
HOOKSETT SEWER COMMISSION

DESIGN AND CONSTRUCTION STANDARDS

FOR

SEWER WORKS

MAY 1989

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PART I – GENERAL	3
1.01 INTRODUCTION:	3
1.02 DEFINITIONS:	3
1.03 AUTHORITY & DUTIES OF SUPERINTENDENT/ENGINEER:	3
PART II – PROJECT PHASES	4
2.01 GENERAL:	4
2.02 SEWER FEASIBILITY:	4
2.03 PROJECT DESIGN:	4
2.04 DESIGN APPROVAL:	5
2.05 CONSTRUCTION:	6
2.06 PROJECT CLOSE-OUT:	8
PART III – DESIGN STANDARDS	10
3.01 GRAVITY SEWER:	10
3.02 SEWER FORCE MAIN:	15
3.03 SEWER SERVICE:	17
3.04 SEWAGE PUMP STATION:	18
3.05 DESIGN DRAWINGS:	29
PART IV – MATERIALS, CONSTRUCTION METHODS AND TESTING	31
4.01 GRAVITY SEWER:	31
4.02 SEWER FORCE MAIN:	43
4.03 SEWER SERVICE:	50
4.04 SEWAGE PUMP STATION:	53

PART I – GENERAL

1.01 INTRODUCTION:

- A.** Purpose: These specifications have been developed to ensure uniform construction standards for sewer works (sanitary sewers, force mains, and pump stations). All Hooksett Sewer Commission technical standards supplement Chapter 700 of the New Hampshire Code of Administrative Rules. In either case, the most stringent standard(s) shall dictate.
- B.** Governing Body: The Hooksett Sewer Commission is the governing body that enforces these regulations and may act in person or through its "Superintendent" or designated agent ("Engineer").
- C.** Revision of Standards: These standards are subject to change without notice. The Owner/Developer/Contractor is responsible for obtaining and being in compliance with the most current standards. All construction shall be in compliance with those standards currently in effect at the time of design approval.

1.02 DEFINITIONS:

- A.** Owner/Developer/Contractor: Any entity proposing or responsible for any construction relating to, or impacting sewer works in Hooksett. Such definition includes all contractors for, employees of, and agents or representatives for said entity.
- B.** Superintendent/Engineer: The Hooksett Sewer Department Superintendent or other Hooksett Sewer Department employee under the direction of the Hooksett Sewer Commission or a designated agent of the Hooksett Sewer Commission ("Engineer").
- C.** Consulting Services: Shall be any service requested by the Hooksett Sewer Commission of the "Engineer" in an effort to ensure uniform construction of sewer works according to these standards and State standards.

1.03 AUTHORITY & DUTIES OF SUPERINTENDENT/ENGINEER:

- A.** Superintendent/Engineer shall be authorized to review all design and technical specifications for conformance with the Hooksett Sewer Commission's sewer design standards. The Superintendent/Engineer shall have the authority to reject or request revisions to any design that does not meet the sewer design standards.
- B.** Superintendent/Engineer shall be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work, and to the preparation or manufacture of the materials to be used. In case of any dispute arising between the Owner/Developer/Contractor and Engineer as to the materials furnished or the manner of performing the work, the Superintendent shall have the authority to reject materials and/or workmanship or suspend the work until the question at issue can be referred to and decided by the Hooksett Sewer Commission.

PART II – PROJECT PHASES

2.01 GENERAL:

- A.** This section serves to identify the general sequence of activities required during the planning and construction phases of any sewer-related project including gravity sewer, sewer force main or sanitary pump station construction. Its purpose is to inform prospective Owners/Developer/Contractors of the steps required to see their project to completion. In short, the Owner/Developer/Contractor shall adhere to the following sequence of activities:
 - 1. Sewer Feasibility
 - 2. Project Design
 - 3. Design Approval
 - 4. Construction
 - 5. Project Close-Out
- B.** The requirements for each activity are described in further detail in the following sections.

2.02 SEWER FEASIBILITY:

A. GENERAL:

- 1. First and foremost, the Owner/Developer/Contractor shall meet with the Hooksett Sewer Commission for determination of sewer construction feasibility. The Hooksett Sewer Commission will determine if the proposed location and configuration fits within the Commission's long-term plans and sewer service zones. In the event that the proposed sewer works abut or could jointly serve a zone designated for future growth, the Commission may require the project be designed and constructed for present and future community needs. Sewer works locations, configurations or capacities may require adjustment to accommodate these future community requirements.
- 2. The Hooksett Sewer Commission will provide the Owner/Developer/Contractor with a preliminary estimate of the "System Development Charge", as well as other potential costs, including peer review fees and construction inspection fees. For more information regarding the "System Development Charge", refer to the Hooksett Sewer Ordinance.

2.03 PROJECT DESIGN:

A. GENERAL:

- 1. Once the project is determined to be feasible, the Owner/Developer/Contractor may move forward with the design phase. The design drawings and technical specifications must be prepared by, or under the direct supervision of, a New

Hampshire-licensed professional engineer. The project shall be designed in accordance with the requirements set forth in this document.

2.04 DESIGN APPROVAL:

A. GENERAL:

1. The Owner/Developer/Contractor's next step shall be to submit the design for approval. This typically requires an escrow fund account be established for design peer review by the Engineer.

B. ESCROW FUNDS:

1. The Owner/Developer/Contractor must establish an escrow account with the Hooksett Sewer Commission for expenses associated with the Engineer's peer review services. The amount of funds for the escrow account shall be determined by the Hooksett Sewer Commission, but this in no way is an estimate of the cost of said review services. Upon request, the Owner/Developer/Contractor shall be sent copies of invoices deducted from the escrow account for review services. The escrow account must be maintained with sufficient funds to cover the cost of review services. Should the escrow account become depleted, all review services shall be halted until such time as the funds have been replenished.

C. PEER REVIEW:

1. The Owner/Developer/Contractor shall submit to the Sewer Department for review and approval, design drawings, calculations and technical specifications for any proposed gravity sewers, sewer force mains or sewage pumping station(s).
2. Submittal requirements for **gravity sewer and force main projects** are as follows:
 - a. Design flow calculations.
 - b. Nature of flow.
 - c. Complete system specifications.
 - d. Design drawings, which shall include all information specified in Section 3.05.
3. Submittal requirements for **sewage pumping station(s)** are as follows:
 - a. Pump flow calculations including peak wastewater flows.
 - b. Pump curves with duty points labeled.
 - c. Wet well detention calculations.
 - d. Anti-flotation calculations.
 - e. Force main velocity calculations.

- f. Complete system specifications.
 - g. Design drawings, which shall include all information specified in Section 3.05.
4. The Engineer will issue peer review letter(s) identifying items or issues that must be addressed or revised. The Owner/Developer/Contractor must then make the required revisions and resubmit for the Engineer's peer review. This process shall continue until such time as all the issues have been resolved and the Engineer issues a letter stating such.
 5. Following design approval by the Engineer and Hooksett Sewer Commission, the Owner/Developer/Contractor must submit six (6) sets of drawings and specifications, plus all additional sets required for the Owner/Developer/Contractor's use, to the Hooksett Sewer Commission for endorsement. Any minor change in the plans needs the approval of the Superintendent/Engineer. Any major change in the plans needs the approval of the Superintendent/Engineer, followed by the approval of the Hooksett Sewer Commission.
 6. An electronic version of the approved drawings shall be submitted to the Superintendent/Engineer in the most recent version of AutoCAD.
 7. The Hooksett Sewer Commission requires that all Contractors work only from plans with original Hooksett Sewer Commission signatures. The applicant is advised to submit plans for construction use, in addition to the six (6) sets required above.
 8. If the project requires a NHDES Discharge Permit, the Owner/Developer/Contractor must submit a completed Discharge Permit Request for signature by the Hooksett Sewer Commission. The Owner/Developer/Contractor is then responsible for submitting the signed Discharge Permit Request and any associated fees to NHDES. The Owner/Developer/Contractor shall inform the Hooksett Sewer Commission upon approval of the permit by NHDES.

2.05 CONSTRUCTION:

A. GENERAL:

1. The construction phase of the project can not commence until all approvals have been received. The Owner/Developer/Contractor should be aware of the various activities that comprise the construction phase. Prior to actual construction, escrow funds must be established and bonds posted. The Owner/Developer/Contractor must also hire a Contractor for the work, attend a pre-construction meeting, and schedule inspections throughout the course of construction.

B. ESCROW FUNDS:

1. The Owner/Developer/Contractor shall establish an escrow account with the Sewer Department to cover the cost of construction inspection, testing services, and as-built drawings. The Sewer Department will notify the Owner/Developer/

Contractor of the estimated cost of these services. Should the escrow account become depleted, no further inspections, sign-offs or approvals will be granted until the additional funds requested are deposited into the escrow account. Work performed without the required inspections will not be accepted by the Hooksett Sewer Commission.

C. BONDS:

1. Prior to commencing construction, a bond made payable to the Town of Hooksett will be required. The amount applicable to the sewer portion of the project shall be determined by the Hooksett Sewer Commission. For additional information regarding bond requirements, refer to the Hooksett Sewer Ordinances.

D. SEWER CONTRACTOR:

1. The Hooksett Sewer Commission reserves the right to reject a Contractor, either prior to construction or during construction, should it become obvious to the Superintendent/Engineer that the Contractor is not capable of performing the work.

E. PRE-CONSTRUCTION MEETING:

1. For large projects involving multiple town departments, the Town Engineer (or Highway Manager, in absence of a Town Engineer) will schedule a pre-construction meeting with all involved parties. For smaller projects dealing only with the Sewer Department, the meeting may be arranged directly with the Superintendent. At this meeting, the Owner/Developer/Contractor will be required to submit a complete project schedule identifying all inspections for all departments (see inspection checklists for each department).

F. INSPECTIONS:

1. The Owner/Developer/Contractor shall not install or bury any pipes, manholes or other appurtenances except in the presence of the Superintendent/Engineer. The Superintendent/Engineer must also be present to observe any sewer testing. The Owner/Developer/Contractor must give proper notice to the Superintendent/Engineer as to the time and place for construction or testing. The lead time for scheduling inspections are as follows:
 - a. 24 hours prior to any house service construction.
 - b. 48 hours prior to any sewer construction other than house service construction.
 - c. 24 hours prior to any sewer testing.
 - d. The above stated lead times do not include holidays and weekends.
2. Inspectors from the Sewer Department are available between 8:00 am and 3:30 pm, Monday through Friday. No inspections will be made on weekends or holidays. Hours for inspections performed by the Engineer can often be adjusted to accommodate the Owner/Developer/Contractor's hours of operation.

3. Cancellation of a scheduled inspection must be made by 12:00 pm (noon) the day prior to the requested inspection day. In cases where the required notification time is not provided, a minimum charge of three (3) hours will be assessed to the Owner/Developer/Contractor.
4. Full-time inspection is required when trenching, installing pipe, backfilling or testing sanitary sewers or force mains. Work performed in the absence of the Superintendent/Engineer will not be accepted. Any work done contrary to the direction of the Superintendent/Engineer will also not be accepted. The Contractor shall remove and replace such work to the satisfaction of the Superintendent/Engineer when directed. Work satisfactorily replaced will then be accepted. All costs associated with field representation services shall be borne by the Owner/Developer/Contractor.

2.06 PROJECT CLOSE-OUT:

A. GENERAL:

1. The last phase of the project is the project close-out. It entails final flushing of the sewer, submittal of as-built plans and, oftentimes, transfer of ownership to the Town of Hooksett. In addition, any excess escrow funds will be returned to the Owner/Developer/Contractor.

B. FINAL FLUSHING:

1. Prior to acceptance of pipe, manholes and inverts, the Contractor shall fully flush all lines from the topmost manhole(s) through the entire system to the bottom manhole(s). All pipes shall be inspected for cleanliness prior to acceptance. The downstream manhole shall be plugged and flushing water pumped out. Flushed water shall not be discharged to sewer system. All flushing shall be performed in the witness of the Superintendent/Engineer.
2. Alternatively, the Contractor may use a vacor truck to flush the line from manhole to manhole. This shall also be performed in the witness of the Superintendent/Engineer.

