

Sanitary Sewer Systems

A. Description

This work shall consist of furnishing and installing, or removing and relaying, pipes, structures and appurtenances at the locations shown or ordered, including the necessary joints, fittings, and connections as required.

B. Materials

Certificates of Compliance shall be submitted by the Contractor for each material to the City of Concord's Representative for review and approval.

The materials shall be subject to rejection at any time due to failure to meet any of the specification requirements. All fittings shall be of compatible construction materials and shall be used exclusively for the intended purpose of the manufacturer. All fittings used for repairs must first be approved by the Engineering Services Division prior to installation. Only new materials will be accepted for installation.

THE COMMUNITY DEVELOPMENT DEPARTMENT, ENGINEERING SERVICES DIVISION, RESERVES THE RIGHT TO REQUIRE A SAMPLE FOR EVALUATION OF ANY ITEM SUPPLIED. ALTERNATE ITEMS MUST RECEIVE PRIOR APPROVAL OF THE CITY ENGINEER.

Storage and Handling of Materials

Preventing damage: All materials shall be handled in a manner to prevent warping, twisting, bending, breaking, chipping, rusting or any damage whatsoever. Pipe and structures shall be lifted and moved with the appropriate apparatus without being pushed, pulled or rolled by equipment.

Storage of cement: Cement shall be stored under cover, off the ground, and shall be kept completely dry at all times.

Storage of reinforcing steel: All reinforcing steel shall be stored off the ground, or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water to minimize rusting.

Precast concrete handling: Precast concrete units shall be handled in a manner to prevent chipping or cracking.

Handling and storage of masonry products: Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and spalling.

Damaged materials: All materials that have become so damaged as to be unfit for the intended use shall be promptly removed from the work site.

Sewer Mains

Polyvinyl Chloride (PVC) pipe:

Gravity pipe and fittings shall conform to ASTM D-3034 and shall be SDR 35. Pipe and pipe fittings between manholes are to be of the same manufacturer. Joint compression rings shall be of an oil resistant rubber type or flexible elastomeric seals conforming to ASTM D-3212. Manufacturer's certificate of compliance shall be furnished to the City prior to installation.

Pressure pipe and fittings shall conform to ASTM D2241 and shall be SDR 26 or approved equal.

Reinforced concrete pipe (RCP):

Pipe shall conform to the standard specifications for reinforced concrete sewer pipe, ASTM Designation C76; pipe shall be Class V.

The pipe interior shall comprise a continuous internal concrete skin and shall be smooth and even, free from roughness, projections, indentations, offsets, corrugations, exposed reinforcing or, other irregularities.

The pipe shall be clearly marked as required by ASTM C76, and shall not be shipped until 5 days after manufacture. Pipes that have been damaged during or after delivery will be rejected, and if such pipe has already been laid it shall be acceptably repaired (if permitted), or removed and replaced.

Ductile iron (DI) pipe:

Ductile iron pipe shall conform to ANSI/AWWA C150/A21.50 (pressure class pipe) with size as shown on the drawings. Pipe shall have either the rubber ring type, push on joint, or standard mechanical joint. Rubber gasket joints shall conform to ANSI A21.11 for mechanical and push on type joints. All pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside, and a coal tar enamel coat on the outside.

Should any pipe line be found unsatisfactory due to nonconformance to line or grade requirements or due to conflicts with other utilities and an adjustment in place will not correct the situation thus requiring the pipe to be physically removed; then the pipe may not be considered for reuse unless inspected and approved by the City of Concord's Representative.

Repair Couplings

Rigid wrap-around stainless steel and PVC repair couplings or ductile iron couplings will be allowed on mainline repairs. The use of Fernco (or approved equal) couplings may be used when field conditions do not allow for other types of couplings. The use of Fernco (or approved equal) couplings must be approved by the City of Concord's Representative.

Structures and Appurtenances

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 are to be sealed with Portland cement mortar flush to the outside structure wall prior to backfilling.

