

City of Franklin
Specifications For Sanitary Sewer Construction

CONSTRUCTION OF SEWER SYSTEM FRANKLIN, NEW HAMPSHIRE

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SECTION 1 SEWER SYSTEM DESIGN

PART 1 GENERAL

1.01 DESIGN GUIDELINES

- A. These general design criteria are established for the design of sewer system in the City of Franklin. This portion of the document shall be utilized concurrently with the applicable sections of the Construction Standards and Technical Specifications. Design drawings and technical specifications for proposed new or modified publicly or privately owned sewage and wastewater treatment facilities shall be submitted to the department for approval in accordance with these rules.
- B. All design and construction drawings for sewer system shall comply with these standards, and the (NHDES) State of New Hampshire Standards for Sewerage and Wastewater Treatment Facilities latest revision .
- C. Plans should show appropriate clear phase lines and match lines. Provide all applicable detail drawings. Call out interferences with conflicting pipes with indication of “over” or “under” on plan sheet.
- D. Certificates of Compliance shall be submitted by the Contractor for each material to the Municipal Services Department of the City of Franklin’s for review and approval.
- E. Application for connection to the public sewer shall be made with the City. There shall be two (2) classes of building service connections: (1) for service to establishments producing sanitary sewage only, and (2) for service to establishments producing industrial wastes. The application shall be supplemented by any plans, or other information considered pertinent in the judgement of the Municipal Services Department or the Winnepesaukee River Basin Program. In the event that a connection must be made to a major interceptor sewer, it will also be necessary to obtain a permit in writing from Winnepesaukee River Basin Program. City Sewer Service Connection Permits shall expire one year from the date of issue. A new application and permit shall be required in all instances where previously issued permits have been revoked or have expired All design approvals shall lapse 4 years after issuance, if system construction has not been started. Systems that have begun construction, but not started operation on the 4th anniversary of the approval date, shall meet all then current design criteria prior to startup. A new design review fee and appropriate design revision shall be required for reapproval of lapsed designs.

- F. The designer shall provide calculations for the sanitary sewer system (onsite and off-site for both existing and proposed conditions as required) to the points of connection to the City's sanitary sewer system. The applicant shall provide the quantity or flow rate of the proposed wastewater discharge in conformance with the STANDARDS OF DESIGN AND CONSTRUCTION FOR SEWERAGE AND WASTEWATER TREATMENT FACILITIES, latest addition.
- G. Upon final approval from the Planning Board any connection that meets the NHDES requirements (see below) must submit a discharge permit request to Department of Environmental Services. All Plans and specifications shall be approved by the City of Franklin prior to submission.
 - 1. The owner shall submit design drawings and technical specifications for any proposed sewer that serves more than one building or that requires a manhole at the connection, and for any proposed sewage pumping station that serves more than one building or has a capacity in excess of 50 gpm.

1.02 LOCATION OF SEWERS AND MANHOLES

- A. In general, sewer lines and manholes shall be located within legally established public streets or right-of-way wherever possible. If sewers cannot be located in right-of-way or public streets, then access easements to all manholes, sewer line and laterals shall be provided. Sizing of sewer mains shall meet minimum state requirements of 8" . Standard sewer line sizes are 8", 10", 12", 15", 18", 21", 24", 27", and 30" diameter. Other sizes must be approved by Municipal Services.
- B. Easements for sewer line construction shall meet the following requirements:
 - 1. The easement width shall be a minimum of 20 feet. If the line is over 12 feet in depth, then the minimum easement width shall be 25'.
- C. Plan and profile of the sanitary sewer system is required. The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90 degrees unless approved in writing by the Director of Municipal Services.
- D. A table of lateral elevations at cleanout invert and minimum building sewer elevations shall be included in plans. Building sewer elevation shall be a minimum of two feet above cleanout invert elevation.
- E. Manholes for access to sewer lines shall be provided at:
 - 1. All points of change in alignment;
 - 2. All points of change in grade.
 - 3. At the terminal end of the sanitary sewer line.

4. At intervals not exceeding 300 feet on all sewers.
5. A sampling manhole will be required for all non-residential users. The sampling manhole may be used in lieu of the required cleanout at the property/easement line.
- F. When it is necessary, due to steep slopes, increased velocity, or invert elevation differences equal to or greater than 24 inches, a drop connection shall be employed. The maximum difference in elevation between the influent and effluent flows within the manhole itself shall be six inches. The minimum diameter manhole for use with an inside drop connection shall be five feet. Only one inside drop shall be installed per five-foot diameter manhole. Two inside drop connections may be made in a six-foot diameter manhole. Outside drop manhole connections are acceptable but inside drop manholes are preferred.
- G. Manholes for sewers up to 16 inches in diameter shall not be less than four feet inside diameter (except inside drops, see E above). Manholes for sewers up to 36 inches shall have an inside diameter of not less than five feet. If hydraulic characteristics do not permit use of a four-foot inside diameter manhole, then a five-foot diameter manhole or special manhole detail must be provided.
- H. Maximum sewer main depth is not to exceed 20 feet without prior approval by the Municipal Services Department. No services will be allowed on mains deeper than 15 feet unless specifically approved by Municipal Services.
- I. Sewers shall be located at least 10 feet horizontally from any existing or proposed water main. Water services and sewer stubs shall have at least 10' horizontal clearance and 18" vertical. Check for crossing or parallel utilities. Maintain minimum vertical and horizontal clearances. Avoid crossing at highly acute angles (the smallest angle measure between utilities should be between 45 and 90 degrees).
- J. Whenever sanitary sewer must cross water mains, the sewer - shall be constructed as follows:
 1. Sewer pipe shall be class 52 ductile iron or PVC pipe equivalent AWWA C 900, a minimum distance of 6 feet each side of the crossing.
 2. Vertical separation of the sewer and water main shall be not less than 18 inches, with water above sewer.
 3. Joints shall not be located within 6 feet of the crossing.
- K. All other utilities(gas,cable, fiber optic,telephone,and storm) shall have a horizontal clearance of at least five (5) feet.

1.03 SERVICE LATERALS

- A. A single six(6) inch service line main service up to two units.
- B. Lateral sewers shall connect to the main line sewer with a wye rather than a tee, unless specifically approved by Municipal services.
- C. Building service connections are to be SDR 35 or SDR 26 PVC pipe. Cast iron pipe and ductile iron pipe may be used should conditions warrant. Penetrations at foundation walls and basement floors must be protected from abrasion by providing at least ½-inch clearance around the PVC. The void between the piping and the wall or floor slab (from the outside through to the inside) shall be sealed with an approved vermin resistant sealant.
- D. Minimum size service lateral shall be 4 inches. Minimum slope for a service lateral shall be 2 percent. Commercial units shall have a minimum service size of six (6) inches. Maximum slope of service lateral shall be 45 degrees within public easements or right of- ways.
- E. Service laterals eight(8) inches in diameter must terminate in a sanitary sewer manhole structure.
- F. Lateral sewer shall have minimum 6' of cover at property line.
- G. A backflow valve shall be installed.
- H. Clean Outs: Clean outs shall be constructed on service laterals as directed by the City's inspector and shall be located as follows:
 - 1. 4 inch and 6 inch service - one clean out at any directional change greater than 45- degrees.
 - 2. Clean outs will be constructed using "Wyes" (either 4x4x4 or 6x6x6 inch) and incorporating a 45-degree elbow to bring the stack vertical.
 - 3. A cast iron cleanout box with cover marked "sewer" is required over 4" & 6" sewer service clean outs
 - 4. Clean outs will be required at or near the property line for testing purposes should the installation not be completed to a building or a manhole structure.
 - 5. Each individual unit will have its own service connection and shall be accompanied by its own individual clean out
 - 6. Clean outs shall be located outside of the City of Franklin's R.O.W.

7. Clean outs shall be located no greater than 100-feet apart unless otherwise directed by the BOCA Plumbing Code

1.04 MANHOLE

- A. Standard sanitary manholes: Manholes will be of precast concrete construction; precast concrete barrel sections and precast manhole bases shall conform to ASTM Designation C478. The wall thickness shall not be less than 5 inches for 48 inch inside diameter structures, or 6-inches for 60-inch and 7-inches for 72-inch inside diameter barrel sections. Lift holes and boot recesses are to be sealed with Portland cement mortar flush to the outside structure wall prior to backfilling.
- B. Any manhole less than 6' deep (rim to invert) shall be a flat top H20 loading. All other manholes shall be provided with eccentric cone.
- C. Inside drop structures for mainline sewer construction require a minimum 60-inch inside diameter manhole. Manholes with service connections greater than 6-inches in diameter also require a 60-inch minimum manhole diameter. Inside drop manholes shall be required for new manholes.
- D. Manhole frames and cover shall have a minimum clear opening of 30". All manholes greater than 60 inch diameter and 14 feet deep shall have a clear opening of 36".
- E. Maximum distance between Manholes shall be 300 feet
- F. Minimum invert slope across manhole shall be 0.1 ft/ft.

1.05 FORCEMAINS

- A. The minimum size for force mains shall be four inches except when using grinder pumps.
- B. Force mains for constant speed pumps shall be sized to yield a cleansing velocity of 3 feet per second or greater at design pump capacity.
- C. An air relief shall be placed at the necessary high points in the force main to release trapped air.
- D. All force mains shall connect to a cleanout with a drop stack connection at the right-of-way or easement line. From there the flow shall be gravity into the public system. Forcemain may connect to a manhole with the approval of Municipal Services. Forcemains 4" diameter shall connect to a manhole.

SECTION 2A
SANITARY SEWER AND WATER EARTHWORK

PART 1 GENERAL

1.01 SCOPE

- A. The work of this section includes all labor, materials, tools, equipment, accessories and appurtenances necessary to satisfactorily complete all stripping of topsoil, excavation of earth and rock, stockpiling, removal of unsatisfactory bearing materials, backfilling, filling, and grading not specified elsewhere, and all incidental work pertaining thereto within the limits of the work indicated and as specified herein.

1.02 SPECIAL REQUIREMENTS

- A. Contractor shall perform his operations in a manner which will not damage utility lines, roads, structures or any other installation located in or adjacent to work areas. The Contractor shall be responsible for any damage caused by his operations whether within or beyond the limit of work lines. If existing utility lines are damaged, they shall be repaired with similar or better materials of the same size and in conformance with the requirements of the affected utility. The Contractor shall have on site the necessary manpower, materials and equipment such as pumps and piping bulkheads, required to protect and maintain uninterrupted flows in existing utilities during construction.
- B. The Contractor shall maintain all benchmarks, monuments and other reference points and, if disturbed, shall replace them at no additional cost to the City.
- C. Where excavations are to be made in paved or surface treated areas, the pavement shall be cut with a pavement saw or wheel cutter before excavation. In areas where the trench width is greater than anticipated, the pavement shall be re-cut before excavating to the greater width. In no case shall pavement be excavated beyond the cut line.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill materials, meeting the following requirements, shall be used in the areas shown on the drawings or where specified herein. Fill materials may be obtained from either on-site excavations or from off site sources as required.