C. FINAL INSPECTION:

1. A final inspection shall be conducted by the Superintendent/Engineer prior to acceptance of the pipe. At this time, each manhole will be inspected for overall integrity and cleanliness, proper installation of the frame and cover, and proper construction of the brick invert and shelf. A final mirror test will also be conducted for each sewer run to check for excess deflection, horizontal alignment, and vertical alignment.

D. AS-BUILT PLANS:

1. At the completion of the project or project phase, the Owner/Developer/Contractor must submit a set of as-built drawings to the Superintendent/Engineer. The as-built drawings shall indicate any field adjustments, all buried

structures, utilities and services. In addition, the as-built drawings shall include swing-ties to all sewer service laterals.

2. The as-built drawings shall be submitted to the Superintendent/Engineer in hard copy, 24" x 36" in dimension, and electronically in the most recent version of AutoCAD. The Owner/Developer/Contractor can choose to retain the Engineer via the Sewer Commission to generate a set of as-built drawings from the working drawings (red-lines). One copy of the as-built drawings shall also be submitted to the Highway Department for central filing.
3. No new project phase shall be started until as-built drawings of the earlier phase have been completed, submitted and approved by the Superintendent.

E. OPERATION AND MAINTENANCE MANUALS:

1. For sewage pump station projects, the Owner/Developer/Contractor shall supply the Town of Hooksett with four (4) sets of manufacturer's Operation and Maintenance manuals. A complete package of manufacturer's recommended spare parts shall also be provided, including one (1) of each type of seal used, one (1) of each type of wear ring used, one (1) of each type of O-ring or rubber seal used, and one (1) gallon of each type of paint used.

F. TRANSFER OF OWNERSHIP:

1. In any case in which an Owner/Developer/Contractor installs sewer or sewage pump station(s) and intends that such utility be owned, operated, or maintained by the Town of Hooksett or any entity other than the Owner/Developer/Contractor, the Owner/Developer/Contractor shall transfer to the Town of Hooksett or other entity the necessary ownership rights allowing them to operate and maintain the utility.
2. Easements for the sewer utility shall be provided, where necessary, and shall be at least thirty (30) feet wide; fifteen (15) feet on either side of the sewer centerline.
3. For sewage pump station(s), the land which the pump station is located on shall be deeded to the Town of Hooksett.

G. ESCROW FUNDS:

1. Upon completion and final acceptance of the work, the Owner/Developer/Contractor shall submit a letter requesting the return of any excess escrow funds.
2. All fees associated with the project must be paid in full prior to the release of any excess escrow funds.

PART III – DESIGN STANDARDS

3.01 GRAVITY SEWER:

A. GENERAL:

1. All new sewage systems or extensions shall be designed as separated sanitary sewer systems.
2. Rainwater from roofs, streets, and other paved areas, and groundwater from foundation drains and sump pumps shall be excluded from the sanitary sewer.

B. DESIGN CAPACITY AND DESIGN FLOW:

1. Design Period:

- a. Sewer systems shall be designed based on full build-out.

2. Design Flow:

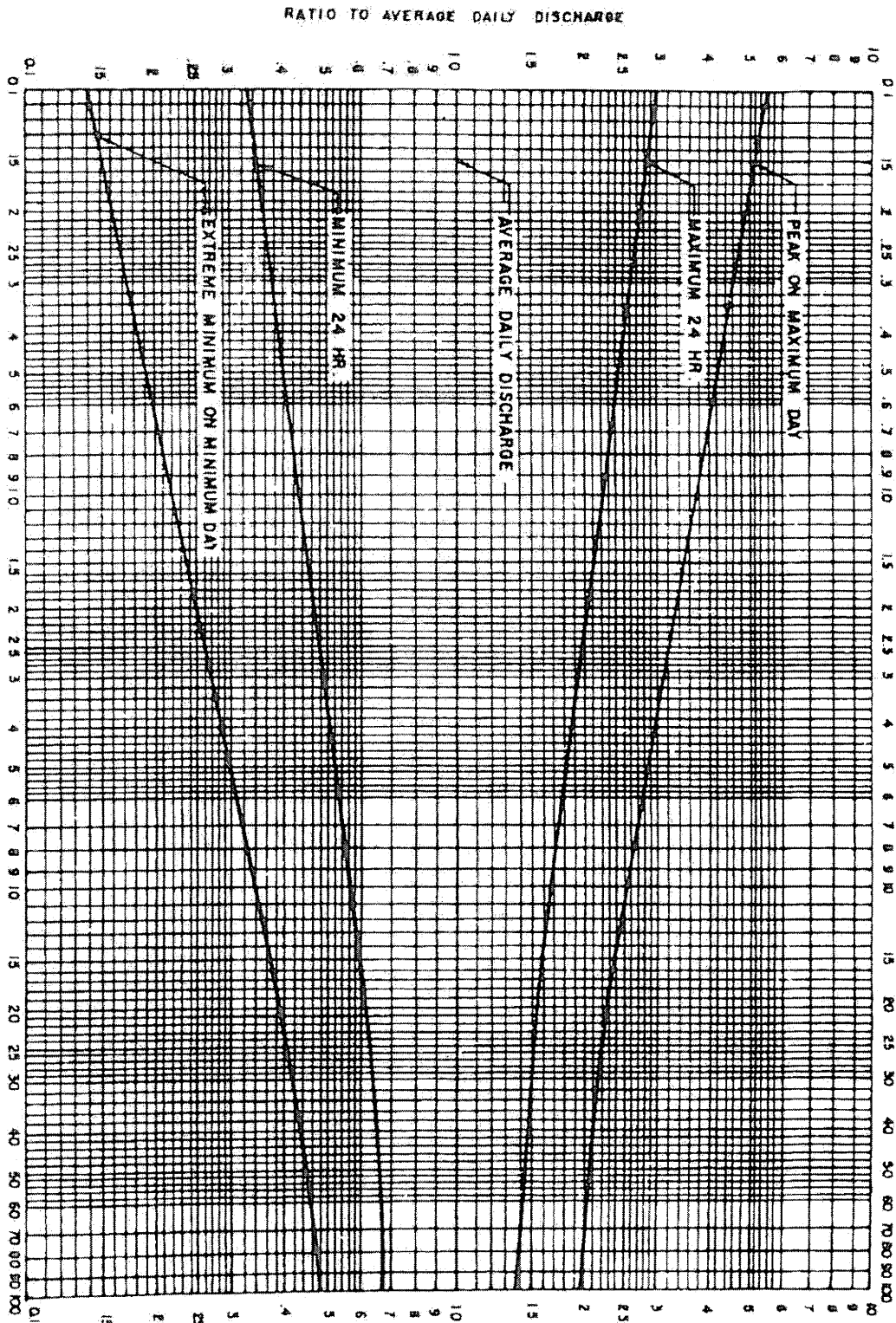
- a. When available, existing wastewater flow and/or consumption data shall be used as a basis for sewer design.
- b. Where actual flow and/or consumption data cannot be obtained, sanitary wastewater flows for proposed facilities shall be based on the following:
 - i. For commercial, institutional or recreational facilities, the flows shall be as specified in the Hooksett Sewer Department Sewer Use Ordinance, Appendix B: Wastewater Flow Estimates.
 - ii. For residential areas, an average daily per capita flow of not less than 70 gpd.

3. Peak Design Flow:

- a. Sanitary sewers shall be designed on a peak hourly flow rate basis. The peak hourly flow rate is defined as the largest volume of flow to be received during a one-hour period and expressed as volume per unit time. Peak hourly flow rate is calculated as the product of the average daily flow rate for the service area multiplied by a peaking factor, plus an infiltration allowance.
 - i. Peaking factors for average daily flow rates in excess of 100,000 gpd shall be as derived from Figure 2.1 of TR-16 Guides for the Design of Wastewater Treatment Works, New England Interstate Water Pollution Control Commission, 1998 Edition. A copy of the figure is provided on page 11. A peaking factor of 10 shall be used for average daily flows less than 100,000 gpd.
 - ii. Infiltration allowance for the design of sewers shall be as follows:
 - o For areas to be sewered in the future, an infiltration allowance of 150 gpd per acre shall be used.
 - o For sewers under design, an allowance of 300 gallons per inch diameter per mile per day shall be made.

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RELATION OF EXTREME DISCHARGES ON MAXIMUM AND MINIMUM DAYS
 TO THE AVERAGE DAILY DISCHARGE OF DOMESTIC SEWAGE
 (FROM MOP9 "SEWER DESIGN & CONSTRUCTION")
 ASCE & WPCF



C. DETAILS OF GRAVITY SEWER DESIGN:

1. Minimum Pipe Size:

- a. Gravity sewers shall not be less than 8 inches in diameter.

2. Depth:

- a. To maintain proper separation between sewer, water and drain utilities, a minimum of 8 feet of cover shall be provided for sewer in all roadway locations. A minimum of 6 feet of cover may be acceptable in areas that do not present a separation conflict between other utilities and a minimum of 4 feet of cover may be provided in all cross-country locations.
- b. Sewer pipe shall be insulated where there is less than 5 feet of cover and where sewer pipe crosses under an open culvert and pipe separation is less than 3 feet.

3. Slope:

- a. Sewers shall be designed and constructed at such slopes as to prevent deposition of organic solids with a minimum flow velocity (when flowing full) of not less than 2.0 feet per second based on Manning's formula using an "n" value of 0.013.
- b. The minimum allowable pipe slopes shall be as follows:

Nominal Pipe Diameter (inches)	Minimum Slope (feet/foot)
8	0.0040
10	0.0028
12	0.0022
14	0.0017
15	0.0015
16	0.0014
18	0.0012
21	0.0010
24	0.0008
27	0.0007
30	0.0006
36	0.0005

- c. Velocities shall not be greater than 10 feet per second when flowing at the 0.8 depth point.

- d. Impervious dams tied into an upstream relief drain shall be installed in the trench to control the flow of groundwater within the pipe bedding material when the surrounding native material is considerably less impervious than the pipe bedding material. The number of impervious dams and their spacing shall be such that the flow of groundwater will never get within 4 feet of finished grade.

4. Manholes:

a. General:

- i. The minimum internal diameter of manholes shall be 48 inches for standard manholes and 48 inches or 60 inches for inside drop manholes, as defined below.

b. Location:

- i. Manholes shall be installed at the end of each main; at all changes in grade, size, or alignment; and at all intersections.
- ii. In no case shall the distance between manholes be greater than 300 feet.
- iii. Manholes must be installed in locations that allow for 24-hour access. Such locations shall be plowed and maintained year round.

c. Flow Channel:

- i. A drop of at least 0.1 feet shall be provided between the incoming and outgoing sewers on all manholes.
- ii. No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench.
- iii. The invert of an incoming pipe shall be no more than 6 inches above the invert of an outgoing pipe unless a drop entry pipe is used.

d. Drop Type:

- i. A drop entry pipe shall be used for any sewer entering a manhole at an elevation of 24 inches or more above the manhole outlet invert. The drop pipe shall be constructed inside the manhole.
- ii. The maximum size limits and number of internal drop pipes within a manhole shall be as follows:
 - o For 48-inch diameter manholes, one 8-inch or 10-inch internal drop pipe shall be allowed.
 - o For 60-inch diameter manholes, one 12-inch or 15-inch; or two 8-inch or 10-inch diameter drop pipes shall be allowed.

e. Doghouse Type:

- i. Doghouse manholes may be permitted when it is necessary to construct a new manhole over an existing sewer that can not be temporarily taken out of service to construct the new manhole.