Reinforcing steel shall conform to the requirements of NHDOT 544. Fibers shall only be used in structures with 4 feet or less inside diameter and shall be as shown on the NHDOT Qualified Products List.

Concentric or eccentric cone sections with 30-inch openings are required, except where the cover over the top of the pipe is less than 4-feet for 48-inch diameter manholes, or 7-feet for 60-inch and 72-inch diameter manholes, in which case, precast concrete top slabs designed for H-20 loading may be allowed.

The use of water plug is permitted for special applications where the City Engineer deems appropriate.

Frames and Covers: North American and India castings are allowed, provided the India castings are from SIGMA Corporation or approved equal. All castings shall be designed for H-20 Loading.

Sewer Service Laterals

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.

Masonry

Brick: Brick shall be solid, sound, hard, and have plain or smooth surfaces on both ends and on the face side, and be satisfactory to the City Engineer. Brick shall comply with A.S.T.M. Standard Specifications for Sewer Brick, Designation C32, for Grade SS, Hard Red Brick. Brick samples will be required for approval prior to incorporation in the work.

Cement: Cement shall be straight Portland Cement, Type I, II, or a Type I/II. Lime mortar or Masonry cement is not to be used on structures.

Mortar Sand: Mortar sand shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>% Passing</u>
No. 8	100
No. 16	60-100
No. 50	15-35
No. 100	2-15
No. 200	0-5

Sand Bedding / Blanket

Sand bedding and blanket material required for the installation of the sewer mains, services and appurtenances shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>% Passing</u>
1/2 Inch	100
No. 200*	0-12

*Fraction passing the #4 sieve

Crushed Stone Bedding

Crushed stone shall be ¾ inch (ASTM #67) stone and meet the following gradation requirements:

<u>Sieve Size</u>	<u>% Passing</u>
1"	100
¾"	90-100
⅜"	20-55
#4	0-10
#8	0-5

C. Construction Requirements

The Community Development Department in conjunction with the General Services Department will oversee all work related to these utilities. Unauthorized use of hydrants is strictly prohibited. Should a contractor desire to use City water for dust control, sewer testing and flushing operations, etc. the City will furnish a temporary meter. A deposit is required and the contractor will be charged for the water used. **Only qualified City of Concord personnel are authorized to manipulate hydrants.** Unauthorized usage of City water is subject to a minimum \$1,000.00 fine.

Work under the control of the General Services Department

The contractor may make the tap onto a sewer main and install service laterals to the property line, or request the General Services Department's utility forces to install services should they be available. In the former, the contractor will be required to deposit the funds estimated to cover the cost of the City's Inspector assigned to the project. In the latter case, the applicant will be required to deposit separate funds estimated to cover the cost of the General Services Department's utility forces (not to be confused with the Engineering Services Division inspection fees).

Laying Sewer Pipe

1. Sewer manholes are required at every change in vertical grade or horizontal pipe alignment along a main. Cleanouts are required along sewer services as noted below.
2. Should construction operations reveal or expose a water main running under, approximately parallel to (less than 10-feet from a proposed sewer installation), and where it is not practical to relocate the sewer, the sewer shall be reconstructed of ductile iron pressure class pipe until the minimum 10-foot separation can be achieved.

Whenever sewers must cross over water mains, the sewer shall be constructed of ductile iron pressure class pipe for a minimum distance of 9 feet each side of the crossing. Joints shall be water pressure rated with zero leakage when tested at 25 pounds per square inch for gravity sewers and 1½ times working pressure for force mains, and joints shall not be located within 9 feet of the crossing point.

Should the vertical separation of the sewer and water main be less than 18", the water main or the sewer main must be relocated to achieve the required separation.

In conflicts requiring the relocation of utilities, preference shall be given:

- a. to utilities with grade restrictions.
- b. to existing utilities already in service.