2.02 COMMON FILL

- A. Common fill shall be granular material, consisting of hard, sand and gravel with less than 35 percent passing the No. 200 sieve, free of organic matter, trash, roots or other deleterious material. Common fill material shall contain no stone measuring greater in any dimension than two-thirds of the loose lift thickness or 12 inches whichever is smaller. Common fill material shall be capable of forming a firm, stable base when spread and compacted in accordance with this specification. In addition, the common fill shall be non-plastic (plasticity index zero, defined as liquid limit minus plastic limit). Any materials, excavated from the site, not conforming to this specification, shall be disposed of as specified and replaced with approved material, as required, at no additional cost to the City.

2.03 GRAVEL FILL

- A. Gravel fill shall consist of hard, durable gravel and sand, free from trash, organic matter and clay, surface coatings, and other deleterious materials.
- B. Gravel fill shall have a maximum stone size of two thirds of the loose lift thickness or 8 inches whichever is smaller. Gravel fill used for pipe bedding shall have a maximum stone size of 2 inches. That portion passing the 4 inch sieve shall meet the following gradation requirements, as determined by ASTM C136 and ASTM C117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
4 inch	100
1/2 inch	50-85
No. 4	40-75
No. 40	10-35
No. 200	0-10

2.04 SELECT FILL

- A. Select fill shall consist of hard durable sand or sand and gravel, free from trash, organic matter, clay, surface coatings and other deleterious materials. Select fill placed between the mid-height of a pipe and 12 inches above a pipe shall have a maximum stone size of 4 inches. Select fill used for other purposes shall have a maximum stone size of two thirds of the loose lift thickness and that portion passing the 4 inch sieve shall meet the following gradation requirements, as determined by ASTM C136 and ASTM C117:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
4 inch	100
No. 10	30-100
No. 40	0-70
No. 200	0-15

2.05 CRUSHED STONE

- A. Crushed stone shall consist of clean, crushed, non-porous rock, or crushed gravel, uniformly blended, and shall conform to ASTM D448, size Number 6, 3/4 in. to 3/8 in. stone.

2.06 GRANULAR FILL

- A. Granular fill utilized as a bedding material from the mid-diameter of the pipe to the bottom of the excavation shall be crushed stone or gravel borrow meeting the following specifications:

1. Crushed stone shall consist of clean, crushed, non-porous rock, or crushed gravel, uniformly blended, and shall conform to the following tabulation of sizes as determined by ASTM D422 and D2217, Paragraph B:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
3/4 inch	90-100
1/2 inch	10-50
3/8 inch	0-20
No. 4	0-5

2. Gravel borrow shall consist of hard, durable stone and coarse sand, free from loam and clay, surface coatings and other deleterious materials. Gravel borrow shall be uniformly blended, and shall conform to the following tabulation of sizes as determined by ASTM D422 and D2217, Paragraph B:

<u>U.S. Sieve Size</u>	<u>Percent Passing</u>
3 inch	100
1/2 inch	50-85
No. 4	40-75
No. 40	10-35
No. 200	0-8

3. Material removed from the trench excavation, satisfying the requirements for gravel borrow, shall be used for pipe bedding. However, it will be responsibility of the Contractor to have a sieve analysis performed by an independent testing laboratory to demonstrate that the excavated material meets the above specification. The number and frequency of the sieve analysis shall be at the descretion of the Engineer.

2.07 FILTER CLOTH

- A. filter cloth shall be Mirafi 140N, Carthage Mills FX-40HS, Amoco 4545 or equal approved by the City.

PART 3 EXECUTION

3.01 PREPARATION

A. Stripping

1. Prior to any excavation, filling, or grading operations, all topsoil and subsoil or similar organic soils found within the Limit of Work line shall be stripped to their full depth in the area of all structures and in all areas required to be filled, excavated or graded. Stripped materials suitable for re-use as loam shall be stockpiled. Stockpiles shall be kept separate and stabilized. Excess stripped materials and unacceptable materials shall be disposed of off site by the Contractor.
2. All excavated material from the City of Franklin right-of-way remains the property of the City of Franklin. The material may be disposed with permission of the City of Franklin.

3.02 EXCAVATION

A. General

1. Excavation shall consist of the removal of soil, rock, and other materials to the limits shown on the drawings, specified herein, and as required to provide firm bearing.
2. Earth excavation shall include all materials other than solid rock and detached rock or boulders exceeding 1 cu. yd. in volume.
3. Rippable rock shall be considered earth excavation. Rippable rock is defined as rock which can be excavated using a single tooth hydraulic ripper pulled by a D8 or equivalent dozer.
4. Excavated materials meeting the requirements for the various fill materials specified herein shall be stockpiled for reuse. Unsuitable or excess suitable materials shall be disposed of off site by the Contractor.
5. Excavation shall be to the limits shown on the drawing or, where limits are not shown, as necessary to install foundations, utilities, pavement or other facilities.
6. The proposed contour lines and spot grades shown on the drawings are finish elevations. Excavation to subgrade shall be the distance below these elevations as may be required by the size and thickness of pavements, structures, utilities and surface treatments as shown on the plans, details and sections, or as specified herein.
7. Excavating equipment shall be of such size and type, and used in a manner, that will not damage existing paved surfaces, utilities, structures, trees, etc. Rubber tired equipment shall be used for backfilling trenches in paved areas.

B. Trench Excavation

1. Trench excavation shall consist of the satisfactory removal of all materials encountered. Excavations shall be made to accommodate the elevation, depth of cover, or detail shown on the drawings or specified. Trench widths shall be kept to the minimum practicable but shall be at least 3 feet wide or 2 feet, plus the outside diameter of the pipe, whichever is greater. The bottom of the trenches shall be firm and free of water and shall be accurately graded and shaped to allow placement of required bedding beneath the bottom of all barrels, bells or couplings of all pipes installed. Trenches for utilities in fill areas shall be excavated after all fill materials have been placed, spread and compacted to an elevation at least one foot above the top of the proposed utility.
2. If, through the Contractor's error, the excavations are carried beyond the specified limits, or if inadequate dewatering causes softening of the subgrade which necessitates removal, backfill shall be with gravel fill as specified and installed in accordance with the requirements for compaction of pipe bedding.
3. When trenching occurs around trees to remain, the tree roots shall not be cut but rather, the trench shall be tunnelled under or around the roots by careful hand digging and without injury to the roots.
4. The Contractor shall excavate to provide a minimum cover over the top of pipe of 5 feet below finished grade unless otherwise shown. For pipes laid within a slope which rises above the adjacent roadway, the top of pipe shall be 5 feet below the top of the adjacent roadway. See Typical Trench Section.

C. Excavation in Graded Areas

1. Excavation in graded areas shall be performed as necessary to bring such areas to proper subgrade or finish grade as the case may be. Subgrade for grass areas shall be 6 inches below finish grade.

D. Rock and Boulder Excavation

1. Rock excavation shall include the excavation, removal and disposal of rock and all boulders 1 cubic yard or more in volume which require blasting or drilling and splitting.
2. Blasts shall be covered to prevent scattering of material and all adjacent property shall be suitably protected. Explosives shall be transported, handled and stored in a safe manner and in compliance with all state and local regulations. Charges shall not be so large as to shake, loosen or endanger adjacent structures or their contents or to do harm to their occupants. Responsibility for damage to persons or property shall rest solely with the Contractor. Only personnel qualified in the use of explosives shall be employed for blasting.
3. The Contractor shall design his blast pattern and use blast control methods to prevent detrimental effects to the rock outside of the excavation limits. All loose, unsound or semidetached rock fragments which may be detrimental to the proposed structure or installation shall be removed from the excavation. Excavation beyond the required limits, made to remove damaged rock shall be backfilled by the Contractor.
4. After blasting, the rock surface at subgrade shall be thoroughly cleaned of all vegetation, soil, excessively broken rock, excessively weathered or decomposed rock, loose fragments, ice, snow, and other objectionable substances. Picking, barring, wedging, streams of water, hammers, and other effective means shall be used as required to accomplish this cleaning. All free water left on the surface of the rock shall be removed. The Engineer shall be notified and provided the opportunity to observe the cleaned rock surface before any masonry, concrete, bedding, or fill is placed on or against the rock.
5. Where boulders are on the sides of or in the bottom of excavations, they shall be wholly or partially removed. In removing boulders lodged in the sides of the excavations, the Contractor shall not disturb or undermine adjacent pavement or structures. If pavement surfaces are damaged beyond reasonable limits, the Contractor shall repair such damage. In general, boulders or rock fragments which extend under paved surfaces shall be removed by blasting or mechanical splitting.
6. Unauthorized excavations in rock, or excavations made beyond or below the indicated or directed limits shall be refilled and compacted with approved gravel fill.
7. Depressions below the required grade resulting from the removal of boulders and rock fragments shall be refilled with compacted gravel.
8. Whenever provisions for a future connection are placed in pipelines in rock areas, the rock shall be removed for a distance of at least 3 feet, or more if directed, horizontally from the end or face of the pipe and in the direction of the future connection.
9. Rock encountered in areas where blasting is not permissible shall be removed by drilling and splitting using rock splitters, feathers and wedges, jackhammers or by hand.

E. Excavation of Unsuitable Materials

1. Existing soils, which are considered unsuitable foundation materials by the Engineer, shall be removed to the limits required. For pipelines, the horizontal limits are defined as one foot beyond the outside face of the pipe or a minimum of 3 feet whichever is larger unless otherwise directed or shown. For manholes and catchbasins, the horizontal limits are defined as 2.5 feet outside the inside face of the structure. The exposed subgrade shall be compacted and the area backfilled with gravel fill as specified.

3.03 TEMPORARY EARTH SUPPORT

- A. The Contractor shall design, furnish, install and maintain temporary earth support systems, as required, to prevent injury to persons, collapse of the sides of the excavation, and damage, disturbance and settlement of adjacent property. Sheet piling, bracing, trench box shall be of adequate type, size and strength for the conditions encountered and shall be driven to true alignment in a workmanlike manner. Temporary Earth support shall be in compliance with OSHA standards.

