus of Elasticity: 4.5 x 106
(d) Surface Scaling (De-icing salt solution freeze/thaw): No deterioration after 120 cycles.

(e) Compressive Strength 2 hours 50% RH): 150 minimum
(f) Compressive Strength 28 days 50% RH): 5,500 psi minimum
(g) Flexural Strength 28 days 50% RH): 1,300 psi minimum
(h) This system shall conform with ECA/USPHS Standards for surface contact with potable water.
(i) This system shall not produce a vapor barrier.
(j) This system shall be thoroughly compatible with concrete.

2. Epoxy-Modified Concrete: The purpose of this specification is to describe a two-component, 100% solids, liquid epoxy-resin system which is formulated as an additive to Portland cement concrete or mortar mixes to produce a high strength structural repair concrete or mortar. This system shall be applicable for use on horizontal, vertical, and overhead surfaces, on grade, above or below grade.

a. The concrete or mortar mix shall be in accordance with the manufacturer's recommendations. Cement, aggregate, sand, and water shall meet the requirements specified elsewhere in this Section.
b. If the color of the cured epoxy modified concrete does not reasonably match he color of the existing concrete to the satisfaction of the Engineer, the Contractor shall apply an approved surface coating, suitable for the intended exposure of the patched area, to blend the patchwork into the surrounding concrete.
c. The following manufacturer's products, or equal products, will be considered for approval:

(1) SIKADUR 362 as manufactured by Sika Corp., Lyndhurst, New Jersey.
(2) DURALGUARD Modifier E Gel as manufactured by Dural International Corp., Deer Park, New York.

K. Type 1 Grout

1. Type 1 grout shall be expansive grout.
2. The grout shall be composed of selected silica sands, modified cements, pozzolanic, plasticizing, and water reducing admixtures.
3. The grout shall be entirely non-metallic and shall be suitable for both interior and exterior applications.

4. The grout shall be a one-step product delivered to the job site in bags containing a premixed formulation requiring only the addition of water prior to use.
5. The physical properties of the grout shall meet the following requirements:

    a. Initial Set (ASTM C 1910): 45 min.
    b. Final Set (ASTM C 191): 180 min.
    c. Compressive Strength (ASTM C 109):

        (1) 24 hours: 5,000 psi
        (2) 3 days: 6,000 psi
        (3) 7 days: 8,000 psi
        (4) 28 days: 10,000 psi

    d. Volume Change (ASTM C 827):

        (1) 24 hours: +0.032%
        (2) 3 days: +0.033%
        (3) 7 days: +0.035%
        (4) 28 days: +0.035%

    e. Tensile Strength:

        (1) 24 hours: 400 psi
        (2) 3 days: 460 psi
        (3) 7 days: 550 psi
        (4) 28 days: 600 psi

6. The following grout manufacturers' products, or equal products, will be considered for approval:

    a. SONOGROUT as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.
    b. FIVE STAR GROUT as manufactured by U.S. Grout Corp., Old Greenwich, Connecticut.
    c. SET NON-SHRINK GROUT as manufactured by Set Products, Macedonia, Ohio
    d. SEALTIGHT 588 as manufactured by W.R. Meadows, Elgin, Illinois.

L. Bonding Agents: The following bonding agent manufacturers' products, or equal products, will be considered for approval:

1. EPOXTITE BINDER as manufactured by Construction Products Div., W. R. Grace & Co., Cambridge, Massachusetts.

2. SIKADUR HI-MOD EPOXIES as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
3. SONOBOND as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.

M. Cement Based and acrylic Polymer Compounds: The following cement based or acrylic polymer compound manufacturers' products, or equal products, will be considered for approval:

1. THOROSEAL as manufactured by Standard Dry Wall Products, Inc., Miami, Florida.
2. LATEX LIQUID FLOOR as manufactured by the Camp Co., Inc., Chicago, Illinois.

2.2 CONCRETE

A. General

1. Concrete shall be Class A, B, C, or D as specified in this Article. All concrete shall be assumed to be Class A, unless specifically expected.
2. The slump of all concrete shall be not more than 5 inches or less than 2 inches unless specifically excepted by the Engineer.
3. The air content by volume of all concrete shall be 6% plus or minus 1%.
4. Class A concrete shall contain a water-reducing and retarding admixture, unless specifically excepted. Use of a water-reducing and retarding admixture in Class B, C, or D concrete is optional. Use of a retarding admixture with fly ash concrete is optional.
5. Do not exceed the water-cement ratio of the design mix which includes all water added. The water-cement ratio shall not exceed 0.45. The water-cement ratio shall be based on the total cementitious materials content.
6. The water reducing and retarding admixture shall be in accordance with the manufacturer's requirements.
7. Class A concrete shall have a minimum cement content of 564 lbs./cubic yard.
8. An approved fly ash may added to the cement in Class A or B concrete in an amount not to exceed 15% by weight of cement, provided all applicable requirements for these classes of concrete are met and proposed mix designed are approved.

B. Class A Concrete

1. Class A concrete shall be structural concrete with a 28-day compressive strength of 4,000 psi.

2. Proportion Class A concrete in accordance with ACI 211.1.

C. Class B Concrete

1. Class B concrete shall be plain concrete with a 28-day compressive strength of 2,000 psi.
2. Proportion Class B concrete in accordance with ACI 211.1.

D. Class C Concrete

1. Class C concrete shall be structural lightweight concrete with a 28-day compressive strength of 3,000 psi.
2. Proportion Class C concrete in accordance with ACI 211.2.
3. The maximum density shall be 115 pcf.