3. Sewer service lateral sizing shall be as follows:
 - a. Single residential unit = 4-inch minimum.
 - b. Commercial, Industrial or multifamily = 6-inch minimum.
4. Sewer service laterals shall be constructed with the following minimum slopes, yet not to exceed a 10% slope:
 - a. 4 inch service = 1/4 inch per foot = 2%
 - b. 6 inch service = 1/8 inch per foot = 1%
5. All pipe utilizing Bell and Spigot joints shall be laid with the spigot end downstream. Bells will not be permitted in structures.
6. Green detectable "sewer" tape shall be installed in the sewer trench on top of the 12-inch sand blanket on all sanitary sewer mains and services.
7. Whenever feasible, all service connections shall be tied into a sanitary sewer manhole, if this is not possible then sanitary sewer service connections shall be accomplished by using an approved sanitary tee fitting, as described in the City of Concord's Building and Plumbing Code Regulations, at the sanitary sewer main in the City street. The connection shall be made in accordance with the City of Concord's Building and Plumbing Code Regulations, and the International Plumbing Code.
8. Service laterals shall outlet into manholes at the top of the brick shelf. Where grades prohibit such a connection, service laterals shall connect to the manhole 2" above the inlet of the main where it enters the manhole. Refer to the City of Concord's Construction Details for additional information.
9. Should an existing sanitary sewer service lateral need to be replaced, it shall conform to the standards described here within.
10. Service laterals greater than six (6) inches in diameter must terminate in a sanitary sewer manhole structure.
11. Ninety degree (90°) bends are **not** permitted for sanitary sewer service connections.
12. 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.
13. Sewer service laterals shall be designed for a minimum of four (4) feet of cover at the building foundation. Insulation will be required should the sanitary sewer lateral be less than the required four feet deep. Under no circumstances will the use of insulation be permitted without the authorization of the City of Concord's Representative.
14. No trench shall be left open at the end of the workday. Contractor shall take all the necessary precautions to "button-up" the work zone for the general public during the night. Precautions include but not limited to, placing steel plates over the trench, barricades, lighting, signs, etc. Contractor shall contact the City of Concord's Representative before leaving the site at the end of the day, to ensure that work zone has been adequately closed up for the safety of the public.

15. Prior to directional boring/drilling and or jacking, all utilities (communication, electric, gas, sewer, water, storm drain, etc.) in close proximity, shall be exposed to verify location. A fully detailed plan showing the proposed construction activity shall be submitted to the City Engineer for review at least two (2) weeks prior to the commencement of the construction activity. The proposed sleeve shall consist of either steel or HDPE with a traceable wire placed over the utility.
16. **Driveways should be avoided when determining the path of the service lateral.**

Installing Sewer Manholes, Frames and Grates

1. Should more than 4 service laterals be proposed for one manhole, then a 60-inch minimum inside diameter structure will be required.
2. 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 or outside drop service connection details must be submitted to the Engineering Services Division for approval prior to construction. Larger structures are preferred over outside drop structures for new construction.
3. Inside drop house service connections are preferred over outside drop service connections.
4. The use of sanitary sewer “doghouses” are not permitted unless approval has been granted by the City Engineer.
5. All cast iron manhole frames and covers are to be set no less than 1/8-inch lower or no more than 1/4 inch lower than finish pavement.
6. All brickwork used to adjust manholes and catch basins to grade shall be laid in a header course pattern - (end showing) as opposed to a batter course – (edge showing).

Cleanouts

Cleanouts 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 cleanout is required prior to any horizontal and/or vertical directional change greater than 45°. If a service changes direction more than once, a cleanout will be required 5’ from the right-of-way for every two elbows regardless of the angle of change. (i.e. 1-22.5° & 1-45° requires one cleanout.).
2. Cleanouts will be constructed using wyes (either 4x4x4 or 6x6x6 inch) and incorporating a 45° elbow to bring the stack vertical.
3. A cast iron cleanout box with cover marked “sewer” is required over 4” & 6” sewer service cleanouts.
4. Cleanouts 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 cleanout.
6. Cleanouts shall be located outside of the City of Concord's R.O.W.
7. Cleanouts shall be located one per 100' with no greater than 100-foot separation unless otherwise directed by the BOCA Plumbing Code.
8. Cleanouts shall be the same diameter as the carrying pipe, except for cleanouts on service laterals greater than six (6) inches, where a six (6) inch cleanout is acceptable.
9. Cleanouts shall be installed just upstream of bends (manufactured fittings). Only one cleanout is necessary when two 45° bends are used to make up a 90° turn. A minimum of 2-feet of exposed pipe is required between bends.
10. A cleanout is required should a service lateral diameter be reduced between the building and the sewer main.