3.04 CONTROL OF WATER

- A. Contractor shall be responsible for obtaining all federal and state permits. Contractor shall provide a stormwater pollution prevention plan at the job site, as required by federal and state regulations.
- B. The Contractor shall provide and maintain all pumps, piping, drains, wellpoints, or any other facilities for the control and collection of groundwater or surface water. The dewatering operations shall be such that excavations are kept free from water at all times so that all construction work may be performed in the dry. Pumping shall be continuous where required to protect the work and to maintain satisfactory progress. All pipelines and structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected.
- C. Excavation shall be protected from flooding by surface water by use of berms, ditches or other suitable means.
- D. The Contractor shall dewater in a manner which does not cause loss of ground or disturbance to the bearing soil or soil supporting adjacent structures.

3.05 BACKFILLING TRENCHES AND AGAINST STRUCTURES

A. General

1. The requirements for pipe bedding and trench backfilling are described herein and are shown in the Typical Trench Section.
2. Pipe and/or structures shall be placed on specified bedding materials, to provide uniform support and a stable foundation for the pipeline or structure and backfill material. No bedding shall be placed on unstable subgrade soils. An unstable subgrade is defined as a condition of running sand, running silt, quick bottom, or otherwise soft, soupy or spongy bottom. If an unstable condition exists, or developed during the excavation, the Contractor shall excavate, dewater and stabilize the subgrade to the extent necessary to provide a firm stable foundation prior to placing bedding, pipe and/or structures.
3. The height of fill adjacent to structures and pipelines shall be increased at approximately the same rate on all sides to prevent displacement.

B. Trench Bedding

1. Pipelines and appurtenant items of work shall be laid in the bedding material, from the bottom of the excavation to the mid-diameter of the pipe, for the full width of trench. Bedding material shall be compacted to a minimum density of 95 percent of the maximum density as determined by ASTM Methods 1557 (Modified Proctor) and shall meet the requirements for ¾" crushed stone.
2. The type and thickness of bedding material will be determined based on field conditions, as follows:
 - a. The excavation shall be made to a depth of 6 inches below the bottom of pipe for placement of bedding material.
 - b. Where the bottom of the trench excavation is below the groundwater level and pumping of water is done from within the excavation, the Contractor shall use a bedding system which provides a stable working surface which limits the disturbance of the subgrade and prevents piping or washing of fine soils from the subgrade due to the flow of water into the trench. If the subgrade is stable and meets the requirements of gravel fill, excavation for 6 inches of bedding material is not required.
 - c. Where the subgrade soil type is a low or nonplastic silt (ML), silty or clayey sand (SM, SC), fine to medium sand (SP), or silty or clayey gravel (GM, GC), as defined by the soil classification system described in ASTM Standard Method D2487 (Unified System), a 2-layer bedding system shall be utilized, with an approved filter cloth to prevent migration of silt into the bedding material. The top layer of this bedding system, from the mid-diameter of the pipe to 6 inches below the bottom of pipe, shall be crushed stone as described hereinbefore, and the lower layer shall be at least 6 inches of gravel fill placed on top of the filter cloth. The filter cloth shall be continuous along the trench bottom, and shall wrap up the sides of the trench, to above the mid-diameter of the pipe. All joints in the filter cloth shall lap at least 18 inches.
3. No more than 6 inches of crushed stone bedding shall be placed beneath the bottom of any pipe or structure. If through an error in excavation, or the need to remove unsuitable material to greater depths than required to install the pipe bedding, the Contractor shall backfill this additional excavation with specified compacted Gravel Fill. Bedding material and Gravel Fill used to replace unsuitable material shall be placed in lifts not exceeding 6 inches loose measure and shall be compacted to a minimum density of 95 percent of the maximum density determined by ASTM Method D1557, (Modified Proctor).
4. If crushed stone is used as bedding material, a 12-inch wide impermeable clay cutoff barrier shall be installed across the trench from the bottom of the excavation to the mid-diameter of the pipe every 300 feet to prevent groundwater from flowing unimpeded along the pipe trench, through the crushed stone. Trenches for sewer pipes with slopes over 0.08 feet per foot and trenches for sewer pipes below seasonal high ground water level shall have impervious trench dams constructed every 300 feet to prevent potential disturbance to pipe bedding and blanket materials.

C. Trench Backfilling

1. Paved Areas: Backfill materials, meeting the requirements for Select Fill, having a maximum particle size of 4 inches, shall be installed above the mid diameter of the pipe to 12 inches above the pipe. All trenching shall be backfilled with either crushed surfacing materials conforming to Section 4-04 of the "Standard Specifications for Road and Bridge Construction". All trench backfill materials shall be compacted to ninety-five percent (95%) maximum dry density, as determined by

ASTM D-1557. If the existing material is determined by the City to be suitable for backfill, the Contractor may use the native material. Backfill compaction shall be performed in 8 to 12 inch lifts. The Contractor shall perform compaction tests. The test results shall be given to the City for review and approval prior to paving. Tests shall be performed at maximum intervals of 50 feet along the length of the trench.

2. Cross-Country Areas: In trenches through unimproved areas, pipe shall be bedded as specified. The remaining backfill shall be compacted to a minimum of ninety percent (90%) of maximum dry density, as determined by ASTM D-1557. Backfill materials placed from 12 inches above the pipe to the bottom of the roadway base course in paved areas or to the bottom of the loam in cross country areas shall meet the requirements for Common backfill. It shall have a maximum stone size of 6 inches. The backfill shall be placed in layers not exceeding 12 inches before compaction. Backfill shall be mounded 6 inches above original ground at cross country locations
3. All settlement shall be repaired by the Contractor at its own expense. Driving over trenches with trucks and/or excavation equipment will not be considered suitable compaction.
4. All surplus material shall be removed and disposed of by the Contractor after trenches have been backfilled. The removal of surplus material, cleaning up of trench surfaces along streets and premises shall closely follow the pipe laying.
5. Where hardened surfaces or roadways, driveways, or walls are dug up or interfered with, special attention shall be given to the backfilling operations before resurfacing.
6. The Contractor shall continually provide street sweeping on roadways used by his vehicles in order to reduce dust, siltation and nuisance problems.

D. Against Structures

1. Unless otherwise specified, backfill against structures shall meet the material requirements for Common Fill. No backfill whatever shall be placed on or against masonry, or other cast-in-place structures until the masonry has been in place a minimum of 7 days, or has been suitably braced. Backfill shall be uniformly distributed, and compacted to a minimum density of 90 percent of the maximum density determined by ASTM D1557, (Modified Proctor). All piping into structures shall have a joint within 2 feet of the exterior face of the wall.

3.06 SOIL TESTING

A. General

1. Three types of soil tests shall be performed by an approved soil testing laboratory furnished by the Contractor. The type of tests, timing and frequency are described below. The performance of these tests does not relieve the Contractor of his responsibility to control his operations and perform tests as necessary to assure that the work performed meets the requirements of the specifications.

B. Sieve Analysis Tests

1. Sieve analysis tests shall be performed on soil samples obtained by the Contractor for approval of material from off site borrow sources or from on-site excavations. Additional tests shall be performed on samples obtained from the fill when it is suspected by the City that the material does not meet specifications. Tests shall also be performed when it is noted that the gradation of material actually being placed differs significantly from the documented gradation from a particular source.

2. Sieve analysis shall be performed in accordance with ASTM C136 and C117.

C. In-Place Density Tests

1. The City will determine the location, number and timing of In-Place Density tests. In general, at least one test shall be performed for each 300 feet of pipeline installed. Structural and embankment fills shall be tested at least once for each 1,000 cu. yd. of fill placed. For structures and embankments, a minimum of four tests shall be performed during each of two separate visits by the testing laboratory. Tests shall be performed in accordance with ASTM D-1556 or ASTM D-2167. Additional tests shall be performed in areas where compaction is doubtful.

D. Moisture Density Relationship Test

1. Moisture Density Relationship Tests (Proctor Tests) shall be performed in conjunction with In-Place Density Tests for each different fill material tested. Tests shall be performed in accordance with ASTM D1557.

3.07 GRADING

A. General

1. The areas to be graded shall be raked or machine-graded to remove stones and other unsatisfactory material and then shall be compacted as specified. Any depressions which occur during the compaction operation shall be filled with additional suitable material and the surface then regraded and compacted until true to line and grade as required.
2. The work includes all grading required including shaping, trimming, compacting and finishing of the surfaces. The grading of shoulders and sloped areas may be done by machine methods. Up to 2 inches in 10-foot tolerance will be permitted on slopes over 2 percent, and 1 inch in 10-foot on slopes under 2 percent provided the slopes are uniform in appearance and without abrupt changes. All ruts shall be eliminated. Grading of subgrades for paved areas shall be finished at the required depth below and parallel to the proposed surface with 1/2 inch in 10-foot tolerance.
3. No stones larger than 4 inches in largest dimension shall be placed in the upper 6 inches of fill. Grading operations shall be completed after the buildings have been finished, the utilities installed, the site improvements constructed, and all materials, rubbish and debris removed from the site.

B. Paved Areas

1. The subgrade for areas on which pavement is to be placed shall be finished to the required depth below and parallel to the proposed pavement surface, after any pipes in the paved area are in place and tested.

C. Loamed Areas

1. The grading of the slopes and other areas to be loamed may be done by machine methods and a tolerance will be permitted in slopes as specified above, provided the slopes are uniform in appearance and without abrupt changes. All ruts shall be eliminated.

D. Finish Grades

1. Finish grades shall be as indicated, and unless otherwise specified, excavations and fills shall be carried to proper subgrade levels below finish grades and contours

shown, to allow for finish work.

E. Grading Around Trees

1. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:
2. When the existing grade at the tree is below the new finished grade and fill not exceeding 16 inches is required, crushed stone shall be placed directly around the tree trunk. The stone shall extend out from the trunk on all sides a minimum of 18 inches and finish approximately 2 inches above the finished grade at tree. New earth shall not be left in contact with the trunks of any trees requiring fill.
3. Existing trees in areas where the new finished grade is to be lowered, shall have regrading work done by hand to elevation as indicated. Roots as required shall be cut cleanly 3 inches below finished grade and scars covered with tree paint.

SECTION 2B
SANITARY SEWER AND APPURTENANCES

PART 1 - GENERAL

1.01 COMPLIANCE

- A. Certificates of Compliance shall be submitted by the Contractor for each material to the City of Franklin for review and approval. The Contractor shall furnish all materials, labor, tools, and equipment, and perform all operations necessary for the installation of the sanitary sewers and appurtenances as indicated on the Drawings.
- B. All materials not specifically referenced shall comply with applicable sections of ASTM, AWWA or the APWA/Standards of Design and Construction for Sewerage & Wastewater Treatment Facilities, 2006 or latest revision. All materials used must meet NH Department of Environmental Services regulations and City of Franklin requirements.