E. Class D Concrete

1. Class D concrete shall be insulating concrete with a 28-day compressive strength of 140 psi.
2. The minimum density shall be 24 pcf.

F. Type 2 Grout: Type 2 grout shall be cement mortar grout. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion materials to produce a grout which is suitable for the intended application.

PART 3 – EXECUTION

3.1 SUBGRADE PREPARATION

A. Subgrade shall be free of sawdust, debris, water, ice, snow, frozen material, extraneous oil, mortar, or any other substances that may be deleterious to the concrete.

B. Clean rock surfaces by air-water cutting, wet sandblasting, or wire brush scrubbing. Wet rock surfaces immediately prior to placement of concrete.

C. Earth surfaces shall be firm and damp.

D. Do not place Class A concrete on mud, dried earth, uncompacted fill, or frozen subgrade. Mud mats of Class B concrete will be permitted upon written approval of the Engineer.

E. When Class A concrete is to be placed on highly pervious materials which might allow flowing groundwater to damage fresh concrete, the contact

surface shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete.

3.2 FORMWORK

A. All formwork shall be done in accordance with recommended practices contained in ACI 347.

B. Forms shall be of wood, plywood, steel, or other approved materials and shall be mortar-tight.

C. Construct forms and associated falsework so finished concrete conforms to the dimensions and contours shown on the drawings.

D. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.

E. Coat forms with a non-staining oil before being set in place.

F. Metal ties or anchorages within the forms shall be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete.

G. Remove forms in a manner and at such time to ensure complete safety of the structure. Do not remove supporting forms or shoring until sufficient strength has been developed in the concrete to support weight and load.

3.3 REINFORCING STEEL

A. Reinforcement shall be free from excessive amounts of scale, rust, form oil, or any other coating that will reduce bond.

B. Cut and bend reinforcement in accordance with recommended practices contained in ACI 315.

C. Bar supports shall conform to standards recommended in ACI 315.

D. Any dowel or lap shown on the drawings and not dimensioned and any splices required but not shown shall be the minimum allowable Class C tension splice according to ACI 318, based on Grade 60 steel reinforcing and 4,000 psi 28-day concrete.

E. A mat of steel shall be considered as two layers of reinforcing bars forming a grid. When one mat of steel is to be placed in a wall or slab, place the mat in the center of the section unless specifically excepted. When two mats of steel are to be placed in a wall or slab, place one mat in

each face of the section utilizing the minimum allowable clear distance per ACI 318, unless specifically excepted.

3.4 CONCRETE

A. General: Measure and mix concrete in accordance with ACI 614.

B. Class A Concrete

1. Concrete shall be Class A concrete, unless otherwise shown on the drawings or specified in this Section.
2. No measurable amount of water shall pass through structural concrete when a head of water equal to 12 inches of depth per inch of concrete is applied.
3. Use one brand of cement only in concrete which will have exposed surfaces.

C. Class B Concrete: Fillets shall be Class B concrete, unless fillets are constructed monolithic with walls or slabs. Mud mats shall be Class B concrete, unless specifically excepted.

D. Class C Concrete: Use Class C concrete where shown on drawings.

E. Class D Concrete

1. Insulating concrete on roofs shall be Class D concrete.
2. Class D concrete shall not be less than 1 inch or more than 8 inches thick.
3. Application of Class D concrete shall meet the requirements of the concrete manufacturer.
4. Limit foot traffic on new concrete until roof material has been applied.

F. Ready-Mixed Concrete

1. Mix, deliver, and place ready-mixed concrete in accordance with ASTM Specification C 94.
2. Discharge concrete from a truck within 1-1/2 hours after water has been added to the mix in the truck.
3. The delivery ticket shall contain the cubic yards in the load, the percent of air, the total number of bags of cement in the load, and the total gallons of water in the load. Copy of delivery ticket shall be given to the Engineer’s representative.
4. Water may be added at the job site if the water-cement ratio after the addition of the water does not exceed the water-cement ratio of the applicable design mix. When water is added at the job site,

there shall be a minimum 1-1/2 minutes of mixing per each cubic yard remaining in the truck.

G. Site-Mixed Concrete

1. Thoroughly mix site-mixed concrete in an approved type batch mixer having a capacity of not less than ½ cubic yard. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer.
2. The mixing time for each batch, after addition of water to cement and aggregate, shall not be less than 1-1/2 minutes for each 1 cubic yard of materials. Operate the mixing drum at the speed for which it was designed, provided the speed is more than 14 rpm and less than 20 rpm.

3.5 WATERSTOPS

A. Waterstops shall be placed in all walls and floor slabs where earth or air is on one side and fluid on the other side.

B. Waterstops shall be placed in all walls and floor slabs where it is possible to isolate one tank or structure from each other.

C. Waterstops will not be placed in divider walls where fluid is on either side, except in the case where tank or structure can be isolated.

3.6 EQUIPMENT MOUNTING PADS

All floor mounted equipment shall be installed on a minimum 4" concrete pad as shown on standard detail drawings. Type 1 grout shall be used on all equipment mounting pads, unless otherwise directed by the Engineer.

3.7 PLACING CONCRETE

A. Place concrete in accordance with ACI 304. Provide chutes, drop pipes, and other placing equipment properly designed and appropriate for the intended use to prevent segregation of coarse aggregate.

B. Remove construction debris and extraneous matter from within the forms.

C. Remove temporary struts, stays, bracing, and blocks serving to hold the forms in correct shape and alignment until concrete is placed.