5. Changes in Pipe Size:

- a. Changes in pipe size shall only take place at manholes.
- b. When a smaller sewer joins a larger sewer, the invert of the larger sewer shall be lowered sufficiently to maintain the same energy gradient. This may be accomplished by placing the 0.8 depth point of both sewers at the same elevation. When the diameter ratio of the smaller sewer to the larger sewer is equal to or greater than 0.8, it is permissible to match the crowns.
- c. A reduction in the size of the outgoing sewer from a manhole shall be allowed only on sewers larger than 24-inch diameter and only if the capacity of the outgoing sewer is not exceeded.

6. Connections to Existing Sewer:

- a. Where new construction is intended to connect to an existing brick or block manhole, the existing manhole shall be replaced. If the existing manhole is of concrete or pre-cast concrete and is in satisfactory condition, as determined by the Superintendent/Engineer, this requirement may be waived.
- b. Any connection to an existing manhole shall utilize a kor-n-seal boot.

7. Manhole Stub-Outs:

- a. Manhole stub-outs at the end of pipelines shall be installed in any case where future extension of the sewer is possible.
- b. Stubs shall be at least 3 feet in length and shall be plugged at the manhole and capped at the stub.
- c. Materials for the stub shall be of the same material, class and quality as that for the sewer.
- d. An invert shall be constructed for the stub at the time of installation.

8. Sewer Service Laterals:

- a. Sewer service laterals and cleanouts shall be constructed at the time of sanitary sewer construction.
- b. Sewer service laterals shall extend to the property line or right-of-way line of each proposed and existing lot to be served.

9. Relation to Water Mains:

a. Horizontal Separation:

- i. Sewers shall be laid out at least 10 feet from any existing or proposed water main. If conditions prevent a horizontal separation of 10 feet, exceptions may be made on a case-by-case basis when supported by data from the design engineer. Such an exception may allow the sewer to be installed closer than 10 feet from a water main, provided that it is laid out in a separate trench with the crown of the sewer at least 18 inches below the invert of the water main.

b. Vertical Separation:

- i. In instances where sewers must cross water mains, the sewer shall be laid out such that the crown of the sewer is at least 18 inches below the invert of the water main. The sewer joints shall be located as far away as possible from the water main joints.
- ii. When the above requirements cannot be met, one full length of ductile iron pipe shall be used for the sewer. The pipe shall be centered beneath the water main so that both joints will be as far as possible from the water main.

10. Relation to Water Works Structures:

- a. No sewer shall be located within the well protective radii established in Env-300 of the New Hampshire Code of Administrative Rules for any public water supply wells or within 100 feet of any private water supply well.

11. Fill Area Requirements:

- a. When constructed in fill areas, gravity sanitary sewers shall be ductile iron pipe, not PVC pipe.

12. Inverted Siphons:

- a. As a general rule, inverted siphons shall not be used. The Hooksett Sewer Commission may consider their use on a case-by-case basis only if conditions warrant. If allowed, inverted siphons shall have no less than two barrels with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance.

3.02 SEWER FORCE MAIN:

A. GENERAL:

- 1. Sewer force main(s) and associated pump station(s) shall only be used when gravity sewer is not feasible.

B. DETAILS OF FORCE MAIN DESIGN:

1. Force mains for constant speed pumps shall be sized to yield a cleansing velocity of 3.0 feet per second or greater at design pump capacity.
2. Force mains for variable speed pumps shall be sized to yield a velocity of 2.0 feet per second or greater at average daily design flow.
3. Force mains shall be designed to withstand hydrostatic pressures of at least 2.5 times the design total dynamic head. The design engineer shall include design calculations to support pressure class of the pipe design.
4. Force mains shall have a minimum diameter of 4 inches.
5. To maintain proper separation between sewer, water, and drain utilities, a minimum of 8 feet of cover shall be provided for sewer force mains in all roadway locations. A minimum of 6 feet of cover may be acceptable in areas that do not present a separation conflict between other utilities and a minimum of 4 feet of cover may be provided in all cross-country locations.
6. Force mains shall be insulated where there is less than 5 feet of cover and where sewer pipe crosses under an open culvert and pipe separation is less than 3 feet.
7. When constructed in fill areas, force mains shall be ductile iron pipe, not PVC or HDPE pipe.
8. Whenever possible, force mains shall be installed with positive slope, without high or low points.
9. Air relief valves shall be provided at all relative high points in the force main to prevent air locking. They shall be located within manholes.
10. Cleanouts shall be provided at all topographical low points. They shall be installed in minimum 5-foot diameter manholes with two cast iron wyes installed on the force main to provide access for cleanout in two directions. Branches of both wyes shall be fitted with a resilient wedge gate valve and blind flange. The wyes shall be set at slightly opposing angles for ease of access. Branches shall be the same diameter as the force main.
11. Access manholes (housing air relief valves, cleanouts, etc.) must be installed in locations that allow for 24-hour access. Such locations shall be plowed and maintained year round.
12. Concrete thrust restraints made of corrosion-resistant material shall be placed at all bends, elbows, tees and junctions.
13. In general, force mains shall enter the receiving manhole at a point no more than 6-inches above the flow line of the outgoing pipe unless an internal drop entry pipe is used.
14. When the ratio of force main diameter to gravity sewer diameter is greater than or

equal to 0.5, a trough shall be constructed inside the manhole and crowns matched. When the ratio is less than or equal to 0.5, the force main may be directed into the outlet pipe.

15. Impervious dams tied into an upstream relief drain shall be installed in the trench to control the flow of groundwater within the pipe bedding material when the surrounding native material is considerably less impervious than the pipe bedding material. The number of impervious dams and their spacing shall be such that the flow of groundwater will never get within 4 feet of finished grade.

3.03 SEWER SERVICE:

A. GENERAL:

1. Connection to the sanitary sewer shall only be permitted for sanitary waste flow from toilets, sinks, laundry, etc. Roof leaders, footing drains, sump pumps or any other similar connection carrying rain water, drainage, or ground water shall not be permitted.
2. There shall be a minimum of 10 feet of horizontal separation between the sewer service and water service. The two services shall not be laid in the same trench.

B. DETAILS OF SEWER SERVICE DESIGN:

1. Sewer services shall have a minimum diameter of 6 inches from the right-of-way or property line to the sanitary sewer. The service may have a diameter of 6 inches or 4 inches from the right-of-way or property line to the building.
2. Single gravity and force main residential sewer services shall tie into the gravity sanitary sewer.
3. Industrial services shall only tie into manholes.
4. Commercial services shall tie into the gravity sanitary sewer or into a manhole at the discretion of the Superintendent/ Engineer.
5. Multiple single-family, force main connections may tie into a manhole. Each force main shall connect to a 6-inch SDR 35 pipe that penetrates through the manhole wall. Within the manhole, crowns shall be matched and troughs used for each service. The connection between the force main and 6-inch SDR 35 pipe shall be made with a Fernco type coupling, or equal, outside of the manhole.
6. Connections between a sewer service and gravity sanitary sewer shall be made through a wye. Only in instances where a wye is not available, may a service saddle be permitted. A Fernco saddle, or approved equal, shall be used for services up to 6 inches in diameter.
7. The minimum slope for sewer services shall be ¼-inch per foot of length, unless otherwise directed by Superintendent/Engineer.
8. Where the depth of the sanitary sewer exceeds 12 feet below grade, a sewer

service riser shall be installed. The sewer service riser shall not be the vertical chimney type.

9. A 6" x 6" wye with a cleanout shall be installed at the property line. Cleanouts shall also be located every 75 feet from the property line to the house. The elevation of cleanouts shall be at finished grade.
10. Backflow preventers must be installed at all service connections and in an accessible location. If installed outside of a building, the backflow preventer must be placed in a structure which affords accessibility.
11. Restaurants, prepared food producers, and any commercial establishment discharging grease or fat materials into the sewer system shall install an approved grease trap through which all such waste shall flow. No discharge from water closets, urinals, etc. shall be piped through the grease trap. Such grease traps shall be constructed outside of the building and shall be readily accessible by Hooksett Sewer Department personnel at all times. They shall have a minimum of 24 hours usable storage volume or 1,000 gallon storage capacity, whichever is greater. The Owner/Developer/Contractor shall submit engineering computations verifying that the grease trap is sized in accordance with the above criteria.
12. Any establishment likely to discharge gas, oil, petroleum or grit into the sewer system shall install an approved oil/water/grit separator through which all such waste shall flow. No discharge from water closets, urinals, etc. shall be piped through the oil/water/grit separator. Such oil/water/grit separators shall be constructed outside of the building and shall be readily accessible by Hooksett Sewer Department personnel at all times. They shall have a minimum of 24 hours usable storage volume or 1,000 gallon storage capacity, whichever is greater. The Owner/Developer/Contractor shall submit engineering computations verifying that the oil/water/grit separator is sized in accordance with the above criteria.

3.04 SEWAGE PUMP STATION:

A. GENERAL:

1. Pump stations shall be designed to satisfy the long-term needs of the Town and must accommodate future growth within the topographic service zone where they are located. The Hooksett Sewer Commission shall determine the suitability and adequacy of proposals to accommodate the at-large needs of Hooksett.
2. Pump stations shall be designed as one of four classes of stations, as defined below:
 - a. **Class "A" Pump Station:**
 - i. Class "A" pump stations shall be the wet well/dry well type.
 - ii. This type of pump station may be used for municipally or commercially owned pump stations.

- iii. The pump station shall be designed to accommodate 500 gpm pumping rate or greater, or equipped with 25 horsepower pumps or greater.
- b. Class "B" Pump Station:**
- i. Class "B" pump stations shall be the submersible pump type. If municipally owned, the pump station shall be constructed to enable future expansion to a Class "A" pump station.
 - ii. This type of pump station may be used for municipally or commercially owned pump stations, or for multi-family dwellings that opt not to have a Class "D" pump station for each individual dwelling unit, as defined below.
 - iii. The pump station shall be designed to accommodate less than 500 gpm pumping rate and equipped with less than 25 horsepower pumps.
- c. Class "C" Pump Station:**
- i. Class "C" pump stations shall be the above-ground, suction lift type with a separate wet well.
 - ii. This type of pump station may be used for municipally or commercially owned pump stations.
 - iii. Pumps shall be the self-priming, suction lift type as manufactured by Gorman-Rupp or equivalent.
- d. Class "D" Pump Station:**
- i. Class "D" pump stations shall be those designed to accommodate single residential units or small commercial systems having a design flow of less than 2,000 gpd.
 - ii. This type of pump station shall be equipped with a grinder type pump.
 - iii. Multi-family dwellings shall have a separate Class "D" pump station for each unit. A pump station serving an entire multi-family dwelling shall be a Class "A", "B" or "C" pump station as described above.
3. The following pump facilities shall not be permitted in Hooksett:
- a. Pneumatic Ejector Stations.
 - b. Low Pressure Force Main Systems: Any wastewater collection system which requires pumps located on individual, private properties to serve those properties and which pumps to a common force main. As a general rule, this type of system is not allowed. However, under extenuating circumstances where it is impossible to provide gravity sewer, the Hooksett Sewer Commission may entertain the use of a low pressure force main system. Under no circumstance shall this system be used for a design flow exceeding 2,000 gpd or shall it require any force main greater than 1-1/2 inch diameter. This type of system, if allowed, shall be privately owned and maintained.
4. Pump stations are prohibited from any site which may be served by gravity sewers, whether existing or conceptual.
5. Class "A", "B" and "C" pump stations shall have a minimum of two (2) pumps,

each designed to handle peak hourly flows. Where three (3) or more pumps are provided, they shall be designed such that with any one unit out of service, the remaining units shall have the capacity to handle peak hourly flows. In other words, all pump stations must have one spare pump to replace any pump that may be out of service.