1.02 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Inspection of Material and Delivery Point.
 - 1. When delivered to the site, and prior to unloading, the Contractor shall inspect all pipe and accessories for loss, damage or lack of specified identification and markings.
 - 2. Any defective or improper material shall be immediately marked and shall not be unloaded.
- B. Handling - In storing and installing, pipe and accessories shall be kept in a sound, undamaged condition. They shall, at all times, be handled with care and shall not be dropped, dumped or bumped against any other object. Any material(s) damaged shall be marked and immediately removed from the job site.
- C. Storing
 - 1. Pipe shall be stored off the ground on sticking or pallets. Pipe shall be stacked with spigot ends projecting from the stack in opposite directions for alternate rows.

1.03 SUBMITTALS

- A. Shop drawings, brochures and samples shall be submitted for all items to be furnished to the City of Franklin for approval. These shall include but not limited to manholes, frames, covers, pipe, and brick.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Pipe and fittings(6"-15") shall be PVC. All pipe shall be integral wall bell and spigot, rubber gasket joint, unplasticized Polyvinyl Chloride (PVC) pipe. All PVC pipe shall have a minimum "pipe stiffness" of 46 psi at 5 percent deflection at 73 degrees F when tested in accordance with ASTM Designation D2412, external loading properties of plastic pipe; and a minimum impact strength based on ASTM D3034. shall be of the material indicated on the Drawings or specified herein. Pipe and fittings shall be supplied by the Contractor; detection of defects and storage will be the responsibility of the Contractor. Pipe and fittings for gravity sewer shall be polyvinyl chloride (PVC) and shall meet the requirements of ASTM D 3034 for SDR 35, polymer compounding and classification shall be in accordance with ASTM D-1784, (class 12454-B). Joint seals for PVC pipe shall be oil resistant compression rings of elastomeric material conforming to ASTM D-3212 and shall be push-on, bell and spigot type. Pipe stiffness shall be in accordance with ASTM D-2412 and shall be a minimum of 46 psi and 5% deflection. Joint seals for PVC pipe shall be oil resistant compression rings of electrometric material conforming to ASTM D-3212, type shall be push-on, bell and spigot. Fittings shall be manufactured and supplied by the pipe manufacturer.
- B. Pipe and fittings (18"-27") shall be PVC. All pipe shall be integral wall bell and spigot, rubber gasket joint, unplasticized Polyvinyl Chloride (PVC) pipe. All PVC pipe shall have a minimum "pipe stiffness" of 46 psi at deflection at 73 degrees F when tested in accordance with ASTM Designation D2412, loading properties of plastic pipe; and a minimum impact strength based on ASTM F679. All PVC sewer pipe and fittings manufacture and installation shall meet or exceed the ASTM recommended specifications F679 for thickness class T-1, unless otherwise specified, and all installations shall be in strict compliance with the manufacturer's directions. All pipes shall be clearly marked with the date of manufacture. There shall be no reduction in pipe wall thickness at the bell as a result of bell formation. All pipes shall be provided with a reference mark for proper spigot insertion. Joint gaskets shall be fabricated from a compound of which the basic polymer shall be a synthetic rubber consisting of styrene, butadiene, polyisoprene or any combination thereof and shall meet the requirements of ASTM D-3212.

- C. Pipe and fittings for gravity sewer as an alternate shall be reinforced concrete pipe and conform to the requirements of ASTM C-76 or C-361 of a class 3 or greater. Concrete pipe shall conform to AWWA C302. Prestressed concrete cylinder pipe and fittings shall conform to AWWA C301; and joints for concrete cylinder pipe shall be made of oil resistant elastomeric material conforming to AWWA C301 specification.
- D. Gravity sewer with ductile iron pipe and fittings shall conform to the following standards of the American Water Works Association (AWWA): (1) AWWA C151/A21.51-02 for ductile iron pipe, centrifugally cast in metal- or sand-lined molds, for water or other liquids; (2) AWWA C150/A21.50-02 for thickness design of ductile iron pipe and with ASTM A536 ductile iron castings; and (3) Joints shall be mechanical type, push-on type, or ball-and-socket type. Double cement lining, inside seal coating and bituminous outside coating shall meet or exceed AWWA C104.
- E. PVC Sewer pipe joints shall conform to ASTM 3212. Joints shall be provided with gaskets conforming to ASTM F477; resistant to common ingredients of sewage and industrial wastes, including oils and groundwater; and capable of enduring permanently under conditions of proposed use. Fix gaskets into place in bells to avoid dislodging during joint assembly.
- F. Where indicated on the plans and approved by Franklin for special use, gravity sewer pipe shall be manufactured in accordance with AWWA Standard C900, with the following additional requirements or exceptions.
 - 1. 4" through 12" nominal diameter PVC pipe shall be furnished in cast iron pipe equivalent outside diameters.
 - 2. C900 PVC pipe shall be pressure class 150 (DR 18) unless otherwise called for in the plan. Pipe joints shall be manufactured using an integral bell with an electrometric gasket push-on type joint. Electrometric gaskets shall conform to ASTM F477. All fittings shall be PVC, compatible with C900 PVC pipe class called for in the plan, unless otherwise approved. PVC fittings shall conform to AWWA C900 with respect to joint dimensions and physical properties.
- F. PVC pressure pipe shall conform to AWWA C900 pressure class 100 (DR 25) unless otherwise called for in the plan. Joints shall be made up as recommended by the pipe manufacturer for pressure pipe. PVC fittings compatible with AWWA C900 pipe, or ductile iron fittings, when allowed, shall conform to these specifications. PVC used for force mains shall conform to ASTM D-2411, polymer compounding shall be to ASTM D-1784 (class 14254-B). A safety factor of 2.5 shall be used for pressure rating determination with a standard dimension ratio (SDR) no higher than 26.

2.2 SERVICE CONNECTIONS

- A. Service connection piping and fittings shall correspond in materials furnished for the gravity sewers. The pipe shall be manufactured to the requirements of the appropriate piping specification. Contractor shall confirm location of mainline sewer and service lateral has no conflicts prior to construction.
- B. Sewer service laterals shall be constructed with the following minimum slopes: 4-inches and 6-inches 1/4 inch per foot.
- C. Minimum sewer service lateral sizing shall be as follows:
- One housing unit - 4 inch min. size
 - Commercial, Multi-family, or Industrial - 6 inch min. size
- D. Clean outs shall be constructed on sewer service laterals and shall be located as follows: every 100 feet and any direction change greater than 45 degrees. Clean outs shall not be located within the City right-of-way. Clean outs shall be the same diameter as the carrying pipe, except for clean outs on service laterals greater than six (6) inches, where a six (6) inch clean out is acceptable. Only one clean out is necessary when two 45 degree
- E. A backflow valve shall be installed where plumbing fixtures are subject to backflow from the public sewer (BOCA Plumbing Code P-1003.2). Generally where the first floor elevation is lower than the street this will be required. The effective operation of the backwater sewage valve shall be the responsibility of the owner of the lateral sewer. Before any installation of this nature is made, the owner will be required provide an agreement or to comply with provisions of this regulation to save the City harmless from damage or injury.
- F. Service lateral 8-inch or larger shall terminate in a manhole.
- G. Green detectable tape: green detectable "sewer" tape shall be installed in the sewer service trench on top of the 12-inch sand blanket on all sanitary sewer services
- H. Wherever a situation exists involving an unusual danger of backup, a backwater valve is required. The effective operation of the backwater sewage valve shall be the responsibility of the owner of the lateral sewer. Before any installation of this nature is made, the owner will be required to comply with provisions of this regulation concerning the agreement to save the City harmless from damage or injury.

2.3 MANHOLES

- A. Manholes shall be precast reinforced manhole sections or monolithic cast-in-place structures with or without reinforcement which shall withstand an H-20 loading. The sections a minimum of four foot in diameter. For sewers larger than 24-inch in diameter, manhole diameter shall be increased so as to provide at 12 inches of shelf on each side of the sewer. Precast sections shall conform to ASTM C478. Manholes shall not leak in excess of one gallon per day per vertical foot of manhole for the life of the structure. A period in excess of 25 years shall be the life of the structure. Precast sections shall have the date of manufacturer, date of leakage test, and the name or trademark of the manufacturer impressed indelibly marked on the inside wall.
- C. Base sections shall be monolithic to a point 6" above the crown of the incoming pipe, and shall be pre-cast reinforced concrete or pre-cast non-reinforced concrete. There shall be a minimum distance of five inches between the invert of the lowest out flowing sewer and floor of the precast base to provide for the construction of a formed invert and bench wall within the manhole. No more than two lift holes shall be cast in the bases.
- D. When manhole depth is less than 6 feet and with specific approval of the City of Franklin, a reinforced concrete slab cover may be used in lieu of a cone section, provided the slab has an eccentric entrance opening and be capable of supporting H-20 loads.
- E. Manholes shall be precast concrete sections with a confined O-ring rubber gasket joints per ASTM C-478 and ASTM C-443 with either a precast base or a cast-in-place base made from a 3,000 psi structural concrete. All structure shall be reinforced concrete. Concrete adjustment rings shall conform to the ASTM C-32, Grade MA.
- F. Outside drop structures shall be constructed with AWWA C900 pipe and fittings, DR 18. Inside drop structures shall be constructed of ASTM D3034, SDR 35 PVC pipe and fittings. Cast-in-place place sections shall be constructed of poured-in-place, non-reinforced concrete or reinforced concrete.
- G. Manhole barrels and top sections shall have a minimum thickness of five inches for reinforced design and eight inches for non-reinforced design. The top section shall be eccentric conical section with thickened upper walls with the smallest inside diameter equal to 30 inches, to receive the manhole frame and cover.
- H. Horizontal joints between sections of pre-cast concrete barrels shall be an overlapping type, which shall, in general, depend for water-tightness upon and elastomeric or mastic sealant.
- I. Pipe to manhole joints shall be as follows: (1) elastomeric, rubber, sleeve with watertight joints at the manhole opening and pipe surfaces; (2) cast into the wall or secured with stainless steel clamps, joints at the pipe shall be secured with stainless steel clamps; (3) elastomeric sealing ring cast in the manhole opening with seal formed on the surface of

the pipe by compression of the ring; and (4) non-shrink grouted joints where watertight bonding to the manhole and pipe can be obtained.