Excavation

Excavation shall be accomplished by methods that preserve the undisturbed state of the subgrade soils. A trench may be excavated by machinery to the designated subgrade, provided that the bottom of the trench remains in the undisturbed state and provides the proper foundation for the pipe bedding. Equipment may have to be modified by welding a blade to the bucket teeth to achieve the required shape to fit the lower 1/3 of the pipe exterior for pipe 36" in diameter and larger.

Crushed Stone Bedding

Contractor shall place ¾" crushed stone: for bedding, to the haunch of the pipe and a minimum 6" beneath the pipe throughout the bottom of the excavated trench. PVC sanitary sewers and laterals shall be installed in accordance with ASTM D2321-89.

Mortar

Mortar shall consist of two parts mortar sand to one part Portland Cement. To obtain the proper ratio, one bag of Type I or Type II Portland Cement should be mixed with two-five gallon buckets of mortar sand. The mix shall be thoroughly blended only in such quantity as may be required for immediate use, and shall be used before the initial set has taken place. The mix shall be constantly worked over with hoe or shovel to keep it workable. Adding water after mixing to bring a hardened mix "back to life" will not be allowed.

Brick Masonry

Brick masonry shall be protected from too rapid drying by approved means and shall be protected from weather and frost, as required. Bricks shall be laid in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling. Joints between bricks shall not exceed 3/8 inch and shall be tooled flush to the brick surface.

Brick masonry during winter conditions must be protected from freezing. A suitable heated shelter will be required to assure all materials remain above freezing for 3 days.

All brickwork used to adjust manhole and catch basin frames to grade shall be sealed on the outside of the structure with mortar.

Inverts: Manhole inverts shall be constructed to provide an uninterrupted flow channel and shall correspond in shape to the lower half of the pipe. Brick shall be laid on edge.

Mortar joints shall be tooled flush to the face of the brick to prevent minor depressions. Shelves shall be constructed to the midpoint of the pipe size ranging from 8-inches to 15-inches and to the highest pipe crown on larger pipe diameters. The brick shelf shall be pitched to drain toward the through channel with one inch of difference from the structure wall to the channel edge. Puddles or undue turbulence through the manhole trough will necessitate reconstruction.

The use of fiberglass inverts may be allowed per the authorization of the City Engineer. The contractor shall submit the manufacturer's shop drawings and other pertinent information as needed to the City Engineer for review and approval.

Only solid masonry construction will be accepted under the brick shelf.

Adjusting Frames To Grade: Frames shall be centered over the manhole opening and are to be set no less than 1/8-inch lower or no more than 1/4 inch lower than finish pavement. A minimum of 2 courses of brick are required under the structure frame, yet the adjusting course shall not exceed approximately one foot of brick - (normally 5 course maximum). The final course of brick may be laid on edge. Brick and mortar is the only masonry material to be used between the precast structure and the cast iron frame. The use of barrel blocks and concrete grade rings is not permitted.

Masonry Repairs: All work on existing facilities shall be performed by or under the direction of City forces. Only sound masonry materials shall be incorporated into the work, and any necessary repairs must first be approved by the City of Concord's Representative, and observed prior to backfilling.

Discontinued Services: A contractor installing a new or larger sewer service shall be responsible for properly discontinuing the abandoned service connections. The contractor shall not disconnect any service connections without the proper authorization from Engineering Services.

Discontinued service connections are normally retired at the right-of-way. The service shall be cut and plugged with brick and mortar. If the service is connected to a manhole, the pipe should also be plugged with brick and mortar where it enters the manhole.

D. Inspection Requirements

The Engineering Services Division's representative shall perform full time inspections to assure that all sanitary sewer work conforms to City standards.