B. DETAILS OF PUMP STATION DESIGN:

1. CLASS "A" PUMP STATIONS:

- a. Class "A" pump stations shall be wet well/dry well type stations, constructed of two completely separate chambers. The dry well shall house pumps, motors, piping and valving systems, and any appurtenant equipment, while the wet well shall store wastewater for cyclic or constant level (variable speed) pumping.
- b. Class "A" pump stations shall be equipped with two (or more) vertical close coupled, non-clog type pumps capable of passing 3-1/2 inch solids and shall be driven by 460 volt, 3 phase electric motors. Discharge elbow shall be cast iron with a cleanout fitting. Mechanical seals shall be double carbon ceramic seals.
- c. Controls, indicators, compressors, generators (if applicable) and electrical equipment shall be housed in an above-ground control building located above the dry well. Pumps, valves and associated hardware shall be placed in the lower level.
- d. The dry well shall have a check valve and gate valves for each pump. There shall be one gate valve on the suction side of the pump and one gate valve on the discharge side after the check valve.
- e. Lifting eyes shall be provided in the roof of the control building to enable removal of pumps from the dry well. Lifting eyes shall be located directly over each pump with a minimum clearance of 36 inches over the pump motor to permit operation of a lifting device.
- f. The sewer inlet shall be equipped with either a bar rack or screen box, plus a grinder suitably designed for convenient maintenance access and debris removal.
- g. All electrical shall be explosion proof in the wet well.
- h. The dry well shall provide reserve space for a future additional pump. There shall be a suction line from the wet well to the dry well for the future pump as well, with a blind flange sealing the connection in the dry well.
- i. A sump pump shall be provided in the dry well to remove leakage or drainage, with the discharge above the alarm level of the wet well.
- j. Pump station ladders shall be equipped with safety rails which extend through the hatch opening. Large or deep pump stations may be required to install "ship type" ladders for safety.

k. Refer to Section 3.04.B.5 for standby electric generator requirements.

2. CLASS "B" PUMP STATIONS:

- a. Class "B" pump stations shall be duplex or triplex submersible pump stations with a separate wet well and valve pit.
- b. Pumps shall be of the submersible non-clog type or submersible grinder type. In general, submersible non-clog pumps shall be capable of passing 2-1/2 inch solids and shall be driven by 460 volt, 3 phase electric motors. However, under lower flow conditions, the use of this type of pump may be unattainable. In that case, a submersible grinder pump may be necessary. Pumps shall have cast iron/slip flange base plate assembly with rail systems for pump removal.
- c. For municipally owned pump stations, the pump control panel, indicators, alarms, compressors and generators shall be housed in an above-ground control building located adjacent to the pump station. For commercially owned pump stations, the control panel may be mounted outside on an at-grade backboard support, rather than inside a control building.
- d. Pump controls and power cables shall be connected at a junction box with the disconnect switch immediately outside of the wet well. Electrical connections within the wet well are not permitted.
- e. All electrical equipment inside the wet well shall be explosion proof.
- f. Removal of pumps shall not require personnel to enter the wet well.
- g. Pump stations shall be equipped with davits, winches or other approved device for removal of pumps from the wet well.
- h. The valve pit shall have a check valve and gate valve for each pump. The gate valve shall be located on the discharge side of the check valve.
- i. For municipally owned class "B" pump stations, plans shall provide site space reserved for future expansion to a wet well/dry well (Class "A") configuration. The site plan shall have reserve space clearly delineated and labeled.
- j. Refer to Section 3.04.B.5 for standby electric generator requirements.

3. CLASS "C" PUMP STATIONS:

- a. Class "C" pump stations shall consist of a below-ground wet well and, if municipally owned, an above-ground control building.
- b. Pump(s) shall be the self-priming, suction lift type designed for handling raw, unscreened sanitary sewage. They shall be equipped with a full-flow type check valve capable of passing 3-inch solids and shall be driven by 460 volt, 3 phase electric motors.

- c. Each pump shall be capable of isolation from the force main.
- d. For systems greater than 500 gpm, the sewer inlet shall be equipped with either a bar rack or screen box, plus a grinder suitably designed for convenient maintenance access and debris removal.
- e. For municipally owned pump stations, the pump(s), motor(s), electrical equipment, piping and valving systems, and all other appurtenant equipment shall be housed in a control building located above or adjacent to the pump station. For commercially owned pump stations, the above-stated equipment may be housed in a pre-fabricated, heated enclosure instead of a control building. The pre-fabricated enclosure shall allow access for maintenance.
- f. Refer to Section 3.04.B.5 for standby electric generator requirements.

4. CLASS "D" PUMP STATIONS:

- a. Class "D" pump stations shall be the wet well/submersible grinder pump type complete with grinder pump, check valve, tank and controls.
- b. The grinder pump shall be designed to handle the estimated wastewater loads. It shall produce a flow rate adequate to discharge to gravity sewer at the property line or right-of-way and produce a minimum scouring velocity of 3 feet per second.
- c. The grinder pump shall grind solids into fine particles, allowing them to pass easily through the pump, check valve and small-diameter force main.
- d. The pump discharge shall be equipped with a gravity operated, flapper-type integral check valve built into the discharge piping.
- e. High water level, power failure and pump alarms shall be provided. A remote panel with an alarm test function shall be provided, as shall a remote display with audible and visible alarm. The alarm panel shall be suitable for wall or pole mounting. Panel shall be mounted either outside, adjacent to the pump station, or inside the residence.
- f. Automatic wastewater level sensing controls shall be provided. The level sensing control housing shall be integrally attached to the pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris.
- g. The pressure service shall connect to a gravity service at the property line or right-of-way. A cleanout shall be installed at that location for the gravity line.
- h. Class "D" pump stations shall always remain in private ownership.
- i. Class "D" pump stations are exempt from the specific design criteria found in subsequent sections (i.e. standby electric generator, pump station controls, site requirements, etc.).

5. STANDBY ELECTRIC GENERATOR:

- a. All pump stations that are to be municipally owned shall have a standby electric generator.
- b. All commercially owned pump stations must have either a standby electric generator or provide additional wet well storage above the normal operating system storage provided. The additional wet well storage capacity must equal the maximum expected amount of wastewater for twenty-four (24) hours following the tripped high level alarm.
- c. For municipally owned pump stations, the generator shall be housed in an above-ground control building.
- d. The generator shall be sized to serve the entire facility; capable of powering all pumps, lights, blowers, sump pumps, compressors and other associated electrical devices.
- e. Generator shall be powered by propane or natural gas. Liquid fuel generators are unacceptable.
- f. Each generator system shall include an automatic transfer switch.
- g. Generator shall be equipped with an automatic exerciser to permit regular timed operation of the generator. Exerciser must be capable of adjusting time between exercise cycles and the time duration of exercise, and shall cause lock out of power demand during exercise phase.
- h. Generator shall be equipped with a control panel where all control switching and instrumentation shall be located. All generator functions shall be controlled and monitored from the panel and shall include override start-up or shut-down, test or other required operations. Start-up and shut-down switching (including manual override) shall include automatic electrical load ramp-up and thermal cool-down phases to permit safe start-up and shut-down of the generator.
- i. Control panel shall be equipped with sensors, indicators and automatic shut-down of generator in the event of:
 - i. Motor over-temperature
 - ii. Motor over-speed
 - iii. Low oil pressure
 - iv. Overcrank (failure to start)
- j. The above-noted conditions constitute generator failure, and are considered pump station alarm conditions, as defined in Section 3.04.B.6.

6. CLASS "A", "B" and "C" PUMP STATION CONTROLS:

a. General:

- i. For all municipally owned pump stations, as well as class "A" commercially owned pump stations, controls shall be housed in an above-ground control building.
- ii. Pump stations shall be controlled by means of a bubbler level control system, with duplex air compressor units.
- iii. Pump stations shall be equipped with a main circuit breaker, as well as independent circuit breakers for each pump.
- iv. Pump stations shall include hand-off-auto switching to permit complete override operation of all pumps. Automatic switching shall be run off wet well level and shall include lead/lag alternation with manual lead/lag override options.
- v. Each pump shall be equipped with an electronic soft-start or variable frequency drive motor starter.
- vi. Each pump shall have an independent hour meter to record total length of pump operation.
- vii. All pump stations shall be equipped with a flow meter, and instantaneous flow rate indicator and totalizer calibrated in gallons. Flow meter shall be a magnetic type meter or similar approved device.
- viii. All pump stations shall have a telephone in the station.
- ix. Pump stations shall be equipped with all sensing, control and alarm conditions.
- x. High water level alarms shall be detected by a separate float type switch independent of the bubbler level control system.

b. Municipally Owned Pump Stations:

- i. Municipally owned pump stations shall have a Remote Terminal Unit (RTU) that inputs pump operating status and alarm conditions. Output signals are then transmitted to the Hooksett Wastewater Treatment Plant's Supervisory Control and Data Acquisition (SCADA) system for monitoring of the pump station. The RTU shall input and output the following signals:
 - o Pump run status for each pump
 - o Hand-off-auto switch for each pump
 - o Automatic pump alternation with manual lead pump selection overrides

- Phase overload failure
 - Pump shutdown due to high temperature/moisture in motor housing
 - High pump temperature shutdown (Gorman-Rupp pumps only)
 - Pump seal failure
 - Wet well high and low water levels
 - Pump room flooding (class "A" stations only)
 - Generator run status
 - Generator failure
 - Flow rate and totalization
 - Building high and low temperature
 - Automatic transfer switch position for standby electric generator
 - Building intrusion alarm
 - Combustible gas alarm
- ii. The RTU operator interface terminal (OIT) shall provide the following screens for control and indication:
- Overall station status screen complete with schematic diagram
 - Alarm acknowledge screen
 - Control screen with lights and switches for each pump
- iii. The Owner/Developer/Contractor shall be responsible for making all necessary SCADA system upgrades required at the Hooksett Wastewater Treatment Plant to accommodate the new pump station.

c. Commercially Owned Pump Stations:

- i. Commercially owned pump stations shall input and output alarm conditions as either local alarm (LA) and/or common alarm (CA) conditions. The following are the minimum operational and alarm conditions that each pump station shall have:
- Pump run status for each pump
 - Wet well high and low water levels (LA, CA)
 - Pump room flooding (class "A" stations only) (LA, CA)
 - Combustible gas alarm (LA, CA)
 - Generator run status (if applicable)
 - Generator failure (if applicable) (LA, CA)
 - Flow rate and totalization
 - Building high and low temperature (if applicable) (LA)

- ii. Local alarm conditions shall be signaled by a flashing exterior dome light, visible outside the control building or prefabricated enclosure (depending on station class), and shall be identified on the control panel.
- iii. Common alarm conditions shall be signaled through an automatic phone dialer system or through a telemetry system connected to Central Alarm of Manchester, NH. In either case, a dedicated telephone connection shall be utilized.
- iv. The power source for the telemetering and alarm system shall be an independent battery with continuous charge.

7. SITE REQUIREMENTS FOR MUNICIPALLY OWNED PUMP STATIONS:

- a. Site shall be a minimum of 3,000 square feet in area, with a minimum of 30 feet frontage on a Town-accepted road.
- b. All land proposed for a pump station site shall be upland. No area deeded to the Hooksett Sewer Commission as pump station land shall be designated as wetland or contain wetland vegetation.
- c. The site shall be enclosed by an 8-foot high, 6-gauge galvanized chain-link fence with a 12-foot wide double-leaf lockable gate capable of opening either in or out. The corner and gate posts shall be 3-inch diameter SS40 pipe. Pipe 2-1/2 inches in diameter shall be used for runs between corners, spaced no more than 10 feet apart. Pipe 1-5/8 inches in diameter shall be used for the top connector.
- d. The access road and entire fenced in area shall be paved. All pavement shall be adequate to accommodate heavy vehicular traffic and shall be a minimum of 3 inches thick (2-inch base course and 1-inch finish course), with a 12-inch compacted crushed gravel subbase.
- e. Full size yard hydrant shall be included (Mueller Centurion or equal) with two 2-1/2 inch threaded nozzles and 4-inch pumper nozzle, open left.
- f. A yard light(s) with 150 watt high pressure sodium bulb shall be placed at a minimum height of 10 feet.
- g. All yard fixtures shall be so designed as to accommodate winter maintenance (plowing).
- h. A weather-proof dual 120V electric outlet shall be installed outside of the building.