2.4 FRAMES AND COVERS

A. Frames and Covers: Ductile Iron conforming to ISO 1083, and as follows:

1. Castings to be free from scale, lumps, blisters and sandholes.
2. Machine contact surfaces to prevent rocking.
3. Thoroughly clean and hammer inspect.
4. Capable of withstanding AASHTO H-20 loading unless otherwise indicated or specified.
5. Sewer manhole frames and covers shall be as manufactured by PAMREX or approved equal with minimum 30-inch clear opening.
6. Covers shall be hinged and incorporate a 90 degree blocking system to prevent accidental closure. Covers shall be operable by a one person using standard tools and shall be capable of withstanding a test load of 120,000 lb.
7. Sewer covers must bear the word "SEWER" in 3-inch letters cast into top surface.
8. All frame and cover components shall be bituminous coated at the factory. All castings shall be even-grained cast-iron, smooth, free from scale, lumps, blisters, sandholes, and defects; contact surfaces of covers and frames shall be machined at the foundry, to prevent rocking of covers in any orientation. All castings shall be thoroughly cleaned and subject to careful hammer inspection. A hammer blow shall produce an indentation with no flaking.

B. Bituminous Waterproofing Material:

1. H.B. Tnemecol 46-465, by Tnemec Company.
2. Amercoat 78HB, by Ameron International.
3. Bitumastic Super Service Black, by Carboline.

C. Manhole frame and cover shall provide a minimum of 30 inch diameter clear cover. The word "SEWER" shall be cast in the center of the top surface with 3 inch letters. Manhole frame and cover shall be capable of withstanding an H-20 load.

2.5 BRICK MASONRY

- A. Brick: ASTM C32, Grade SS, but mean of five tests for absorption not to exceed 8 percent by weight.
- B. Mortar shall be composed of; (1) masonry cement meeting the requirements of ASTM C-150 type II Portland cement, (2) hydrated lime meeting the requirements of ASTM C-207 Designation C 207, and (3) sand consisting of inert natural sand conforming to ASTM Standard Specifications for concrete fine aggregates, designation C33. Mortar shall be composed by volume of either 4-1/2 parts sand and 1-1/2 parts cement or 4-1/2 parts sand, 1/2 parts hydrated lime, and 1 part cement.
- C. For Plugging lift holes: Mix Portland cement and sand in proportion by volume of 1: 1-1/2, with sufficient water.
- D. Cement shall be type II Portland cement conforming to ASTM C150.
- E. Hydrated lime shall be type S conforming to the ASTM C207 "Standard Specifications for Hydrated Lime for Masonry Purposes";
- F. Sand shall consist of inert natural sand conforming to the ASTM C33-03 "Standard Specifications for Concrete, Fine Aggregates";

2.6 JOINTS

- A. Between Manhole precast sections: Butyl rubber-based sealants per Type B, AASHTO M198, but no bitumen content.
- B. Resilient connectors for pipes to precast sections: ASTM C923, and to manufacturer's standards. Do not use connectors using castings and bolts with non-resilient bearing.
- C. Rubber ring waterstops for use in pipe-to-manhole joints: Rings of resilient material that will fit snugly over pipes, held firmly against pipe surface by means of a mechanical take-up device which when tightened will compress resilient material or by a stretch fit. Waterstop designed and installed so that leakage between pipe and manhole is minimized. Materials and manufacture of waterstops: ASTM C923.
- D. For pipe connections to existing manholes, cutting into existing manhole to be performed by coring. Use of pneumatic tools for this work not permitted. Flexible pipe-to-manhole connector equal to Kor-N-Seal made by NPC, Inc., Milford, NH.
- E. Provide a flexible joint within 48 inches from a manhole for reinforced concrete (RC) pipe; and within 60 inches for PVC pipe larger than 15-inch diameter. No flexible joint is required for Ductile Iron Pipe or PVC pipe up through 15-inch diameter.

2.7 CAST-IN-PLACE CONCRETE

- A. Concrete for drop supports shall conform to the requirement for class AAA concrete of the New Hampshire department of transportation's "Standard Specifications for Road and Bridge Construction".
- B. Concrete for cast-in-place bases or complete manholes shall conform to the requirements for class AA concrete. Reinforcing for cast-in-place concrete shall be steel or structural fibers that conform to the requirements of the New Hampshire department of transportation's "Standard Specifications for Road and Bridge Construction"
- C. Concrete for encasement shall conform to N. H.std Class C, having a minimum ultimate strength of 2000 psi.

2.8 BEDDING

- A. Bedding material shall be crushed gravel, screened gravel or crushed stone, meeting ASTM C 33 stone size No. 67, free from clay, loam, and organic matter, and shall conform to the following gradation.

100 % passing	1 inch screen
90-100 % passing	3/4 inch screen
20-55 % passing	3/8 inch screen
0-10 % passing	#4 sieve
0-5 % passing	#8 sieve

- B. Where directed by the Owner to stabilize the trench base graded screened gravel or crushed stone 1/2 inch to 1-1/2 inch shall be used.

2.9 SAND FILL (CUSHION)

- A. Material for sand cushion shall consist of clean sand, free of organic matter. The material shall be well graded and shall conform to the following gradation:

85-100 % passing	#4 sieve
0-5 % passing	#200 sieve

2.10 CEMENT MORTAR FOR MANHOLES

- A.. Non-shrink mortar for pipe connections to existing manholes:

1. Masterflow 713 Grout made by Master Builders, Cleveland, OH.

2. Five Star Grout made by U.S. Grout Corp., Old Greenwich, CT.
3. Upcon made by Upco Co., Cleveland, OH.

2.11 TAPE

- A. 6" Green detectable "sewer" tape shall be installed in the sewer service connection trench 12" above newly installed sanitary services.

PART 3 - EXECUTION

3.1 GENERAL

- A. All pipe, manhole, appurtenances, and accessories shall be installed true to lines, grades, and locations indicated on the plans. Alignment procedures shall be subject to constant review and approval of the Owner. Any deviations from the Drawings must be approved by the Owner before installation.
- B. A service lateral shall be installed for each existing building or as directed by the Owner.
- C. Trenches shall be excavated to the line and grade designated by the Engineer and in accordance with the Standard Details. The trench width at the top of the pipe shall be 30 inches for pipe up to and including 12 inch inside diameter and the outside diameter of the pipe barrel plus 16 inches for pipe larger than 12 inch inside diameter. Where higher strength pipe or special bedding is required because of excess trench width, it shall be furnished

3.2 PIPE BEDDING CONDITIONS

- A. All pipe and appurtenances laid in open trench excavations shall be placed and uniformly supported over their full length on beddings of the type specified herein and shown on the Drawings. All work shall be performed in a dry trench.
- B. Pipe shall be placed on a prepared subgrade of imported material at least 6 inches deep below the barrel of the pipe and filled around the pipe to the spring line for all pipe sizes of 27 inches in diameter and smaller, and 8 inches deep for all pipe sizes of 30 inches and larger. Pipe in ledge requires 12". After preparation of the subgrade, bell holes shall be excavated so the pipe, when laid, will have a uniform bearing under the full length of the pipe. The Contractor shall be responsible for adequate support and bedding for the pipe. The trench shall be hand backfilled and compacted from the spring line of the pipe to six inches above the top of the pipe. The material shall be placed in 6-inch layers and compacted to no less than 95 percent of the maximum theoretical density as measured by ASTM D-1557 prior to placement of the next layer.

- C. Where the undisturbed trench below the 6 inch bedding is unstable, the unstable materials shall be removed and backfilled with foundation gravel and/or bedding gravel as necessary to produce a stable foundation upon which to place the bedding. The Contractor shall be responsible for providing a stable foundation for placing of the bedding. Boulders, rocks, and other obstructions (except roots of existing trees to be saved) shall be entirely removed or cut out the full width of the trench and to a depth 6 inches below the pipe bottom and backfilled as provided above.
- D. Whenever the trench is excavated below the depth required for proper bedding, it shall be backfilled with bedding gravel and compacted, as provided above for bedding gravel.
- E. Use Concrete Encasement in accordance with the Standard Detail only upon direction of the City of Franklin.

3.3 TYPE 1 - CRUSHED STONE BEDDING

- A. The pipe shall be bedded in compacted granular material placed on a flat bottom trench. The granular material shall meet the requirements as specified under Bedding in this specification. The bedding shall be have a minimum thickness of six inches or one-fourth the outside diameter of the pipe , whichever is greater. The bedding shall extend halfway up the pipe barrel at the sides to form a positive cradle fitting the bottom half of the pipe. The remainder of the side fills to a minimum of twelve inches over the top of the pipe shall be filled with compacted sand cushion as specified under Sand Fill (Cushion), in this specification.
- B. Bedding and sand cushion shall be spread in six-inch layers. Each layer shall be compacted with 20-pound hand tampers or pneumatic tampers until the required total depth of bedding or cushion is obtained.
- C. Where suitable supporting soil or rock stratum occurs at a depth greater than six-inches, but less than two feet below the pipe and where ordered by the Owner, the pipe bedding shall be modified. The trench shall be excavated to a depth necessary to reach the suitable supporting stratum. Screened gravel or crushed stone bedding shall be spread in six inch layer and compacted with 20-pound hand or pneumatic tampers. The bedding shall carry vertically from the supporting stratum up to a level six-inches below the bottom of the pipe. Type 1 bedding shall be installed as specified above.

3.4 TYPE 2 - CONCRETE ENCASEMENT

- A. The trench shall be excavated to a minimum depth of nine inches below the bottom of the pipe. The pipe shall be supported on solid concrete blocks. Concrete shall be placed , under and around the block, such that the minimum encasement around the outside of the barrel shall be nine inches in thickness. The minimum width the encasement shall be

the width of the trench.

- B. The encased pipe shall be maintained free from ground water for at least four hours. No backfilling of the trench will be allowed until a minimum time of 24 hours has elapsed after the encasement has been poured.

3.5 INSPECTION OF PIPE BEFORE INSTALLATION

- A. All pipe, fittings, and appurtenances shall be carefully inspected in the field before lowering into the trench. Cracked, broken, warped, out-of-round, or otherwise defective pipe, fittings, etc. as determined by the Contractor or the Owner shall be pulled out and not installed. Such rejected pipe shall be clearly tagged in such a manner as not to deface or damage it, and removed from the job site by the Contractor at his own expense.