D. Place concrete on clean, damp surfaces, free from running or standing water.

E. Deposit concrete in approximately horizontal layers, not to exceed 18 inches.

F. Consolidate concrete by means of mechanical vibrating. Insert and remove vibrators vertically at regular intervals to ensure uniform consolidation. Do not use vibrators to transport concrete inside the forms. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute when in operation. At least one standby vibrator shall be on hand at all times during placing.

3.8 CURING

A. Prevent concrete from drying for a period of 7 days after it is placed.

B. Curing may be accomplished by any of the approved methods as listed in ACI 308.

C. Concrete with fly ash may require longer curing time. Curing shall be continuous for a minimum of 7 days or for the time necessary to attain 70% of the specified compressive strength, whichever is greater.

3.9 EPOXY ADHESIVE AND GROUT

A. Use epoxy-resin system in accordance with ACI 503.1 when it is required to grout reinforcing bars or non-expansive anchors into existing concrete.

B. Use epoxy-resin system in accordance with ACI 503.2 when it is required to bond fresh (plastic) concrete to hardened concrete.

C. Joining of new and old concrete shall meet the requirements of the epoxy-resin system manufacturer.

D. Install reinforcing bars and non-expansive anchors as follows:

1. Non-expansive anchors shall be threaded at least the full length of the embedded portion.
2. Concrete strength shall be a minimum of 3,000 psi before starting the embedment procedure.
3. Embedment length shall be a minimum of 10 times the nominal anchor or bar diameter but not less than 6 inches.
4. Diameter of hole shall be a minimum of ½ inch and a maximum of 1-1/2 inches greater than the anchor or bar, bolt-head diagonal or washer diameter, whichever is greater.
5. Vacuum or blow out the hole using oil-free compressed air when a dry drilling method is used.

6. When the drilling process requires the use of water, carefully wash out the hole after drilling to remove residue of drilling slurry. Hole should then be dried if possible.
7. Condition materials to approximately 75ºF for ease of mixing and handling of grout prior to mixing epoxy-resin system.
8. Premix components for one minute with mixing paddle attached to low speed (400 – 600 rpm) electric drill. Pour equal volumes of each component into clean pail. Mix to uniform color. Add approximately a third of the aggregate; mix for another minute. Add remaining aggregate; continue mixing for two to three minutes until grout is thoroughly blended. Move drill continuously to thoroughly mix components. Keep paddle below surface of material to avoid whipping air into mix. Mix only that quantity which can be placed within 30 minutes.
9. Anchors or bars shall be clean, dry, degreased, and free of rust and scale.
10. Vertical Installation

    a. Anchor bolts, dowels, and reinforcing bars may be installed by either of the following methods:

        (1) Pour grout to a predetermined level in bolt hole and insert bolt into grout. Work bolt up and down while tapping lightly to ensure complete embedment.
        (2) Insert bolt and pour grout into annular space between bolt and hole.

    b. Use templates or wedges to hold bolts, dowels, and reinforcing bars in position until grout sets.

11. Horizontal Installation: Install anchor bolts, dowels, and reinforcing bars as follows:

    a. Place grout using a hand- or power-operated caulking gun with a large-diameter tip and polyethylene-tube extension. Install grout to a predetermined depth in bolt hole; insert bolt in grout. Work back and forth, up and down to ensure complete embedment. Pack grout in tightly at the surface; trowel even with the concrete. Position bolt, dowel, or bar in center of drill hole with template or wedges until grout sets.

3.10 MODIFIED CONCRETE

A. Surface Preparation

1. Remove all loose deteriorated concrete, soil, dirt, and any deleterious material down to sound concrete. Undercut concrete a minimum of ½ inch. Do not featheredge patch material.
2. Sandblast or wirebrush clean concrete and reinforcing steel.
3. Moisten surface and allow to dry until damp.

B. Epoxy Modified Bond Coat: Prior to placing epoxy modified concrete or mortar, coat surface of existing concrete and reinforcing steel with epoxy modified bond coat in accordance with the manufacturer's recommendations.

C. Curing: Immediately after placing patch material, cover with wet burlap or polyethylene sheeting for a minimum of 24 hours and protect from heat, sunlight, and wind.

3.11 TYPE 1 GROUT

A. Use Type 1 grout in all areas where the grout could be expected to have some structural requirements such as under column base plates, and all equipment mounting pads.

B. Grout storage, handling, mixing, and placing shall meet the requirements of the grout manufacturer.

C. The clearance between foundations and base plates or equipment bases shall not be less than 1 inch for each 16 inches the grout must flow horizontally.

D. All areas to be grouted shall be clean and free of oil, grease, dirt, and contaminants. Remove all loose material. Provide air relief openings where required to avoid entrapment of air. All metal components to be in contact shall be derusted and free of paint or oils. All concrete to come into contact with the grout shall be rough finished and shall be thoroughly saturated by dampening or soaking prior to placement of grout. Remove excess water from holes and voids.

E. Use forming procedures that allow proper and complete placement of the fluid grout, including the use of head forms. Support elements to be anchored so that no movement is possible. Remove support only after grout has hardened sufficiently. Pretreat wood surfaces that can absorb moisture with forming oils. Cut back edges of concrete to be grouted which are less than 1-inch thick to form a uniform butt.

F. Place grout in accordance with standard grouting procedures and recommendations of ACI for placing and curing of concrete. Use chains, rods, or tamping devices to compact grout tightly, completely removing all

air voids. Place grout quickly and continuously, striking off exposed areas. Cure finished grout by standard methods.

G. Grout protection shall meet the requirement of the grout manufacturer.

3.12 TYPE 2 GROUT

A. Use Type 2 grout for leveling courses, screeded toppings for tank base slabs, and other similar applications.

B. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion the materials to produce a grout that is suitable for the intended application.