Visual Inspections

Visual inspections are normally required to confirm the hydraulic integrity of sanitary sewer systems. Pipelines are required to be true to alignment and at a uniform slope between structures. "Ponding" or deviations in alignment will be cause for rejection. The Engineering Services Division shall determine if the ponding or deviations in alignment are cause for rejection during the review of the sanitary sewer video prepared by the General Services Division.

Video Inspection

1. All pipelines will be subject to the scrutiny of a video inspection prior to acceptance to assure proper jointing and flow characteristics. **All video inspections shall be performed by the City of Concord General Services Division.**
2. Camera inspections will not be scheduled until construction of other utilities in the same area are completed and the pipeline under consideration has been backfilled and compacted to subgrade elevation for at least thirty days prior to the scheduled inspection. The Contractor shall contact General Services to schedule the inspection.
3. All structures are to be accessible to the video inspection vehicle and all pipelines shall be cleaned of all debris prior to the inspection. The presence of debris or insufficient flushing water will necessitate re-inspection following correction.
4. Video camera inspections will be performed after flushing the sanitary sewer main or lateral with water containing a visible dye and allowed to drain. Excessive ponding or alignment deviation deemed by the City of Concord's representative is cause for rejection.
5. Only tractor-type units will be utilized for mainline inspections, push cameras will only be allowed for lateral inspections.
6. The camera shall have pan and tilt capabilities.
7. The camera shall be approved by the manufacturer for the pipe size being inspected (typical camera is rated for 8"-24", without additional accessories).
8. Optional: The camera should be equipped with an inclinometer (these only show the general trend of the pipe slope, not to be viewed alone as acceptance criteria).
9. The camera footage shall be shown on-screen.
10. The unit should be able to provide accurate footage, (1'±) and all measurements shall be taken from the center of manhole structures.
11. The beginning of the inspection shall consist of a title screen that indicates the following information; date, time, location, company doing the inspection, contractor that laid the pipe, type of structure, pipe size and material, and if manhole numbers or line segments are not specifically labeled on the approved plans; than station numbers compete with right or left offsets shall be used to identify line segments.
12. When a lateral line is encountered during the inspection; the camera operator shall stop the camera unit and, using the pan and tilt function, inspect the lateral opening to the best of the camera's ability (dye should be introduced into the lateral, if feasible, to view flow characteristics).
13. When a questionable pipe joint is encountered during the inspection; the camera operator shall stop the camera unit and using the pan and tilt function, inspect the joint to the best of the camera's ability. (Operator should also traverse the joint with the

camera unit to observe the amount of drop/rise the camera experiences over questionable joints).

14. When a sag is encountered during the inspection; the camera operator shall record the beginning and end of said sag, if of questionable depth, then the operator shall drag a ½" tall non-buoyant object through the sag with the camera unit to observe and record actual depth.
15. All defects observed shall be logged into some sort of data management software (PACP or WRC compliant) and compiled into a video report to be submitted with the video inspection.
16. All video inspection submittals shall be DVD format, no VHS will be accepted.
17. Any submittal not meeting these requirements will be rejected.
18. **All costs associated with the video inspection shall be the responsibility of the contractor. Contact the General Service Division for the current fee schedule.**

E. Testing Requirements

Sewer Main Low Pressure Air Testing

Low pressure air testing has proven to be an efficient means of testing sewer lines for leaks. This test may be performed by an independent testing agency after notice to the City Engineer or their designee. Should the contractor conduct their own test, an Engineering Services inspector must be present to witness the results.

Test Requirements: The sanitary sewer main between structures, including laterals and all connections, regardless of length, must hold a positive pressure of 4 PSI over a period of 5 minutes with a maximum pressure loss of 1 psi.

Testing of minor sewer service repairs may be accomplished by visual inspection where "air" and "hydraulic" methods would be impractical.