3.6 INSTALLATION OF PIPE AND FITTINGS

- A. After the trench has been brought to proper grade, as herein specified, the pipe and appurtenance shall be laid. Unless otherwise approved by the Owner in writing, pipe laying shall be done only in the presence of the Owner and the Contractor shall give a minimum of 24 hours notice of scheduled pipe laying operations to the Owner.
- B. All pipes shall be carefully lowered in the trench. Pipes shall be laid true grades shown on the drawings. Each section of the pipe shall rest upon the pipe bed for the full length of its barrel with recesses excavated to accommodate bells and joints. Blocking will not be permitted except where the pipe is encased in concrete. Any pipe that had its grades and joints disturbed after laying shall be taken up and re-laid.
- C. The interior and ends of the pipe shall be thoroughly cleaned of all foreign matter and shall be kept clean during the laying operation by means plugs or other approved methods. Pipe shall not be laid in water or if weather is unsuitable for such work except by permission of the Owner.
- D. All pipe shall be handled, placed and coupled in accordance with manufacturer's recommendations. Pipe cutting shall be done in accordance with the manufacturer's recommendations, but only with the approval of the Owner.
- E. At all times when pipe laying is not actually in progress, the open ends of the pipe shall be closed temporary watertight plugs or by other approved methods. If water is in the trench when work is resumed, the plug shall not be removed until danger of water entering the pipe has passed.

- B. All sewers shown on plans are a minimum of 10 foot horizontal separation from water mains. Contractor must maintain ten foot separation. Sewer pipe which crosses water pipe is shown on the plans with an 18" vertical separation. Sewer pipe must be Class 52 ductile iron or AWWA C-900 PVC force main for a minimum distance of 6 feet each side of the crossing. Joints shall be mechanical type water pressure rated with zero leakage when tested at 25 psi for gravity sewers and 1 ½ times working pressure for force mains and joints shall not be located within 6 feet of the crossing. Water must be above sewer.
- C. Trenches for sewer pipes with slopes over 0.08 feet per foot and trenches for sewer pipes below seasonal high ground water level shall have impervious trench dams constructed every 300 feet to prevent potential disturbance to pipe bedding and blanket materials.

3.7 CONNECTION TO EXISTING STRUCTURES

- A. Connection to existing manholes shall be made by core drilling and installing a flexible sleeve of the Kor-N-Seal type. Work on the manhole masonry shall not damage the water tightness of the concrete shell. Work on manhole masonry must not damage or impair water tightness. Contractor shall contact local officials prior to connection.
- B. Contractor shall provide appropriate plugs and pumping equipment to by-pass flow from existing sewer around section being worked upon.

3.8 SERVICE CONNECTIONS

- A. All service connections shall be made by means of wye or tee branch fittings. Shallow building connections shall have the sewer fitting set at 45 degrees providing a gradual slope entry to the sewer; deeper connections up to four feet rise may have the sewer fitting set vertically with a sanitary entry into the riser at the building connection point.
- B. The service pipe shall run on a grade of at least 1/4 inch per foot for 6-inch sewer, or as directed by the City. The pipe shall be connected to existing house sewer with 6"x 4" adapter, if necessary.
- C. Connections with vertical risers deeper than 4 feet shall have added support to the sewer fitting and riser by encasing the fitting and the riser in concrete to form a chimney. Concreting shall be done in one continuous operation. Precast units which provide equal support to the cast-in-place method may be used, when approved by the City. As an alternate to the cast-in-place and precast chimney, service connections up to 12 feet deep may have special construction using non-encased PVC or DIP risers that are guaranteed by the manufacturer to ensure that vertical pressures will not force pipe penetration or failure at the fitting by the use of bell on bell connections. The sewer fitting shall be encased in concrete for support and set at 45 degrees for the branch

joint.

- D. For existing sewers where fittings can not be installed, saddle connections shall be used.
- E. No flow shall be introduced into service connections until the main sewer has passed the leakage test specified in this section. Ends of service pipe shall be capped and marked with a stake.

3.9 INSTALLATION OF MANHOLES

- A. Before pouring a cast-in-place base, the downstream and upstream piping shall be set to proper grade so the pipe ends will be flush with the inside manhole. When placing the precast or pouring the concrete base, manhole bedding material shall be placed under the base and a minimum of three feet outside the base. Bedding material shall be a minimum of 6-inches deep. Precast bases shall be placed on a 6-inch layer of compacted bedding material that conforms to ASTM C33-03 No. 67 stone. The excavation shall be properly dewatered while placing bedding material and setting the base or pouring concrete.
- B. Pipes entering the precast manhole shall be set securely in the precast opening at the correct line and grade. Joints between manholes shall be sealed by an approved method.
- C. Prior to constructing the inverts and interior shelves the manhole shall be tested in accordance with section 3.11.
- D. Manholes shall have brick paved shelf and brick lined invert constructed to conform to the size of pipe and flow. At changes in direction, the inverts shall be laid out in the curves of the longest radius possible tangent to the center line of the sewer pipes. Shelves shall be constructed to the elevation of the highest pipe crown and slope to the drain toward the flowing through channel under layment of invert and shelf shall consist of brick masonry. Half pipe lining shall not be allowed. Shelves shall be pitched at a minimum of one inch per foot from the inside wall of the manhole to the flow channel.
- D. Following completion of the leakage test, the frame and cover shall be placed on top of the manhole or some other secure means to prevent the unauthorized entry by persons or animals until the Contractor is ready to make the final adjustment to grade. Covers shall be set 1/4 to 1/2 inch below finished pavement. Adjustments to grade shall not exceed 12-inches. Any adjustment shall be made with brick masonry or precast concrete rings.

3.10 SETTING FRAMES AND COVERS:

- A. Set frames with top conforming to finished ground or pavement surface as indicated above.
- B. Set circular frames concentric with top of masonry.
- C. Set frames in full bed of mortar to fill and make watertight the space between masonry top and bottom flange of frame.
- D. Place thick ring of mortar extending to outer edge of masonry, around bottom flange. Finish mortar smoothly and give a slight slope to shed water away from frame.
- E. Hinged covers shall be installed such that when in the open position, they rest between oncoming traffic and the manhole entrance.

3.11 FINAL TESTING OF MANHOLES

- A. All manholes shall meet the test requirements prior to the acceptance of the work.
- B. If the groundwater has been allowed to rise above the bottom of the manhole, it shall be lowered for the test procedure. All lifting holes shall be filled and pointed with approved non-shrink mortar. All pipes and other opening into the manhole shall be suitably plugged during the test procedure.
- C. Manholes shall be tested for leakage using a vacuum test. The manhole vacuum test shall conform to the following:
 - 1. Initial vacuum gage test pressure shall be 10" hg. Test hold time for 1" Hg, pressure drop to 9" Hg shall be:
 - a. At least 2 minutes for 10 ft deep manholes
 - b. At least 2 ½ min. for 10-15 ft deep manholes;
 - c. At least 3 min. for 15 ft deep manholes
 - 2. If the pressure drop exceeds the above limits the unit shall be repaired and retested.
- D. Following completion of the leakage test, the frame and cover shall be placed on the top of the manhole or some other means used to prevent accidental entry by unauthorized persons, children, or animals, until the contractor is ready to make final adjustment to grade.

3.12 FINAL TESTING OF SEWERS

- A. There shall be no more than 1,000 feet of untested pipe constructed at any time. Perform leakage tests and measurements:
 - 1. After completion of backfill.
 - 2. After return of groundwater to normal level.
 - a. Plug underdrains.
 - b. Stop other groundwater drainage.
- B. All new gravity sewers shall be tested for water tightness by the use of low-pressure air tests.
- C. Low-pressure air testing shall be in conformance with ASTM F1417-92(2005) “Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air”; or Uni-Bell PVC Pipe Association Uni-B-6, “Low-Pressure Air Testing of Installed Sewer Pipe” (1998).
- D. All new gravity sewers shall be cleaned and visually inspected and shall be true to line and grade following installation and prior to use.
- E. All leakage tests shall be completed and approved prior to placing of permanent resurfacing.
- F. Perform low pressure air tests on manhole-to-manhole sections of pipeline.
- G. A Low-pressure air test:
 - 1. Equipment:
 - a. Designed for testing sewers using low-pressure air.
 - b. Provide air regulator or safety valve so air pressure does not exceed 8 psig.
 - c. Air through single control panel.
 - 2. Procedure:
 - a. Perform tests from manhole-to-manhole after backfill.

- b. Place pneumatic plugs: (1) Sealing length: Equal or greater than pipe diameter (2) Capable of resisting internal test pressure without external bracing or blocking.
- c. Introduce low-pressure air into sealed line and achieve internal air pressure 4 psig greater than maximum pressure exerted by groundwater above pipe invert.
- d. Limit internal pressure in sealed line below 8 psig.
- e. Allow 2 minutes minimum for air pressure to stabilize. Disconnect low-pressure air hose from control panel.

3. Acceptable Test Result:

- a. Allow a time for pressure to drop from 3.5 to 2.5 psig. greater than maximum pressure exerted by ground water above pipe invert of no less than:

Pipe Diameter (inches)	Time, (minutes).
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5

- b. Allow a time for sewers with more than one size of pipe based on largest diameter reduced by 0.5 min.
- c. Locate and repair leaks, and retest as required.

D. All sections of installed pressure sewers shall be subjected to pressure test and leakage test. Tests shall not be made until at least 36 hours after the last joint to be tested has been made, and at least 3 6 hours after the last concrete thrust or reaction blocking has been cast with high early strength cement, at least seven days after the last concrete thrust or reaction blocking has been cast with standard cement. Force mains and low pressure sewers shall be tested in accordance with section 4 of AWWA C600-05 "Installation of Cast Iron Water Mains and Their Appurtenances", at a pressure equal to the greater of 150 percent of the design operating total dynamic head or at least 100 psi.

The Contractor shall provide suitable equipment to measure leakage during the test.

3.13 DEFLECTION TESTING

- A. All plastic sewer pipe shall be deflection tested not less than 30 days following installation. Pipe installed under this specification shall have a maximum deflection of five percent at the time of testing. Such deflection is defined as the amount of vertical deformation (nominal inside diameter less the minimum vertical diameter when measured) multiplied by one hundred and divided by the nominal diameter of the pipe.
- B. Deflection tests and test gauge diameter for plastic pipe, shall be 7 ½% of average inside diameter. The deflection gauge diameter for this test (G), shall be determined by the following formula: $G = .925 \text{ inches (nominal)}$ where D is the average inside diameter given in applicable ASTM standard. In the cases where inside diameters are not given, they shall be determined by the following formula:

$$D = D' - 2 (1.06 t) \text{ inches}$$

Where

t = maximum solid wall thickness

D' = the average outside diameter

Limits of installed deflection for other flexible pipe materials shall not exceed the above for PVC. Trench compaction shall be by rolling or mechanical tamping.