8. CONTROL BUILDING REQUIREMENTS:

- a. The minimum dimensions of the control building shall be 10' x 10'.
- b. The building shall be constructed above ground and shall have a doorway opening adequate to permit complete replacement of a generator unit,

whether currently in use or not.

- c. The building walls shall be double-wall concrete masonry units or other material as approved by the Hooksett Sewer Commission. Building roof shall be pre-cast concrete roof plank pitched to one side.
- d. The building shall be painted inside and out according to Section 3.04.B.9.
- e. For pump stations serving single commercial buildings, the control building may consist of a separately dedicated room, with minimum dimensions of 10' x 10', within the main building. The room must have direct external access and be located immediately adjacent to the wet well.
- f. The control building shall be heated and shall have potable water, complete with a backflow preventer.

9. PAINT SYSTEMS:

- a. Provide the following paint systems for the various substrate, as indicated. All dry film thicknesses (DFT) are called for as total mils per coat specified and are considered minimums. Superintendent/Engineer to select colors.
- b. The specifications below are based on products manufactured by Tnemec Company, Inc., North Kansas Missouri. Products of equal quality, function and performance may be proposed for substitution.

c. Exterior:

- i. Miscellaneous ferrous metal items:

1st Coat: N69 Hi-Build Epoxoline on unpainted metal or touch-up (4.0 mils DFT)

2nd Coat: N69 Hi-Build Epoxoline (4.0 mils DFT)

3rd Coat: 1075 Endura-shield (1.5 mils DFT)

- ii. Ferrous metals, submerged:

1st Coat: N69 Hi-Build Epoxoline (touch-up primer) (4.5 mils DFT)

2nd Coat: 104 H.S. Epoxy (4.0-10.0 mils DFT)

3rd Coat: 104 H.S. Epoxy (4.0-10.0 mils DFT)

- iii. Galvanized metal:

1st Coat: N69 Hi-Build Epoxoline (Primer) (4.0 mils DFT)

2nd Coat: 1075 Endura-shield (1.5-3.0 mils DFT)

d. Interior:

i. Interior concrete wall, brick wall, and concrete masonry:

1st Coat: 130 Filler II (Primer/Filler) (8.0 mils DFT)

2nd Coat: 84 Ceramlon II (4.0-10.0 mils DFT)

Note: Spray, then roll each coat.

3rd Coat: Series 1080 WB Polyurethane (3.0-4.0 mils DFT)

ii. All interior metals, including structural steel, piping, railings, equipment and stairs:

1st Coat: N69 Hi-Build Epoxoline on unpainted metal or touch-up (4.0 mils DFT)

2nd Coat: N69 Hi-Build Epoxoline (3.5 mils DFT)

3rd Coat: 1075 Hi-Build Epoxoline (1.5-3.0 mils DFT)

iii. All submerged ferrous metals:

Note: Lightly hand-sand all shop-primed surfaces prior to touch-up painting or finish painting to provide proper bonding surface.

1st Coat: N69 Hi-Build Epoxoline on unpainted metal or touch-up (4.5 mils DFT)

2nd Coat: 104 H.S. Epoxy Coating (4.0-10.0 mils DFT)

3rd Coat: 104 H.S. Epoxy Coating (4.0-10.0 mils DFT)

iv. PVC piping:

1st Coat: N69 Hi-Build Epoxoline (2.0-4.0 mils DFT)

v. Copper and bronze piping:

1st Coat: Series 27 Typoxy (2.5-4.0 mils DFT)

2nd Coat: N69 High-Build Epoxoline (3.0-5.0 mils DFT)

vi. Galvanized metals and aluminum:

1st Coat: N69 Hi-Build Epoxoline (2.5-4.0 mils DFT)

2nd Coat: N66 Hi-Build Epoxoline (3.0-5.0 mils DFT)

vii. Painted woodwork and gypsum board:

1st Coat: Use a VOC compliant Wood Undercoater

2nd Coat: V23 Enduratone (2.0-3.0 mils DFT)

3rd Coat: V23 Enduratone (2.0-3.0 mils DFT)

3.05 DESIGN DRAWINGS:

A. GRAVITY SEWER AND FORCE MAIN DRAWINGS:

1. General:

- a. Design drawings shall be clear, legible and drawn to a horizontal scale of 1" = 40'. Drawing sheets shall be 24" x 36" in dimension.
- b. Design drawings shall include the following:
 - i. Locus and vicinity plans drawn to scales of 1" = 1,000' and 1" = 200', respectively.
 - ii. Contour lines at 2-foot intervals and elevations of existing and proposed project area.
 - iii. The locations of all streams and other surface waters, including their direction of flow and water surface elevations at the time of survey.
 - iv. 100-year flood elevations, if available.
 - v. Insets and detail sections with the scale shown directly beneath their subtitles.
 - vi. Plans shall clearly show the location of:
 - o All existing structures affecting the project.
 - o Existing and proposed sewer outlets or overflows.
 - o All other utilities in the vicinity of the proposed sewers.
 - vii. The locations of existing, proposed and future sewers differentiated by appropriate symbols or designations.
 - viii. The horizontal distance or stationing between manholes, grades in feet per foot, and sewer sizes, types and class.
 - ix. All sewer appurtenances depicted by symbols and referenced by a legend, with details of all sewer appurtenances accompanying the detail sewer plans.
 - x. Profile views, drawn at a scale of 1" = 40' horizontal and 1" = 4' vertical, shall be drawn beneath the respective plan views.
 - xi. Profiles shall clearly show the location of:
 - o All manholes with manhole identification numbers.
 - o Existing and proposed water main crossings with elevations.
 - o Sewage pumping station(s).
 - o In the case of stream crossings, the elevation of stream beds, normal flow lines and the type of pipe.
 - xii. The size and gradients of sewers, surface elevations, first floor house elevations, and sewer inverts shown at or between each manhole.

- xiii. Finish grade elevations.
- xiv. Elevations of manhole inverts shown to the nearest 0.01 feet.
- xv. All elevations referenced to a standard datum that is indicated on the plans.
- xvi. The name and signature of the design engineer, and the imprint or stamp of their New Hampshire Professional Engineering license seal.

B. SEWAGE PUMP STATION DRAWINGS:

1. General:

- a. Design drawings shall be clear and legible. The site plan shall be drawn to a horizontal scale of 1" = 40', while the pump station and control building drawings shall be drawn to a horizontal scale of 3/8" = 1'. Drawing sheets shall be 24" x 36" in dimension.
- b. In addition to the requirements listed in Section 3.05.A., all design drawings for sewage pump stations shall include the following information:
 - i. Existing sewage pump station locations and elevations.
 - ii. The location(s) and elevation(s) of all proposed sewage pump station(s), including provisions for installation of future pump(s) if required to meet full built-out of the service area.
 - iii. Elevations of high water at the site and maximum elevation of sewage in the collection system.
 - iv. Separate drawing of site property lines, suitable for conveyance.
 - v. Pump station floor plan.
 - vi. All appropriate details.
 - vii. All appropriate specifications.

PART IV – MATERIALS, CONSTRUCTION METHODS AND TESTING

4.01 GRAVITY SEWER:

A. MATERIALS:

1. SEWER PIPE:

a. PVC:

- i.** PVC sewer pipe and fittings shall meet the requirements of ASTM D3034 for 4" through 15" SDR 35 and ASTM F679 for 18" through 24" sewer pipe. The pipe shall be colored green for in-ground identification as sewer pipe. All pipe shall be made from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 or 12364 as defined in ASTM D1784. Methods of shipping and storage on site shall be such as to avoid injury to the pipe. Damaged pipe shall be rejected and removed from the job site.
- ii.** All fittings shall have bell and spigot configurations compatible with that of the pipe. Fittings shall be injection molded fittings. Fabricated fittings are not allowed.
- iii.** Joints for PVC pipe shall be oil resistant compression rings of elastomeric material conforming to ASTM D3212. Type shall be push-on, bell and spigot. Manufacturer's instructions for installation shall be followed. Solvent cement joints shall not be permitted.

b. Ductile Iron:

- i.** Ductile iron gravity sewer pipe shall conform to AWWA/ANSI C151/A21.51 for sizes 4" through 24". All pipe and fittings shall have a cement mortar lining per AWWA/ANSI C104/A21.4 and bituminous seal coat on the inside. The exterior of the pipe and fittings shall be furnished with 1 mil asphaltic coating per ANSI/AWWA C151/A21.51. Ductile iron pipe shall be AWWA Class 52.
- ii.** Pipe shall have either the rubber-ring type push-on joint or standard mechanical joint. Rubber gasket joints shall conform to ANSI/AWWA C111/A21.11 for mechanical and push-on type joints.
- iii.** Methods of shipping and storage on site shall be such as to avoid injury to the pipe. Damaged pipe shall be rejected and removed from the job site.

c. Other:

- i.** The use of reinforced concrete pipe, vitrified clay pipe, cast iron pipe, HDPE pipe, asbestos-cement pipe or PVC pipe other than SDR 35 shall not be permitted.

- ii. Except in instances where sanitary sewer crosses water, transition couplings shall be made of tough elastomeric polyvinyl chloride with stainless steel clamps. They shall be leak-proof and root-proof and shall be resistant to chemicals, ultraviolet rays, fungus growth, and normal gases. Transition couplings shall conform to ASTM D5926 and ASTM C1173. Type shall be Fernco, or approved equal.
- iii. In instances where sanitary sewer must cross water, solid sleeve ductile iron mechanical joint fittings shall be used to transition between PVC and ductile iron pipe. The fittings shall conform to ANSI/AWWA A21.53/C153 and ANSI/AWWA A21.11/C111 for joints, and ANSI/AWWA A21.4/C104 for cement lining.

2. MANHOLE MATERIALS:

a. Concrete Structures:

- i. Barrel, cone and base sections shall be pre-cast reinforced concrete and shall conform to ASTM C478, except as may be otherwise shown on the Standard Sewer Manhole detail.
- ii. Base sections shall be monolithic to a point 6 inches below the invert to 6 inches above the crown of the incoming pipe, and shall be pre-cast reinforced concrete.
- iii. Horizontal joints between sections of pre-cast concrete barrels shall be sealed with a butyl rubber joint sealant as shown on the Standard Sewer Manhole detail. Seal shall be made with a double row of Kent Seal, No. 2 sealant or approved equal.
- iv. Pipe to manhole joints shall be Kor-N-Seal joints as shown on the Standard Sewer Manhole detail, or approved equal.
- v. Cone sections shall be eccentric as shown on the Standard Sewer Manhole detail.
- vi. All pre-cast sections and bases shall have the date of manufacture and the name or trademark of the manufacturer impressed or indelibly marked on the inside wall.
- vii. Drop manholes, where indicated, shall be inside drop type only as shown on the Internal Drop Manhole detail. External drop manholes shall not be used.
- viii. All sewer manholes shall not have steps.
- ix. The exterior of sewer manholes shall be bituminous coated.
- x. Sewer manholes shall be of such material as to withstand AASHTO H-20 /HS-20 loading without failure.