C. Use a bonding agent to bond the grout to the surface receiving the grout. Use of the bonding agent shall meet the requirements of the bonding agent manufacturer's requirements.

1. The surface to which grout is applied shall be clean and sound. Remove oil, grease, and similar substances. Remove unsound concrete, loose material, and foreign matter by scarifying or other mechanical means. Etch all concrete, whether new or old, with a 1:1 muriatic acid solution (approximately 14%) and thoroughly rinsed with water to remove all trances of acid.
2. Mix and place bonding agent according to bonding agent manufacturer's instructions.

3.13 FINISHING

A. All concrete and grout surfaces shall be true and even, and shall be free from open or rough spaces, depressions, or projections.

B. Accurately screed exposed surfaces of concrete to grade and then float prior to final finishing. Do not use excessive floating or trowel while concrete is soft. Do not add dry cement or water to the surface of screeded concrete to expedite finishing.

C. After removal of forms, remove all bulges, fins, form marks, or other irregularities that may adversely affect the appearance or function of the concrete.

D. Clean and patch all cavities left by form ties or any other device. Use expansive grout for patching.

E. Finish concrete in accordance with the following schedule, unless specifically excepted.

Surface	Finish
All exposed vertical surfaces from six inches below grade or minimum operating level	Smooth rubbed finish
Floor slabs of tanks and channel floors	Smooth floated finish
Floor slabs of tanks or channel floors which will receive leveling grout	Brushed finish
Interior building floors not receiving fluid applied resilient flooring	Steel trowel finish
Interior building floors which will receive fluid applied resilient flooring	Brushed finish
Leveling grout for tank slabs and channel floors	Screeded with steel trowel finish
Exterior horizontal traveled surfaces	Brushed finish
Exposed exterior horizontal surfaces except as listed above	Smooth rubbed finish

F. Cement based or acrylic polymer compounds will be considered as an alternative to rubbing. Preparation and application shall meet the requirements of cement based and acrylic polymer compound manufacturers.

3.14 TESTING

A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform the following tests as specified below and as required by the Engineer.

1. Perform tests in accordance with the following ASTM Specification:

Test	ASTM Specifications
Slump	C 143
Air Content	C 173
Test Cylinders	C 31 or C 513
Core Samples	C 42
Fly Ash	C 311

B. The Contractor and the Engineer's representative shall measure slump each time test cylinders are to be made and at any other time requested by the Engineer. The slump limits given herein-before shall not be exceeded unless specifically expected by the Engineer.

C. Measure air content each time test cylinders are to be made and at any other time requested by the Engineer. The field test may be omitted if the air content is known prior to taking samples. The field test may not be omitted if fly ash is used in the mix.

D. Make test cylinders in sets of four. Field cure one cylinder. Break field cured cylinder at seven days. Laboratory cure the remaining three cylinders from each set of four. Break laboratory cured cylinders at 28 days. The Contractor shall be responsible for handling and transportation of cylinders. If fly ash is used in the mix, a total set of seven cylinders shall be taken. The additional three cylinders shall be laboratory cured and broken at 56 days, if the 28 day strength does not meet specifications.

E. Make one set of test cylinders for each 50 cubic yards, or fraction of 50 cubic yards, of concrete placed, or at other times requested by the Engineer.

F. Fly ash shall be sampled and tested as specified in ASTM C 311 prior to use as an admixture in concrete.

END OF SECTION 9

SECTION 10 – SUBMERSIBLE LIFT STATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and install one submersible, non-clog lift station and all appurtenances necessary to complete same as shown or specified.

1. The lift stations shall be complete with submersible sewage pumps, motors, discharge elbows, access hatch, guide system, piping, valves, electrical controls, and appurtenances as shown on drawings. All components of the lift station shall be furnished by one manufacturer.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:

1. ANSI – American National Standards Institute.
2. ASTM – American Society for Testing & Materials.
3. HI – Hydraulic Institute.
4. NEMA – National Electric Manufacturer's Association

1.2 QUALITY ASSURANCE

A. The pumping unit manufacturer shall test each pump for mechanical and electrical correctness.

B. Perform field tests specified in this Section.

1.3 SUBMITTALS

A. Submittals shall be submitted to the City of Tipton.

B. Submit the following:

1. Manufacturer's Certificate of compliance certifying compliance with the referenced specifications and standards.
2. Shop drawings with performance data and physical characteristics.
3. Manufacturer's installation instructions.
4. Manufacturer's operation and maintenance material and manuals.
5. Certified copies of test reports.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in such a manner to prevent damage to products.

C. The pumps furnished shall be packaged in such a manner as to provide ample protection form damage during handling, shipment, and outdoor storage at the lift station site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.

D. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 – PRODUCTS

2.1 GENERAL

A. Furnish complete a submersible lift stations consisting of submersible non-clog sewage pumps, motors, piping, valves, reinforced concrete wet well, electrical controls, guide system, and other appurtenances as specified in this Section and as shown on the drawings.

B. Pumping units shall meet the requirements of HI standards.

C. Pump materials shall meet the requirements of the latest editions of the following specifications:

Material	ASTM or ANSI Designation
Cast Iron	A-48 Class 30
Stainless Steel	ANSI Type 316L, 304, and 431
Bronze	B-144 Class 3B
Hot Rolled Steel	A 107-50-T Gr. 1015 .20 Cu. Min.
Cold Rolled Steel	A 108-50-T Gr. 1141 Turned, Ground & Polished
Pipe	ANSI A21.51

D. Where applicable specifications are not designed herein, supply high class commercial grades of materials that meet the requirements specified and which are satisfactory to the Engineer.