Deflection Testing

Deflection tests are required for all flexible pipe (ductile iron and concrete pipe are not considered flexible). Deflection tests will be conducted a minimum of 30 days after installation of pipe and after the road has been constructed to subgrade and is ready for select materials. Deflection tests shall be performed on the entire length of the sewer main line on a manhole-to-manhole basis. The go, no-go mandrel test method shall be used and not performed before all utilities have been installed. Maximum deflection shall not exceed 5% of the pipe's internal diameter.

Sewer Force Main High Pressure Air Testing

All sanitary sewer force mains shall be tested for air and water tightness. As with low-pressure air testing, sanitary force main pressure testing may be performed by an independent testing agency. All test results shall be submitted by the independent testing agency to The City of Concord's Representative for review.

Test requirements: The sanitary sewer main between structures, including laterals and all connections, regardless of length, must hold a positive pressure. Pressure for testing force mains should be a minimum of 100 PSI or higher as calculated according to the following formula: $HEAD \times 1.5$ (safety factor) / 2.31 ft/lb = pressure. The static pressure must hold for one hour to be acceptable.

Sewer Service Testing

Test requirements

The service lateral shall be tested at the point of connection with the public sewer to a point within the foundation as provided by the plumber. A water test under a head of 10 feet for 15 minutes or an air test of 4 psi for 5 minutes will be accepted.

Sewer Manhole Testing

Vacuum Test

The vacuum test method is the preferred method to insure manhole integrity; however, water exfiltration testing is an acceptable alternative.

All sanitary sewer manholes will be vacuum tested prior to backfilling around the structure. If the structure is struck by equipment during backfilling operations, the contractor shall be responsible for re-testing of the manhole. The initial test pressure is to be negative 10-inches of mercury. Maximum allowable test time for a 1-inch loss in pressure from negative 10-inches of mercury to negative 9-inches of mercury is 120 seconds for a structure up to ten (10) feet deep (as measured from the floor of the structure to the top of the precast unit). For structures measuring over 10 feet and up to 15 feet deep 150 seconds are allowed. Structures over 15 feet and up to 20 feet deep require up to 180 seconds for acceptance. Structures over 20 feet and up to 25 feet deep require 210 seconds without a 1-inch total loss of vacuum.

Water Exfiltration Test

Water exfiltration test procedures for 4'-0" or 5'-0" diameter manhole structures are as follows:

The manhole pipelines shall be plugged and the structure filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage on the outside of the structure, the manhole structure shall be considered satisfactorily watertight. If the test as described above is unsatisfactory, as determined by the City of Concord's Representative, or if the manhole structure has been backfilled, the test shall continue.

A period of time shall be required for absorption. After absorption, the manhole shall be refilled to the top of the cone section and a measuring time of 8 hours begun. At the end of the test time, the manhole shall be refilled to the top of the cone section, being careful to measure the volume of water added. This amount shall be converted to the 24 hour rate per vertical foot of depth.

The rate is not to exceed 1 gallon per vertical foot for a 24 hour period. If the test fails this requirement, repairs by approved methods or total reconstruction of the manhole structure may be ordered by the inspector to bring the leakage within the allowable limits.

8-hour exfiltration test for 4'-0" diameter or 5'-0" diameter manholes

STRUCTURE HEIGHT	GALLONS ALLOWABLE LEAKAGE	MAXIMUM WATER DROP ALLOWED IN 30 INCH OPENING	
		FEET	INCHES
4'	1.3	0.0354	3/8
5'	1.7	0.0463	1/2
6'	2.0	0.0545	5/8
7'	2.3	0.0626	3/4
8'	2.7	0.0735	7/8
9'	3.0	0.0817	1
10'	3.3	0.0899	1-1/8
11'	3.7	0.1008	1-1/4
12'	4.0	0.1089	1-3/8
13'	4.3	0.1171	1-1/2
14'	4.7	0.1280	1-5/8
15'	5.0	0.1362	1-3/4
16'	5.3	0.1444	1-3/4
17'	5.7	0.1553	1-7/8
18'	6.0	0.1634	2
19'	6.3	0.1716	2-1/8
20'	6.7	0.1825	2-1/4