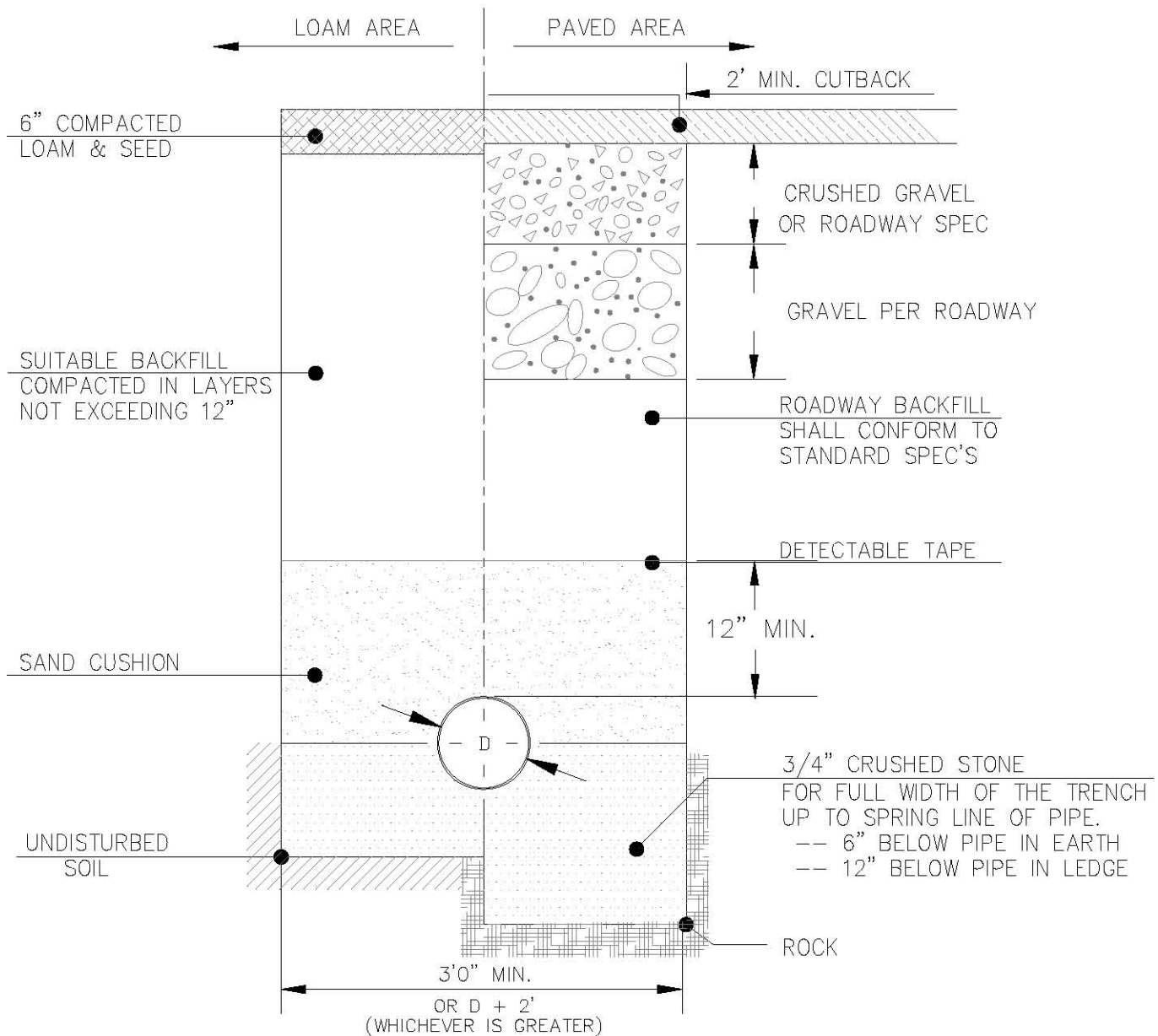
- 1. Upon completion of a sewer section, including the placement and compaction of backfill, and the cleaning of the sewer, the Contractor shall measure the amount of deflection in all of the sewer lines. This testing shall be done by the use of a deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. The method of deflection testing shall have the written approval of the Engineer.
- 2. All sewer lines with a deflection angle of greater than five percent shall be repaired by re-bedding or replacement of the pipe.

3.14 CLEANING

- A. At the conclusion of the work, the Contractor shall thoroughly clean the sewers by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipe lines shall be inspected for cleanliness and to be sure no sand bags, broken pipe, or other obstructions exist.

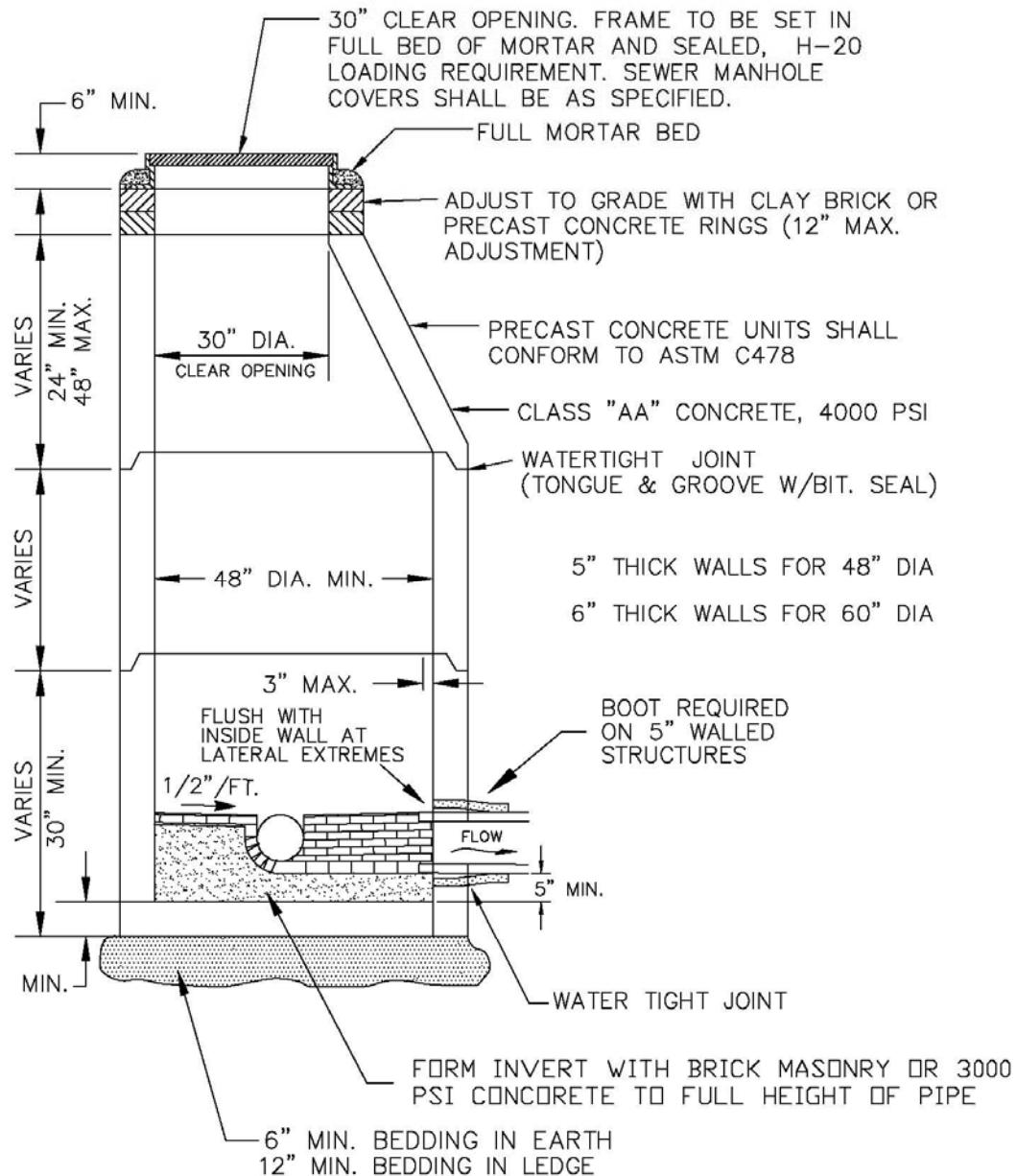
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Sewer Trench



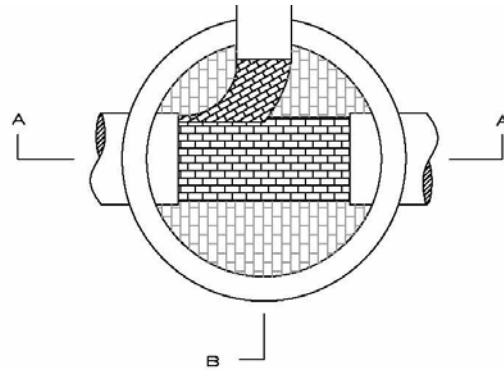
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Manhole Section

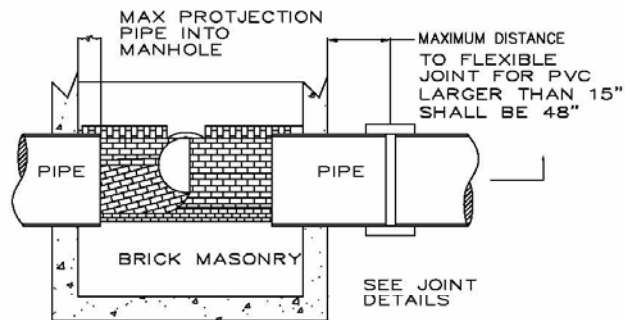


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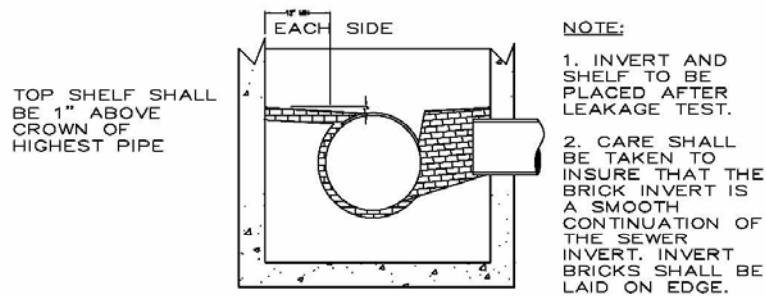
Manhole Detail