- xi. Concrete for cast-in-place bases or complete manholes shall conform to the requirements for Class AA concrete in Section 520 of the New Hampshire Department of Transportation's Standard Specifications for Road and Bridge Construction.
- xii. Reinforcing for cast-in-place concrete shall be steel or structural fibers conforming to the requirements of Section 544 of the New Hampshire Department of Transportation's Standard Specifications for Road and Bridge Construction.

b. Castings:

- i. Manhole frame and cover shall weigh at least 400 lbs., shall provide a 30-inch diameter clear opening, and shall have non-penetrating pick holes, as manufactured by East Jordan Iron Works (LeBaron), Model LA 326-1, or approved equal. The cover shall have the letter "S" or the word "SEWER" in 3-inch letters cast into the top surface.
- ii. The castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined at the foundry before shipment to prevent rocking of covers in any orientation.
- iii. All castings shall be thoroughly cleaned and subject to a careful hammer inspection.
- iv. Castings shall be at least Class 30 conforming to the ASTM Standard Specification for Gray Iron Castings, Designation A48.

c. Brick Masonry:

- i. Bricks for the manhole shelf, invert and grade adjustment shall be sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture, and satisfactory to the Superintendent/Engineer. Brick shall comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick. Rejected brick shall be immediately removed from the work site.
- ii. Mortar shall be composed of Type I/II portland cement and sand in the proportions of 1 part cement and 3 parts sand.
- iii. Sand shall consist of inert natural sand conforming to the ASTM Standard Specifications for Concrete (Fine) Aggregates, Designation C33 as follows:

100% passing	3/8" screen
95-100% passing	#4 sieve
80-100% passing	#8 sieve

50-85% passing	#16 sieve
10-30% passing	#50 sieve
2-10% passing	#100 sieve
Fineness Modulus	2.3 - 3.1

3. TRENCH MATERIALS:

a. Bedding:

- i. Bedding material and fill material for ordered excavation below grade shall be crushed stone (3/4" crushed stone) to ASTM C33 stone size No. 67.
- ii. Crushed stone shall be graded to the following specifications:

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

b. Sand:

- i. Sand blanket material shall be graded sand, free from organic materials. It should be graded such that 100% passes a 1/2-inch sieve and a maximum of 15% passes a #200 sieve.

c. Backfill:

- i. Backfill material for installation in road, traveled ways, and shoulders shall be natural material excavated from the trench during construction, excluding debris, pieces of pavement, organic matter, top soil, all wet or soft muck, peat, clay, stones greater than 6 inches in diameter, and all excavated ledge material not approved by the Superintendent/Engineer.
- ii. For cross-country construction, suitable material shall be as described above, except that the Superintendent/Engineer may permit the use of top soil, loam, muck or peat if satisfied that the completed construction will be entirely stable and provide easy access to the sewer for maintenance.

d. Gravel Base Course:

- i. Gravel base course material for trench repair shall consist of hard, durable particles or fragments of stone or gravel. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used for gravel base course material. Fine particles shall consist of natural or processed sand. The material shall be free of harmful amounts of organic material.

- ii. Gravel base course material shall be graded to the following specifications:

100% passing	3" screen
95 -100% passing	2-1/2" screen
55-85% passing	1" screen
27-52% passing	#4 sieve
0-12% passing	#200 sieve

e. Loam and Seed:

- i. Loam shall be screened with a 3/4" screen and shall be generally free from stones, lumps, stumps, subsoil, roots and weeds. The minimum and maximum pH value shall be from 5.5 to 7.6. Loam shall contain a minimum of 3% and a maximum of 10% of organic matter. Not more than 65% shall pass a No. 200 sieve. In no instance shall more than 20% of the material passing the No. 4 sieve consist of clay size particles.
- ii. Park seed Type 15 shall normally be used on loam areas. This seed shall conform to the following specifications:

<u>Seed Type</u>	<u>Min. Purity (%)</u>	<u>Min. Germ. (%)</u>	<u>Pounds/Acre</u>
Creeping Red Fescue	96	85	40
Perennial Ryegrass	98	90	50
Kentucky Bluegrass	97	85	25
Redtop	95	80	5

f. Pavement:

- i. For sewer projects located in roadways, please refer to the Roadway Construction Standards for pavement specifications and requirements.

B. CONSTRUCTION METHODS:

1. SEWER PIPE:

a. Pipe Handling:

- i. The Contractor shall arrange for the delivery of the pipe sections at approved locations in the vicinity of the portion of the sewer line in which the pipe sections are to be laid. To this end, the contractor shall do such work as is necessary for access and for delivery of the pipe. Pipes shall be stored in an approved, orderly manner so that there will be a minimum of re-handling from the storage area to the final position in the trench and so that there is a minimum of obstruction and inconvenience to any kind of traffic. Deliveries shall be scheduled so that the progress of the work is at no time delayed and so that quantities of pipe shall not be stored for excessive lengths of time in crowded locations or in locations where large

storage areas might be considered objectionable. Storage of pipe will be restricted to approved or permitted areas.

- ii. The Contractor will be required to furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from delivery areas to the trench shall be restricted to operations which can cause no injury to the pipe.
- iii. The pipe shall not be dropped from trucks or into the trench.
- iv. The Contractor shall have on the job site with each pipe laying crew, all the proper tools to handle and cut the pipe. The use of hammer and chisel, or any other method which results in rough edges, chips and damaged pipe, shall be prohibited.
- v. Damaged pipe coating and/or lining shall be restored before installation as approved or directed by the Superintendent/Engineer.

b. Control of Alignment and Grade:

- i. The Contractor is responsible for establishing the location of the pipe, manholes and other appurtenances, and establishing bench marks along the route of the pipeline at convenient intervals for the use of the Contractor and for his own reference in checking the pipe and manhole invert and other elevations throughout the project.
- ii. The Contractor will use an in-pipe laser alignment instrument to assist in setting the pipe. A pipe ventilation blower shall be used with the laser.
- iii. The use of string levels, hand levels, carpenter's levels and other relatively crude devices for transferring grade or setting pipe will not be permitted.
- iv. During construction, the Contractor shall provide the Superintendent /Engineer all reasonable and necessary materials, opportunities and labor assistance for checking work and taking field measurements. The Contractor shall not proceed until the Superintendent/Engineer authorizes the Contractor to continue. Any corrective work shall be done in strict conformance with the Superintendent/Engineer's instructions. The Contractor shall maintain all vertical and horizontal survey control stakes.

c. In-Trench Dimensions:

- i. For sewer pipe up to 15 inches in diameter, the allowable trench width at a plane 12 inches above the pipe shall be no more than 36 inches. For pipe greater than 15 inches, the allowable width shall be equal to the pipe outside diameter plus 24 inches.

d. Preparation of Bed:

- i. As soon as excavation has been completed to the proper depth, a 6-inch

layer (minimum) of bedding material shall be placed and compacted to the elevation necessary to bring the pipe to grade. It shall be the Contractor's responsibility to control any water in the trench below the pipe invert with pumps or other means including the use of clay or other impermeable materials placed in the bedding at intervals to prevent horizontal movement of the bed and to dewater the trench.

- ii. If in the opinion of the Superintendent/Engineer, the material below the bedding (6 inches below grade of pipe bottom) is unsuitable for foundation, it shall be removed and replaced with bedding material.

e. Laying Pipe:

- i. Each pipe length shall be inspected for cracks, defects in coating or lining, and any other evidence of unsuitability. Before lowering in place, the pipe shall be struck with a suitable tool to verify its soundness.
- ii. Pipe shall then be laid on the trench bedding as shown on the Sewer Trench Section detail, and the spigot pushed home. Jointing shall be in accordance with the manufacturer's instructions and the appropriate ASTM Standards, and the Contractor shall have, on hand for each pipe-laying crew, the necessary information to install the pipe in a workman-like manner. Pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow.
- iii. After the pipe has been set to grade, additional bedding material shall be placed up to the spring line (mid-depth) of the pipe. Tamping bars shall be carefully employed to assure compaction of the bedding under the lower quadrants of the pipe.
- iv. Filter fabric shall then be placed in all paved locations. The sand blanket shall be carefully placed to a depth of 12 inches over the crown of the pipe.
- v. Each layer shall be thoroughly compacted with mechanical equipment. Care should be taken that the equipment does not damage the pipe.
- vi. Compaction shall be in 12-inch lifts for bedding and blanket materials.
- vii. All trench backfill shall be compacted to a 95% modified proctor in roadways and to a 90% modified proctor in cross country locations. At a minimum, a reversible plate compactor with an operating weight of at least 400 lbs. and a centrifugal force of at least 7,000 lbs. shall be used to achieve the required compaction.
- viii. The pipe shall then be checked for line and grade and any debris shall be removed. If inspection of the pipe is satisfactory, the Contractor may then backfill the remainder of the trench in accordance with the Sewer Trench Section detail.
- ix. Backfill material shall be compacted in 3-foot layers to the ground surface,

except for road construction where the final 3 feet shall be compacted in 12-inch layers to the surface of the gravel base course. Backfill material shall have no stones larger than 6 inches in diameter.

- x. Where sheeting is placed alongside the pipe and extends below mid-diameter, it shall be cut off and left in place to an elevation not less than one foot above the top of the pipe. Where sheeting is to be left in place, it shall be cut off at least 3 feet below finish grade, but not less than one foot above the top of the pipe.
- xi. At any time that work is not in progress, the end of the pipe shall be suitably closed to prevent the entry of animals, earth, etc.
- xii. At the end of each day's work or at intervals of no more than 300 feet of length, the Superintendent/Engineer, with the Contractor, will inspect the pipe for alignment with lamps or mirrors. Unsatisfactory work shall be dug up and reinstalled to the satisfaction of the Superintendent/Engineer.

f. Insulation:

- i. Insulating material, where necessary, shall be 3-inch thick fiberglass pipe insulation with pit-wrap jacket as manufactured by Owens-Corning or equal, or 2-inch thick R-10 rigid foam board sheets, as appropriate.

2. MANHOLES:

a. Installation of Manhole and Base Sections:

- i. Pre-cast and poured-in-place bases shall be placed on a 6-inch layer of compacted bedding material. The excavation shall be properly dewatered while placing bedding material and setting the pre-cast base or pouring concrete. Waterstops shall be used at the horizontal joints of poured-in-place manholes.
- ii. Inlet and outlet stubs shall be connected and sealed in accordance with the manufacturer's recommended procedure, and as shown on the Standard Sewer Manhole detail.
- iii. Barrel sections and cones of the appropriate combination of heights shall then be placed, using the manufacturer's recommended procedure for sealing the horizontal joints and as shown on the Standard Sewer Manhole detail. Joints shall be sealed with a double row of Kent Seal No. 2 or approved equal. All lift holes and inside joints shall be plugged with a non-shrinking mortar, as approved by the Superintendent/Engineer.
- iv. A leakage test shall then be conducted. If the manhole has been backfilled and it fails the leakage test, the Contractor can try sealing the manhole from the inside. If it fails again, it must be excavated and sealed from the outside.
- v. Following satisfactory completion of the leakage test, a temporary steel

plate or frame and cover shall be placed on top of the structure to prevent accidental entry by unauthorized persons, children, animals, etc.

- vi. For doghouse manholes, standard base, barrel, and cone sections shall be used. The base and barrel sections shall be notched, as required, to fit over the existing sanitary sewer as shown in the Doghouse Sewer Manhole detail. Subsequent pre-cast barrel sections and cones shall be installed in accordance with the standard sewer manhole specification above.

b. Adjusting Frames to Grade:

- i. Frames shall be centered over the manhole opening and flush to the finished pavement. A minimum of 1 course of brick is required under the frame, yet the adjusting course shall not exceed a 12-inch height of brick. Precast concrete rings and mortar may also be used to adjust the frame to grade instead of brick and mortar.

c. Setting Manhole Frames and Covers:

- i. Manhole frames shall be set concentric with the top of the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.
- ii. Manhole covers shall be left in place in the frames whenever work is not being performed in the manholes.

d. Brick Inverts:

- i. 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 as shown on the Brick Invert and Shelf detail. All inverts must be clean and smooth.
- ii. Mortar joints shall be tooled flush to the face of the brick to prevent minor depressions. Shelves shall be constructed to the mid-point of the pipe on pipe sizes ranging from 8-inch to 16-inch and to the highest pipe crown on larger pipe. The brick shelf shall be pitched to drain toward the flowing channel with a one-inch difference from the structure wall to the channel edge. Excess space below the shelf may be filled with brick and mortar (wet or damp mix at the discretion of the Contractor).

3. SEWER SERVICE LATERALS:

a. General:

- i. Sewer service laterals shall be connected to the gravity sanitary sewer

through a wye branch.