2.2 PUMP DESIGN

A. Pumps shall be capable of handling raw, unscreened sewage and 3-inch spherical solids.

B. The design shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, which shall be permanently installed in the wet well.

C. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wet well.

D. Each pump shall be fitted with a stainless steel lifting chain of adequate strength and length to permit raising and lowering the pump for inspection and removal. The lifting system must permit the pump to be removed in one continuous motion, without intermediate hooking.

E. The pump, with all its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65 feet.

2.3 PUMP CONSTRUCTION

A. All major parts, such as stator casing, oil casing, sliding bracket, volute and impeller, shall be gray cast iron, Class 30, with smooth surfaces devoid of blow holes and other irregularities. All surfaces coming in contact with sewage shall be protected by an approved coating resistant sewage. All exposed bolts and nuts shall be 304 stainless steel.

B. The wear ring shall consist of a stationary ring made of nitrile rubber molded with a steel ring insert which is drive-fitted to the volute inlet and rotating stainless steel ANSI 304 ring which is drive-fitted to the impeller eye.

C. The impeller shall be gray cast iron of a non-clogging design capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications. The impeller shall be constructed with a long throughlet without acute turns. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it. The impeller shall be slip fit to the shaft and key driven. Non-corroding fasteners shall be used.

1. The volute shall be of single piece design and shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller.

D. Pump shall be provided with a mechanical rotating shaft seal system consisting of two totally independent seal assemblies running in an oil reservoir having separate, constantly hydro-dynamically lubricated lapped seal faces. The (lower) seal unit between the pump and the oil chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring.

E. The (upper) seal unit between the oil sump and motor housing shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by a spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. Shaft seals which are lubricated by oil and not the pumped liquid may utilize carbon and ceramic, Type 21, to be considered equal. The shaft sealing system shall be capable of operating when the pump is submerged to depths of/or pressures equivalent to 65 feet. No seal damage shall result from operating the pumping unit out of its liquid environment for extended periods of time. The pump shall be capable of operating for 24 hours in a dry condition without damage to the pump motor or mechanical seal.

F. The pump shaft shall be stainless steel ANSI 420 stainless steel.

G. The cable entry water seal design shall be such that precludes specific torque requirements to ensure a watertight and submersible seal. The cables shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit with cable and housing; strain relief and sealing of the cable is done separately within the body; the cable entry junction chamber and the motor shall be separated by a stator lead sealing gland or terminal board. Epoxy filled terminal housing shall be considered equal providing individual wire leads are spliced in the motor terminal housing and the individual splice caps are filled with epoxy; such construction shall not require a terminal board to isolate the motor interior and the pump top.

H. All mating surfaces of major parts shall be machined and fitted with nitrile O-rings where watertight sealing is required.

I. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces. Square rings which provide the controlled compression of an O-ring and the ease of assembly of a flat gasket shall be considered equal.

J. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to ensure sealing as described above.

K. Each unit shall be provided with an adequately designed cooling system. Thermal radiators integral to the stator housing, cast in one unit, are acceptable. Units which utilize an oil-filled motor and which operate considerably cooler than air-filled motors shall not require additional cooling to be considered equal. Thermal radiators integral to the stator housing, cast in one unit, are acceptable. Where water jackets alone or in conjunction with radiators are used, separate circulation shall be provided. Cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provision for external cooling and flushing shall be provided.

L. Internal thermal sensors shall be required on each pump motor. Thermal sensors shall be used to monitor stator temperatures. There shall be one for each phase group in the motors. These shall be used in conjunction with and supplemental to external motor overcurrent protection, and they shall be located in the control panel. The internal thermal sensors shall show and/or sound an alarm and automatically shutdown the pump before motor damage occurs.

M. Moisture sensing probes shall be installed in the mechanical seal cavity of each pump unit. These probes shall sense the intrusion of the pumped liquid into the seal cavity, send a signal to the panel mounted alarm device, and shut the pump down immediately. The alarm device shall be activated until the pump is removed from service/or repair.

2.4 GUIDE SYSTEM

A. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection which, when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps, or similar devices.

B. Installation of a pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by two guide rails, a T-bar, or other suitable guide system.

C. Guide rail pipes shall be constructed using 304 stainless steel or reinforced fiberglass material.

D. No other motion of the pump unit, such as tilting or rotating, shall be required. No portion of the pump unit shall bear directly on the floor or wet

well. There shall be no more than one 90 degree bend allowed between the volute discharge flange and station piping.

2.5 MOTOR

A. The pump motor shall be housed in an air-filled, watertight casing and shall have moisture resistant Class F 155ºC insulation. Oil-filled motors shall be considered equal providing they are the standard design of a U.S. manufacturer and do not utilize a heat shrunk, pressed in stator assembly. Thermal switches set to open at 120ºC shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with supplemental to external motor overload protection and shall be connected to the control panel. The motor shall be NEMA design B and designed for continuous duty, capable of sustaining a minimum of 10 starts per hour. No motor winding damage shall result from operating the pumping unit out of its liquid environment for extended periods of time.

B. Pump motor cable installed shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Unless otherwise noted, provide adequate cable to complete the installation shown on the drawings.