MANHOLE PLAN



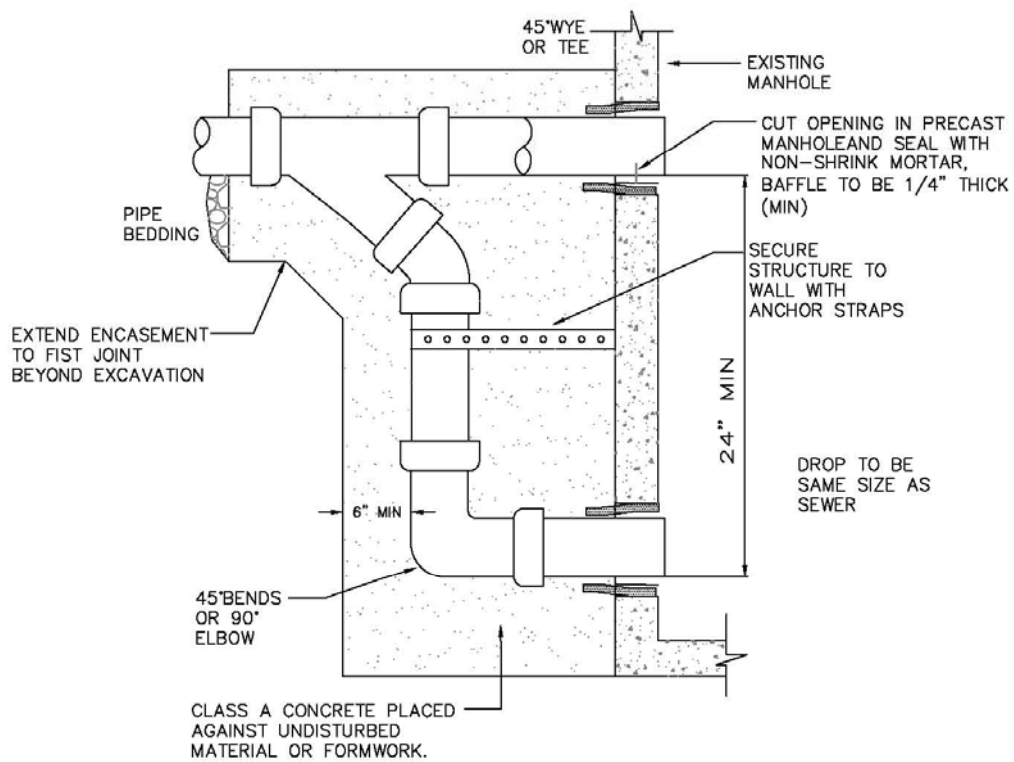
SECTION A-A



SECTION B-B

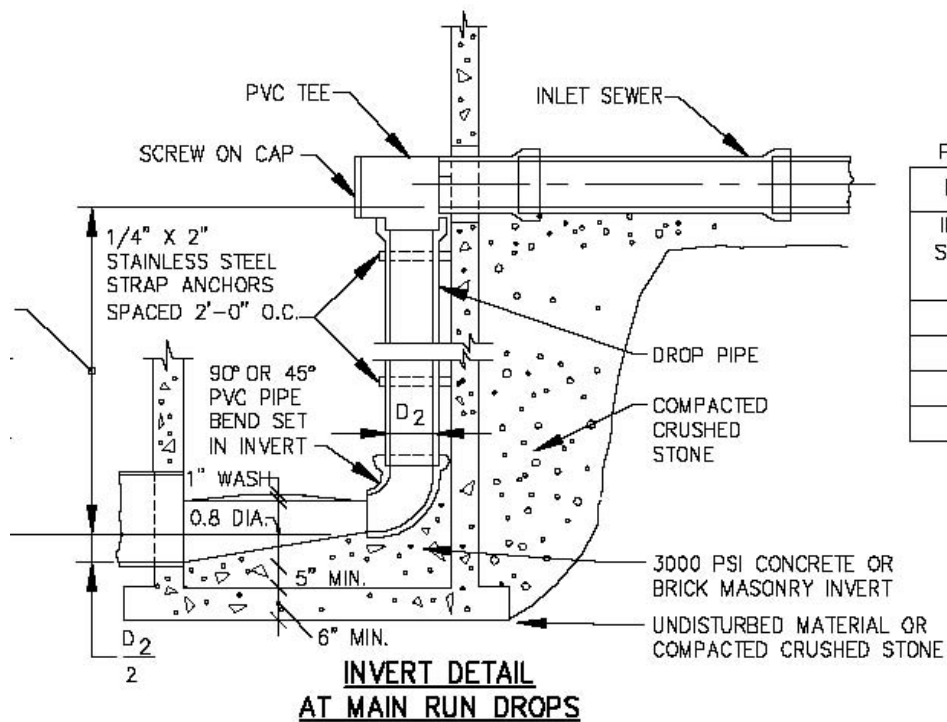
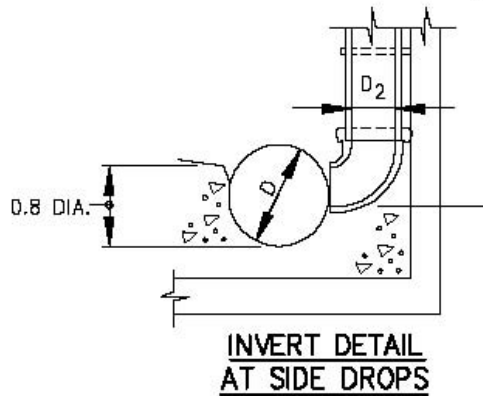
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Manhole Outside Drop Detail



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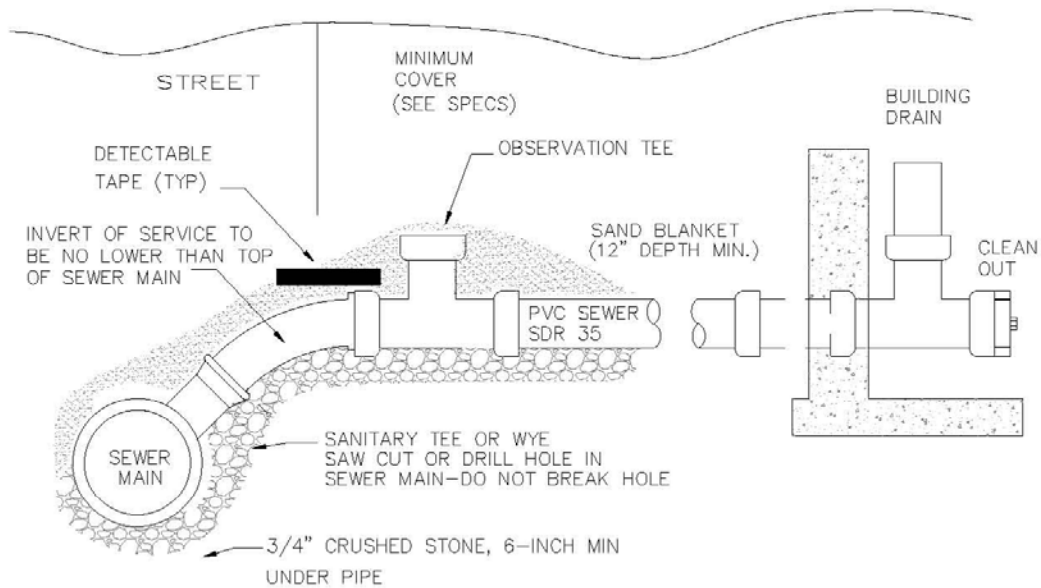
Inside Drop Manhole Detail



PIPE SIZE TABLE	
PIPE SIZES (IN)	
INLET SEWER D_1	DROP PIPE D_2
12	12
10	10
8	8
6	6

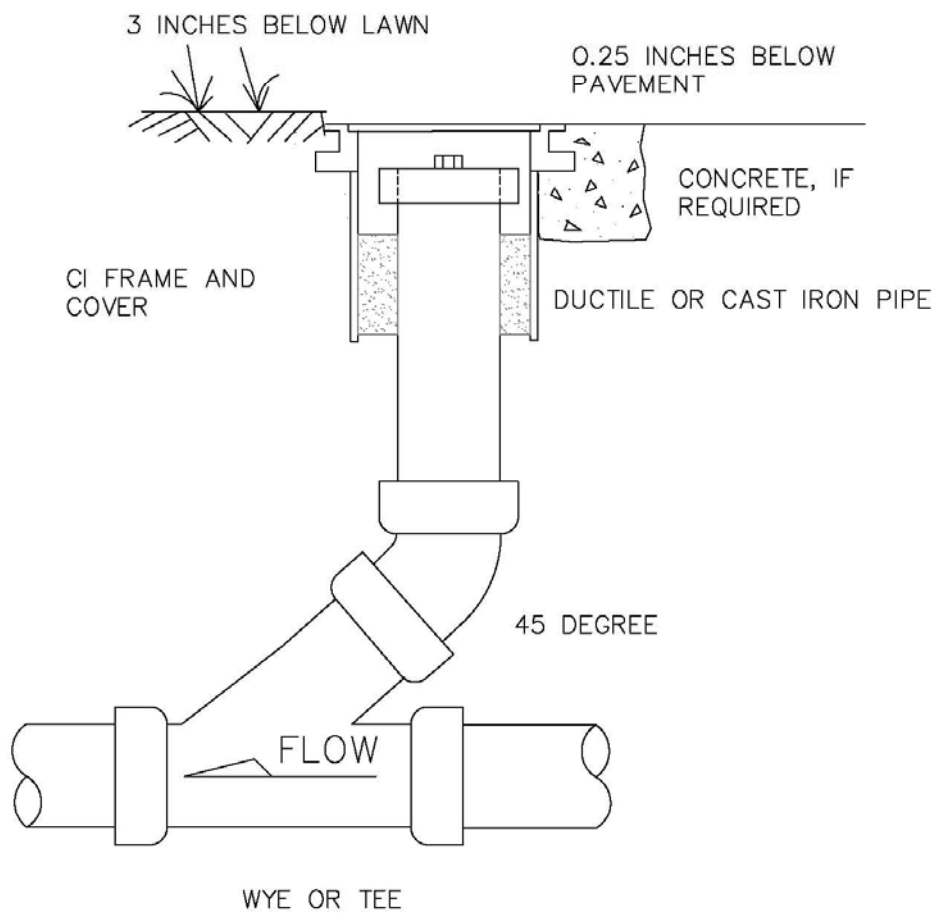
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Sewer Service



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Cleanout



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Cleanout Cover