- ii. At each service termination point, the sewer shall be plugged with a suitable watertight cap or plug. An approved ferrous rod shall be driven to within 2 inches of the surface at the termination point to permit future location with metallic detection equipment.
- iii. If the depth of the sanitary sewer is greater than 12 feet, sufficient riser pipe shall be connected to the wye branch at a 45 degree slope and shall terminate at a depth allowing adequate cover and sufficient slope of the service to the building. The bedding under the wye shall be thoroughly compacted.
- iv. Contractors installing sewer service laterals shall maintain record of elevation and location of sewer service termination points, submitting same to Sewer Department on an 8-1/2" x 11" sheet of paper for each service termination. Swing ties shall be taken to fixed permanent local features (hydrants, building corners, utility poles, etc.).

C. TESTING:

1. LEAKAGE TESTING OF MANHOLES:

a. General:

- i. A Leakage test, observed by the Superintendent /Engineer, shall be conducted on each manhole. The test shall be a vacuum test at all manholes. All testing shall be done prior to backfilling the manhole except when authorized by the Superintendent/Engineer.

b. Test Procedure:

- i. The testing shall be done after assembly of the manhole.
- ii. The manhole-to-pipe connections shall be made. A 60 inch-lb. torque wrench shall be used to tighten the external pipe clamps of the manhole-to-pipe connectors.
- iii. The Contractor shall plug all pipe openings, taking care to securely brace the plugs and the pipe.
- iv. With the vacuum tester set in place:
 - o Inflate the compression band to affect a seal between the vacuum base and the manhole structure.
 - o Connect the vacuum pump to the outlet port with the valve open.
 - o Draw a vacuum to 10" of Hg.
 - o Close the valve and remove the hose.
 - o Record the time required for the vacuum pressure to drop from 10" of

Hg to 9" of Hg.

- v. Each manhole shall pass the leakage test if the time required to drop from 10" of Hg to 9" of Hg is equal to or greater than the following times per manhole depth classification:

<u>Manhole Depth (feet)</u>	<u>Time (seconds)</u>
0 – 10	120
10 – 15	150
15 – 20	180
20 – 25	210

- vi. If the manhole does not pass the leakage test, it shall be repaired and retested at the Contractor's expense.

2. LEAKAGE TESTING OF SEWERS:

a. General:

- i. After completing backfill of the sanitary sewer, the Contractor shall, at his expense, conduct a leakage test using low pressure air. The test shall be performed according to stated procedures and in the presence of the Superintendent/Engineer.
- ii. The Contractor shall have the proper plugs, and other equipment required to perform all tests as required by the Superintendent/Engineer. Testing of each section of installed sewer shall include portions of service connections and cleanouts up to the right-of-way line or equivalent.
- iii. It is recommended that no more than 1,000 feet of gravity sanitary sewer be laid before testing.

b. Test Procedure:

- i. Low pressure air testing shall be in accordance with ASTM C828 or ASTM F1417.
- ii. The line shall be flushed prior to testing to wet the pipe surface and clean out debris.
- iii. All pneumatic plugs shall be seal tested before being used in the actual test installation. One (1) length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 24 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs.
- iv. After a manhole to manhole reach of the pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 24 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater that may be over the pipe. At least two

minutes shall be allowed for the air pressure to stabilize.

- v. After the stabilization period (4.0 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 4.0 to 3.0 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

<u>Pipe in Diameter (inches)</u>	<u>(Time) minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.5
24	11.5

- vi. In areas where groundwater is known to exist, the Contractor shall install monitoring wells adjacent to upstream and downstream manholes to allow measurement of static water pressure relative to the sanitary sewer elevation. The depth of groundwater observed in the monitoring well (measured in feet) shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. For example, if the height of water is 11-1/2 feet, then the added pressure will be 5.0 psig, and the 4.0 psig test pressure will be 9.0 psig. The allowable drop of one pound and the timing remain the same.
- vii. If the installation fails the leakage test, the Contractor shall, at his expense, determine the source of leakage, repair or replace all defective materials and/or workmanship, and retest the line.

3. SEWER DEFLECTION TEST:

a. General:

- i. PVC sewer pipe shall be diametrically gauged for excessive deflection after installation and backfill by passing a properly sized "go, no-go" mandrel through the installed sewers. Sewers shall be cleaned prior to testing. The total length of each sewer pipe run shall be tested. Any pipe found to have greater than 5% diametrical deflection shall not be accepted.
- ii. If the sewer pipe does not pass the deflection test, it shall be repaired and retested at the Contractor's expense.

4. MIRROR TESTING OF SEWERS:

a. General:

- i. Mirror testing shall be conducted to check for excess deflection, horizontal alignment, and vertical alignment. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through a completed run of sewer pipe. Pipe runs that are true and straight in horizontal and vertical alignment will allow for full passage of the reflected light (full moon will be visible).
- ii. If full passage of the reflected light is not achieved, the Contractor shall remove and replace the sewer pipe as necessary and re-inspect.

5. SEWER VIDEO CAMERA INSPECTION:

a. General:

- i. All pipelines will be subject to the scrutiny of a video inspection prior to acceptance. Just before video inspection, a sufficient amount of water colored with red dye shall be flushed through the pipelines to saturate potential low spots so they may be detected during inspection. Low spots holding water in excess of 1 inch or 5% of the pipe diameter, whichever is less, will be considered unacceptable. The video inspection will be at the Contractor's expense.
- ii. If unacceptable low spots exist, the Contractor shall repair or replace sewer, as necessary, as well as re-inspect and test at the Contractor's expense.
- iii. The video inspection shall be copied to a DVD and submitted to the Superintendent/Engineer prior to acceptance of the pipeline(s).

4.02 SEWER FORCE MAIN:

A. MATERIALS:

1. SEWER PIPE:

a. PVC:

- i. PVC pressure pipe shall conform to AWWA C900. SDR 25 (pressure class 100 psi), SDR 18 (pressure class 150 psi) and SDR 14 (pressure class 200 psi) shall be used for pipes 4" to 12" in diameter. SDR 21 (pressure class 200 psi) and SDR 26 (pressure class 160 psi) shall be used for pipes less than 4 inches in diameter. For a given operating pressure, the provided pressure class shall be at least double. All pipe shall be made from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 or 12364 as defined in ASTM D1784. The pipe shall be colored green for in-ground

identification as sewer pipe. Methods of shipping and storage on site shall be such as to avoid injury to the pipe. Damaged pipe shall be rejected and removed from the job site.

- ii. The integral bell joint system shall meet the requirements of ASTM D3139 for joint tightness and shall utilize an elastomeric gasket conforming to ASTM F477. Manufacturer's instructions for installation shall be followed. Solvent cement joints shall not be permitted.
- iii. Fittings shall be ductile iron conforming to AWWA C110 or AWWA C153 with a minimum working pressure of 350 psi. Fittings shall have a cement mortar lining per ANSI/AWWA C104/A21.4 and bituminous seal coat on the inside. The exterior of the pipe and fittings shall be furnished with 1 mil asphaltic coating per ANSI/AWWA C151/A21.51. Fittings shall have restrained mechanical joints (retainer glands). Mechanical joint glands shall be Grade 70-50-05 ductile iron and cast in one continuous ring. Restraint devices for connection to ductile iron mechanical joints shall consist of a serrated-type restraint ring installed on the PVC pipe behind the ductile iron fitting follower gland and gasket.

b. Ductile Iron:

- i. Ductile iron pipe for force mains shall conform to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. All pipe and fittings shall have a cement mortar lining per ANSI/AWWA C104/A21.4 and bituminous seal coat on the inside. The exterior of the pipe and fittings shall be furnished with 1 mil asphaltic coating per ANSI/AWWA C151/A21.51. Ductile iron pipe shall be AWWA Class 52.
- ii. Ductile iron fittings shall conform to AWWA C110 or AWWA C153 and shall have a minimum working pressure of 350 psi. Fittings shall have a cement mortar lining per ANSI/AWWA C104/A21.4 and bituminous seal coat on the inside. The exterior of the pipe and fittings shall be furnished with 1 mil asphaltic coating per ANSI/AWWA C151/A21.51. Fittings shall have restrained mechanical joints (retainer glands). Mechanical joint glands shall be Grade 70-50-05 ductile iron and cast in one continuous ring. Restraint devices shall be a wedge-type joint restraint.
- iii. Ductile iron pipe shall have either the rubber-ring type push-on joint or standard mechanical joint. Rubber gasket joints shall conform to ANSI/AWWA C111/A21.11 for mechanical and push-on type joints.
- iv. Methods of shipping and storage on site shall be such as to avoid injury to the pipe and fittings. Damaged pipe or fittings shall be rejected and removed from the job site.

c. HDPE:

- i. Materials used for the manufacture of polyethylene pipe shall be PE 3408/3608 High Density Polyethylene resin formulation listed with the Plastic Pipe Institute (PPI) as TR-4 and shall have a PPI recommended

Hydrostatic Design Basis (HDB) of 1600 PSI at a temperature of 73.4°F. The resin material shall meet the specifications of ASTM D3350 with a cell classification of PE:345464C.

- ii. Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer.
- iii. Joints between plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle fusion procedures used shall be those recommended by the pipe and fitting manufacturer.

d. Other:

- i. Accessories such as gaskets, glands, nuts, bolts, etc. shall be provided as required to make the installation complete.
- ii. Transition couplings shall be constructed of ductile iron with stainless steel nuts and bolts. Couplings shall be Rockwell 441, Ford 501, or comparable model. Hymax couplings may also be used as appropriate.
- iii. Gate valves shall be of the resilient seat type with neoprene seat and cast iron body. The valves shall be epoxy coated and shall be designed in accordance with AWWA C502. Valves shall have restrained mechanical joints (retainer glands), 2-inch square operating nut, and have a working pressure of 175 psi. Valves shall open left and have a non-rising stem.
- iv. Each exterior valve shall be provided with a valve box and cover. The box shall be constructed of cast iron and shall be adjustable. The letter "S" shall be cast into the covers.
- v. Air release valves shall have a cast iron body and cover conforming to ASTM A126 Class B. Air release valves shall be supplied with stainless steel floats. The valve body and float shall withstand 500 psi shell test pressure. They shall be manufactured by APCO or approved equal.

2. TRENCH MATERIALS:

- a. Force main bedding, blanket and backfill requirements shall be same as for gravity sewer (see Section 4.01.A.3).

B. CONSTRUCTION METHODS:

1. SEWER PIPE:

a. Pipe Handling:

- i. The Contractor shall arrange for the delivery of the pipe sections at approved locations in the vicinity of the portion of the sewer line in which the pipe sections are to be laid. To this end, the Contractor shall do such work as is necessary for access and for delivery of the pipe. Pipes shall

be stored in an approved, orderly manner so that there will be a minimum of re-handling from the storage area to the final position in the trench and so that there is a minimum of obstruction and inconvenience to any kind of traffic. Deliveries shall be scheduled so that the progress of the work is at no time delayed and so that quantities of pipe shall not be stored for excessive lengths of time in crowded locations or in locations where large storage areas might be considered objectionable. Storage of pipe will be restricted to approved or permitted areas.