2.6 ACCEPTABLE PUMP MANUFACTURERS

A. The Flygt Pumps

B. Hydromatic Pumps

2.7 CONTROLS

A. The pump station shall be provided with a NEMA 4X stainless steel starter panel, which shall be sized to accommodate starters and controls for specified pumps. The present pump size shall be as indicated in the pump data sheet below. The starter panel shall consist of, but not be limited to, the following:

1. NEMA 4X stainless steel enclosure, with padlocking hasp and staple, and provided with matching stainless steel drip shield.

    a. The bottom of the enclosure shall be provided with two ½-inch drains located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 17.

b. The top of the enclosure shall be provided with two ½-inch breathers located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 16.
c. The enclosure shall be provided with an internal mounting panel and a swing-out panel.
d. The interior of the enclosure shall be provided with properly sized industrial grade corrosion inhibitors.
e. The enclosure shall be provided with thermostatically controlled, properly sized condensate heater. The heater shall be mounted on the lower portion of the enclosure internal mounting panel.
f. The enclosure shall be provided with a door limit switch actuated panel fluorescent light, which shall be similar in construction to Hoffman Catalog No. A-LFDA2.
g. All wiring within the enclosure shall be installed in a plastic wiring duct. Low level signal wiring shall not be mixed with high voltage (110 Volts AC or greater) wiring within the same duct.
h. All wiring within the enclosure shall be terminated at terminal blocks; splices shall not be permitted within the enclosure.
i. All conduit entry into the enclosure, originating from the wetwell, shall be sealed to prevent moisture and gas vapors from entering the enclosure.
j. All low level signal wiring (mADC) shall be twisted shielded cable types.

2. The enclosure shall be sized to house all electrical equipment described herein, including, but not limited to the telephone dialer as specified herein.
3. The incoming power wiring shall be terminated at distribution lugs and shall be provided with voltage surge arresters to protect all equipment mounted within the enclosure from switching surges and lightning induced surges.
4. Power within the panel shall be distributed further through thermal magnetic circuit breakers and motor circuit protectors, which shall be accessible from the front of the swing-out panel without opening the swing-out panel. Provide the following:

    a. A motor circuit protector for each pump starter.
    b. A circuit breaker for a 480/120 Volt AC transformer (only if the incoming power is 480 Volts AC). The circuit breaker shall have a minimum interrupting rating of 25,000 Amperes.

5. If the incoming power is greater than 120/240 Volts AC, provide a transformer which shall step down the incoming power to 120 Volts AC. The transformer shall be high efficiency type, with 105º

Celsius temperature class, extra regulation and low losses. The minimum size of the transformer shall be 1.0 KVA. The primary feeder of the transformer shall be protected by the circuit breaker described above. The transformer shall be sized to provide power to all 120 Volt AC loads listed below.

6. The 120 Volt AC power within the enclosure shall be further distributed through single pole, 15 Ampere circuit breakers, with 10,000 A.I.C. A dedicated circuit breaker shall be required for each of the following items:

    a. Motor control circuit.
    b. Panel light and thermostatically controlled enclosure heater described above.
    c. Convenient receptacle.
    d. An alarm beacon light fixture.
    e. A telephone dialer.

7. Provide a duplex convenient receptacle unit, which shall be mounted within the starter enclosure, accessible from the front of the swing-out panel. The receptacles shall be 15 Ampere, GFI (Ground Fault Interrupting) types.
8. Each starter power feed shall be provided with magnetic only motor circuit protector. The motor circuit protectors shall be as follows:

    a. They shall be provided with adjustable instantaneous trips.
    b. As a minimum, they shall be rated 25,000 A.I.C. (Amperes Interrupting Capacity). The size, voltage and configuration shall be as required.
    c. The motor circuit protectors shall be accessible from the front of the swing-out panel without opening the swing-out panel.

9. Motor starters shall be NEMA rated, full-voltage, non-reversing type. I.E.C. rated motor starters shall not be acceptable. The starters and thermal overloads shall be sized according to the motor nameplate data.
10. Provide a duplex pump alternator, which shall automatically sequence the operation of the pumps.
11. Control devices shall be industrial grade oiltight and watertight types. Each pump shall be provided with the following controls, which shall be visible from the front of the swing-out panel, with the enclosure door opened:

    a. An H-O-A selector switch.
    b. An amber “FAIL” pilot light.
    c. An amber “SEAL FAILURE” pilot light.

d. A red motor “RUN” pilot light
e. A green motor “OFF” pilot light.
f. A “RESET” push button.
g. A non-resettable elapsed time meter.

12. Each starter shall be provided with the following:

    a. A minimum of two sets of normally open starter auxiliary contacts.
    b. A minimum of two sets of normally closed starter auxiliary contacts.
    c. One set of normally open auxiliary overload alarm contacts.

13. Control circuits shall be designed such that the pump station will operate as follows:

    a. When the H-O-A selector switch is in the “H” position, the pump motor shall run.
    b. When the switch is in the “O” position, the pump motor shall be off.
    c. When the switch is in the “A” position, the pump shall operate automatically as described below.
    d. The amber “FAIL” light shall be energized when the starter thermal overload relay trips, or when the motor winding temperature detector trips.
    e. The amber “SEAL FAILURE” light shall be energized when the seal failure contacts trip.

14. Pump motors shall be provided with motor high winding temperature and seal failure detector.

    a. The detector circuit shall shut down the motor and energize the pump “FAIL” pilot light when the motor winding temperature detector trips. The motor shall remain shut down until its’ associated “RESET” push button is depressed.
    b. The detector circuit shall energize the “SEAL FAILURE” pilot light when the seal failure detector trips. The seal failure detector shall automatically reset when moisture is no longer detected in the motor housing.