- ii. The Contractor will be required to furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from delivery areas to the trench shall be restricted to operations which can cause no injury to the pipe.
- iii. The pipe shall not be dropped from trucks or into the trench.
- iv. The Contractor shall have on the job site with each pipe laying crew, all the proper tools to handle and cut the pipe. The use of hammer and chisel, or any other method which results in rough edges, chips and damaged pipe, shall be prohibited.
- v. Damaged pipe coating and/or lining shall be restored before installation as approved or directed by the Superintendent/Engineer.

b. Control of Alignment and Grade:

- i. The force main shall be laid and maintained to the required lines and grades with fittings, valves and other appurtenances at the locations depicted on the design plans. The Contractor is responsible for establishing bench marks along the route of the pipeline at convenient intervals for use in checking the pipe and other elevations throughout the project.
- ii. During construction, the Contractor shall provide the Superintendent /Engineer all reasonable and necessary materials, opportunities and labor assistance for checking work and taking field measurements. The Contractor shall not proceed until the Superintendent/Engineer authorizes the Contractor to continue. Any corrective work shall be done in strict conformance with the Superintendent/Engineer's instructions. The Contractor shall maintain all vertical and horizontal survey control stakes.

c. In-Trench Dimensions:

- i. For sewer force main up to 15 inches in diameter, the allowable trench width at a plane 12 inches above the pipe shall be no more than 36 inches.

d. Preparation of Bed:

- i. As soon as excavation has been completed to the proper depth, a 6-inch layer (minimum) of bedding material shall be placed and compacted to

the elevation necessary to bring the pipe to grade. It shall be the Contractor's responsibility to control any water in the trench below the pipe invert with pumps or other means including the use of clay or other impermeable materials placed in the bedding at intervals to prevent horizontal movement of the bed and to dewater the trench.

- ii. If in the opinion of the Superintendent/Engineer, the material below the bedding (6 inches below grade of pipe bottom) is unsuitable for foundation, it shall be removed and replaced with bedding material.

e. Laying Pipe:

- i. Each pipe length shall be inspected for cracks, defects in coating or lining, and any other evidence of unsuitability. Before lowering in place, the pipe shall be struck with a suitable tool to verify its soundness.
- ii. Pipe shall then be laid on the trench bedding as shown on the Sewer Trench Section detail, and the spigot pushed home. Jointing shall be in accordance with the manufacturer's instructions and the appropriate ASTM Standards, and the Contractor shall have, on hand for each pipe-laying crew, the necessary information to install the pipe in a workman-like manner. Pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow.
- iii. After the pipe has been set to grade, additional bedding material shall be placed up to the spring line (mid-depth) of the pipe. Tamping bars shall be carefully employed to assure compaction of the bedding under the lower quadrants of the pipe.
- iv. Filter fabric shall then be placed in all paved locations. The sand blanket shall be carefully placed to a depth of 12 inches over the crown of the pipe.
- v. Each layer shall be thoroughly compacted with mechanical equipment. Care should be taken that the equipment does not damage the pipe.
- vi. Compaction shall be in 12-inch lifts for bedding and blanket materials.
- vii. All trench backfill shall be compacted to a 95% modified proctor in roadways and to a 90% modified proctor in cross country locations. At a minimum, a reversible plate compactor with an operating weight of at least 400 lbs. and a centrifugal force of at least 7,000 lbs. shall be used to achieve the required compaction.
- viii. The pipe shall then be checked for line and grade and any debris shall be removed. If inspection of the pipe is satisfactory, the Contractor may then backfill the remainder of the trench in accordance with the Sewer Trench Section detail.
- ix. Backfill material shall be compacted in 3-foot layers to the ground surface, except for road construction where the final 3 feet shall be compacted in

12-inch layers to the surface of the gravel base course. Backfill material shall have no stones larger than 6 inches in diameter.

- x. Where sheeting is placed alongside the pipe and extends below mid-diameter, it shall be cut off and left in place to an elevation not less than one foot above the top of the pipe. Where sheeting is to be left in place, it shall be cut off at least 3 feet below finish grade, but not less than one foot above the top of the pipe.
- xi. At any time that work is not in progress, the end of the pipe shall be suitably closed to prevent the entry of animals, earth, etc.
- xii. At the end of each day's work or at intervals of no more than 300 feet of length, the Superintendent/Engineer, with the Contractor, will inspect the pipe for alignment. Unsatisfactory work shall be dug up and reinstalled to the satisfaction of the Superintendent/Engineer.

f. Setting Valves and Fittings:

- i. Valves shall be set plumb and a valve box shall be provided for every buried valve. The valve box shall not transmit shock or stress to valves and shall be centered and plumb over wrench nut of valve, with box cover flush with finished grade.
- ii. Backfill around valve shall be carefully tamped in 6-inch layers for full depth of trench with the valve box in place.

g. Providing Thrust Blocks:

- i. Provide thrust blocks between solid ground and the fitting to be anchored.
- ii. Place the base and thrust bearing sides of the thrust block directly against undisturbed earth.
- iii. The thrust block must be placed such that fitting joints will be accessible for repair.

h. Insulation:

- i. Insulating material, if necessary, shall be 3-inch thick fiberglass pipe insulation with pit-wrap jacket as manufactured by Owens-Corning or equal, or 2-inch thick R-10 rigid foam board sheets.

C. TESTING:

1. PRESSURE AND LEAKAGE TEST:

a. General:

- i. All force mains shall be hydrostatically tested according to AWWA C600 Section 4.

b. Test Restrictions:

- i. Test pressure shall not be less than 1.5 times the working pressure at the highest point or 50 psi, whichever is greater.
- ii. Test pressure shall not exceed pipe or thrust-restraint design.
- iii. The hydrostatic test shall be of at least a 2-hour duration.
- iv. Test pressure shall not vary by more than 5 psi (35 MPa or 0.35 bar) for the duration of the test.
- v. Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure.
- vi. Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves.

c. Test Procedure:

- i. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing or 50 psi, whichever is greater. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.
- ii. Before applying the specified test pressure, air shall be expelled completely from the pipe and valves. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Superintendent/Engineer.
- iii. Any exposed pipe, fittings, valves and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the Superintendent/Engineer.
- iv. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 MPa or 0.35 bar) of the specified test pressure over a 2-

hour period of time after the pipe has been filled with water and the air has been expelled.

- v. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 11.65 gpd/mi/in of nominal diameter at a pressure of 150 psi.

- vi. Allowable leakage at various pressures is shown in the table below.

Allowable Leakage per 1,000 ft (305 m) of Pipeline – gph

Avg. Test Pressure (psi)	Nominal Pipe Diameter - inches					
	3	4	6	8	10	12
200	0.29	0.38	0.57	0.76	0.96	1.15
175	0.27	0.36	0.54	0.72	0.89	1.07
150	0.25	0.33	0.50	0.66	0.83	0.99
125	0.23	0.30	0.45	0.60	0.76	0.91
100	0.20	0.27	0.41	0.54	0.68	0.81

- vii. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified in the table above, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

- viii. All visible leaks are to be repaired, regardless of the amount of leakage.

4.03 SEWER SERVICE:

A. MATERIALS:

1. SEWER PIPE:

- a. Gravity sewer service laterals shall be constructed of the same material and strength class as that of the gravity sanitary sewer, only if the gravity sanitary

sewer is ductile iron pipe or PVC pipe. If the gravity sanitary sewer is any material other than ductile iron or PVC pipe, the lateral shall be ductile iron or PVC pipe of the same strength class specified in Section 4.01.A.1 of this document.

- b. Pressurized sewer service laterals (those used in conjunction with a grinder pump) shall be constructed of SDR 21 (pressure class 200 psi) or SDR 26 (pressure class 160 psi), as appropriate. Joints shall be push-on type. Solvent welded fittings are not permitted. Refer to Section 4.02.A.1.a for more information regarding pressure pipe and fittings.

2. TRENCH MATERIALS:

- a. Bedding, blanket and backfill requirements for gravity sewer services shall be the same as for gravity sewer (see Section 4.01.A.3).
- b. Bedding and blanket for pressurized sewer services shall be graded sand, free from organic materials. It should be graded such that 100% passes an 1/2-inch sieve and a maximum of 15% passes a #200 sieve. Backfill requirements are the same as for gravity sewer (see Section 4.01.A.3).

3. OTHER:

- a. Oil/water/grit separators shall be of the manhole type. The concrete structure and castings shall comply with the standard manhole specifications in Section 4.01.A.2. Piping shall be cast iron soil pipe as specified in the Oil/Water/Grit Separator detail.
- b. Grease traps shall be a single-chamber, pre-cast concrete tank located below grade with three openings for direct exterior access. Frames and covers shall provide a 30-inch diameter clear opening and shall comply with the standard manhole specifications in Section 4.01.A.2.b. The concrete structure shall be capable of withstanding AASHTO H-20/HS-20 loading without failure. Piping shall be as specified in the Grease Trap detail.
- c. Backflow preventers shall be horizontal in-line backflow valves. They shall be injection molded from ABS or PVC with cleanout opening at the top, as manufactured by Canplas or approved equal. Size shall match that of sewer service.

B. CONSTRUCTION METHODS:

1. SEWER PIPE:

- a. Gravity sewer service pipe installation shall be the same as for gravity sewer (see Section 4.01.B.1).
- b. Pressurized sewer service pipe installation shall be the same as for gravity sewer (see Section 4.01.B.1), except that sand shall be used for the bedding and blanket material.

- c. In regard to sewer service inspections, the Sewer Service Permit fee will cover the cost of one service inspection. For more information about Sewer Service Permits, refer to the Hooksett Sewer Ordinance.

C. TESTING:

1. VISUAL INSPECTION:

a. General:

- i. Prior to backfill of the sewer lateral, it shall be subject to a visual inspection performed by the Superintendent/Engineer.
- ii. If installation of the sewer pipe is deemed to be unacceptable, the pipe shall be dug up, re-laid and re-inspected to the satisfaction of the Superintendent/Engineer.

2. OIL/WATER/GRIT SEPARATOR LEAKAGE TEST:

a. General:

- i. A leakage test shall be performed on all oil/water/grit separators and shall be observed by the Superintendent/Engineer. The test shall be a vacuum test performed prior to backfill, except when authorized by the Superintendent/Engineer.

b. Test Procedure:

- i. The test shall follow the same procedure as that of the manhole leakage test found in Section 4.01.C.1.

3. GREASE TRAP LEAKAGE TEST:

a. General:

- i. A leakage test shall be performed on all grease traps and shall be observed by the Superintendent/Engineer. The test shall be a water exfiltration test performed prior to backfill.

b. Test Procedure:

- i. All inlet and outlet pipes shall be plugged.
- ii. The grease trap shall be filled with water and left to stabilize for a period of twenty-four (24) hours prior to taking measurements (to account for water absorption).
- iii. During the stabilization period, should the water level drop below the original level, the Contractor, in the presence of the Superintendent/Engineer, shall add additional water to account for water lost.

- iv. The test period shall begin following the stabilization period. The addition of water shall not be allowed once the test has begun.
- v. The test shall be conducted for a period of at least two (2) hours. The Superintendent/Engineer shall take three (3) readings of the water level at the beginning of the test period, and three (3) more readings at the end of the test period.
- vi. Leakage shall not exceed one (1) gallon per 1,000 gallons of storage for a two hour test.
- vii. If the structure does not pass the leakage test, it shall be repaired and retested at the Contractor's expense.

4.04 SEWAGE PUMP STATION:

A. CONSTRUCTION MATERIALS AND METHODS FOR TYPE "A", "B" AND "C" PUMP STATIONS:

1. Construction materials and methods shall comply with design standards and general methods specified by product manufacturers and as approved by the Hooksett Sewer Commission.
2. All below grade pump station structures shall be constructed of concrete. Stations made of steel, fiberglass or other materials will not be accepted.
3. All fittings, clamps, anchors, hatches, and appurtenant equipment housed in the wet well shall be made of stainless steel or aluminum.
4. Pipe material for sizes 4" or larger shall be a minimum of C153 flanged ductile iron pipe with 150 lb. cast iron flanged fittings. Isolation valves shall be a minimum of 175 lb. flanged cast iron resilient wedge gate valves or plug valves complete with non-rising stem operators. Check valves shall be flanged on the inlet and outlet sides for ease of maintenance and shall be the external lever type.
5. Pipe material for sizes smaller than 4" shall be SCH 80 PVC pipe or SCH 40 galvanized steel pipe. Check valves shall be flanged on inlet and outlet sides for ease of maintenance.
6. Pump stations shall be equipped with Bilco "SS" type hatches, or equal, equipped with thru-hatch safety handrails for access to wet wells, or to submersible pump stations.