15. The following single-pole double-throw (SPDT) dry contacts shall be provided for remote monitoring purposes:

    a. Pump failure status of each pump motor, which shall include the following conditions:

(1) Starter thermal overload.
(2) Motor winding temperature high.
(3) Seal failure.

b. Wet well high level condition, which shall include contacts from the high level float switch and from the electronic pump controller high level alarm.
c. Level sensor failure from the electronic pump controller.

16. Their wiring shall be terminated at terminal blocks, grouped and dedicated to remote monitoring.
17. The system shall be provided complete with electro-mechanical relays as necessary to achieve the intended operation as described herein.

B. The pump station shall be provided with the following types of level control systems:

1. Pump station less than 15 feet in depth shall be provided with four float switches, to control the pump operation:

a. High level alarm float switch.
b. Start lag pump float switch.
c. Start lead pump float switch.
d. Low level shutdown float switch.

2. Pump station deeper than 15 feet in depth shall be provided with the following pump control systems;

a. High level alarm float switch.
b. Low level shutdown float switch.
c. Submersible hydrostatic pressure type level sensor.
d. Electronic pump controller.

C. The pump station shall be provided with float switches, which shall be constructed as follows:

1. The float switches shall be watertight, encapsulated mercury switch type, encased in a chemical-resistant polypropylene casing.
2. Each float switch shall be suspended on its own cable, which shall be long enough to reach the bottom of the wet well. The switch shall be weighted with enamel coated cast iron weight to permit the float to pivot for proper operation.
3. All installation hardware shall be of 316 stainless steel.

4. The float switch elevation shall be adjustable over the entire wet well depth.
5. The pump station shall be provided with a high level alarm float switch and a low level emergency shutdown float switch.

D. The pump station shall be provided with a submersible hydrostatic pressure type level sensor and an electronic pump controller. The system shall be constructed as follows:

1. The hydrostatic pressure type level sensor shall be submersible type, suspended on its cable, which upper end shall be secured as shown on the drawings.
2. The level sensor shall be mounted on pipe assemblies as shown on the drawings.
3. The level sensor tip shall be suspended not lower than 12 inches above the wet well floor.
4. The level sensor shall be as follows:

    a. The sensor range shall be selected based on the wet well depth.
    b. The sensor output shall be 4 to 20 mADC proportional to water level, 2-wire type, with loop power supply of 12 to 40 Volts DC.
    c. All exposed parts shall be constructed of 316 Stainless Steel
    d. The sensor shall be filled with Silicon Oil.

5. The electronic pump controller shall be mounted in the starter panel enclosure, and shall be visible from the front of the swing-out panel, with the enclosure door opened. The electronic pump controller shall be as follows:

    a. The electronic pump controller shall accept a 4 to 20 mADC, 2-wire level signal, and shall indicate the wet well level digitally in direct engineering units (feet).
    b. The unit shall provide a minimum of four pump control outputs, with independent adjustment for each starting and stopping setpoint. Each level setpoint shall be indicated digitally in direct engineering units.
    c. In addition to the pump control outputs, the unit shall provide outputs for the following points:

        (1) High Water Alarm
        (2) Low Water Alarm
        (3) Level Sensor Failure or signal loss

d. A built-in adjustable time delay for each actuation point shall be provided to permit level signal to stabilize before control actions are initiated.
e. Power to the unit shall be 120 Volts AC.
f. Interposing relays shall be provided for each control output, to provide signal isolation.
g. The electronic pump controller shall be ESSEX Engineering Corporation, model 2410, or equal.

E. Pump Automatic Operation

1. When the pumps are in the automatic mode, (their mode selector switches are in the “A” position), the pumps shall alternate through the following sequence: lead and lag. The level setpoints at which each pump starts and stops in sequence shall be field adjustable through the front panel of the electronic pump controller.
2. The station shall be provided with a back-up high level alarm float switch. When level in the wet well rises to the float elevation, both pumps shall be forced to run.
3. The station shall be provided with back-up low level shut down float switch. When level in the wet sell falls to the float elevation, the switch shall open, both pumps shall be forced to shut down.

F. Provide an alarm beacon light, which shall be energized on high water alarm condition only. The alarm beacon light shall be as follows:

1. The beacon light shall be watertight, suitable for outdoor installation and provided with a red lense.
2. The light source shall be high intensity strobe type, with light intensity of 1,000,000 (1 million) peak candle power.
3. The beacon light shall be mounted on top of the starter panel enclosure using water tight conduit hub, similar to Myers ST-1, T&B 401, or OZ-Gedney CHM-50T.

G. Acceptable Manufacturers:

1. Motor starters and control components: Allen Bradley.
2. Circuit breakers and motor circuit protectors: Square “D”
3. Electronic pump controller: ESSEX Engineering Corporation, Model 2410.
4. Level sensor:

   a. Ametek, model 575, or
   b. Delta Controls Corporation.

5. Beacon light: Federal Signal “Fireball 2”.

6. Alternator: Furnas.

2.8 PIPING MATERIALS

A. Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA standard C151). Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness class shall be 350.

B. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte, or equal.

C. Fittings shall be cast iron or ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi. Fitting joints shall be mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Thrust blocking or restrained joints may be as required or necessary.

D. Gate valves 4-inch and larger shall be full ductile iron body, epoxy fusion bounded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and shall have mechanical joint ends. Exposed bolts and nuts shall be stainless steel. Joint accessories shall meet the requirements of ANSI/AWWA C11/A21.11. Valve opening direction shall be counter-clockwise.

1. Gate valve 4-inch and larger installed in structures shall be full ductile iron body, outside screw, and yoke gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509, except those parts of ANSI/AWWA C500 or C509 only applicable to non-rising stem gate valves and wrench nuts. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be stainless steel. Gaskets shall be full face and shall be red rubber or equal.
2. Gate valves shall be as manufactured by Waterous, U.S. Valve, or equal.

E. Single disc, swing check valves, 4-inch and larger, shall be used in sewage pump stations and shall be iron body, bronze-mounted, swing check, bolted cover, flanged ends, 125 psig working pressure, AWWA Standard C508, suitable for use in a horizontal position. Flanges shall conform in dimensions and drilling to ANSI B16.1.

1. Check valves shall have outside weight and lever.

2.9 CONCRETE WET WELL AND VALVE VAULT

A. The Contractor shall furnish and install a monolithic concrete or precast manhole type wet well as indicated on the drawings. Pump and related equipment shall be installed and/or mounted as shown.

B. A concrete valve vault shall be furnished and installed to house the valves and appurtenances.

C. Precast manhole sections shall conform to requirements of ASTM Specification C478.

D. Contractor may offer wet well sections conforming to ASTM C-76, Class IV, Wall B pipe sections if shown on the drawings.

2.10 ALUMINUM COVERS

A. Frame shall be ¼-inch extruded aluminum with built-in neoprene cushion and with strap anchors bolted to exterior. Cover leaf shall be ¼-inch aluminum reinforced with aluminum stiffeners as required. Stainless steel hinges shall be bolted to underside and pivot on all stainless bolts and hardware shall be used. The cover shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand. Covers shall be built to withstand a live load of 150 pounds per square foot, and equipped with a snap lock and removable handle. When closed, covers shall not protrude above the operating surface in which they are installed. Factory finish shall be aluminum lacquer. Surface contacting concrete shall have bituminous coating.

B. Covers shall be diamond pattern plate.

C. Aluminum covers shall be Bilco Type K or KD, Durred Products Type SLA, DLA or TLA, or equal.

D. When flush mounted covers are furnished, provide two wrenches for opening covers.

E. Valve vault cover shall be water tight with drain system.

F. The Contractor shall provide padlocks for new wet well and valve vault covers. The locks shall be keyed alike with a lock provided by the Owner.

PART 3 – EXECUTION

3.1 INSPECTION

Inspect all pumps, motors, and appurtenances prior to installation in the work. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with new, undamaged and suitable products.

3.2 INSTALLATION

A. Install the submersible pumps in accordance with the drawings and manufacturer's written instructions.

B. The discharge elbow of each pump shall be securely anchored to the wet well base and properly aligned with the guide system and upper guide bracket.

C. The discharge piping shall be properly anchored and supported inside the manhole.

D. All electrical work shall be done by a qualified electrician and shall conform to the National Electric Code.

3.3 TESTING

Each pump shall be fully tested in accordance with manufacturer's written instructions. Certified copies of the test results shall be furnished with each pumping unit. Record the test voltage and amperage measurements.

3.4 WARRANTY

A. The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of five years under normal use, operation, and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear or a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring, and ball bearings. The warranty shall be in published form and apply to all units. The warranty shall not start until the equipment has been placed in operation for beneficial use as determined by the Owner.

B. The manufacturer shall provide the services of a factory trained representative for a period of one day at each lift station to perform initial start-up of the pumping station, to instruct operating personnel in the

operation and maintenance of the equipment, and to demonstrate satisfactorily the performance of each piece of equipment.

C. All equipment supplied and installed under this item of the specifications shall meet the requirements of the Occupational Safety & Health Act of 1970.

PART 4 – FIGURES

4.1 STANDARD DETAILS

FIGURE	DESCRIPTION
LS-1	Sanitary Lift Station – Plan, sections and Details
LS-2	Sanitary Lift Station – Electrical Details

SUBMERSIBLE LIFT STATION DATA SHEET

1. GENERAL INFORMATION

   A. Lift Station Name: _____

   B. Application: Wastewater

   C. Location: _____

2. OPERATING CONDITIONS

   A. Pumping Temperature Range: 55º - 70ºF

   B. Vapor Pressure: 1 psig

   C. Product Handled: Domestic Wastewater

   D. Suction Head: _____

3. PUMP CHARACTERISTICS

Flow Rate (gpm)	Total Dynamic Head (Feet)	Efficiency (%)

   (List three or four points on pump curve)

4. PUMP DATA

   A. No. of Pumps: 2

   B. Type: Submersible Non-Clog

   C. RPM: _____

   D. Discharge Size: _____

   E. Motor HP: _____

   F. Motor Electrical Data: _____

   G. Manufacture & Model: _____

5. AVERAGE DESIGN FLOW: _____ gpm

6. WET WELL: 6’-0” Diameter

7. PUMP OPERATING RANGE: _____

8. AVERAGE WET WELL DETENTION TIME: _____

END OF SECTION 10

SECTION 11 – EXTENSION OF ELECTRIC DISTRIBUTION AND SERVICES LINES

PART 1 – GENERAL

1.1 DESCRIPTION

A. The Electric Utility Superintendent will review the plans of the developer and design the extension of electric distribution and service lines to the proposed development.

B. The design of the extension of electric distribution and service lines will incorporate equipment, whose location, quality and type, will be determined by the Electric Utility Superintendent.

C. It is the current policy of the Electric Utility to construct the extensions of electric distribution and service lines.

D. The Electric Utility Superintendent will estimate the costs to design, purchase necessary equipment, and install the extension of electric distribution and service lines. The developer prior to the ordering of requirement equipment pays the entire estimation of costs for the developers' extension of electric distribution and services up front.

E. Any increased expense due to any deviation from the "final" plans shall be the financial responsibility of the developer.