

TOWN OF MERRIMACK
DEPARTMENT OF PUBLIC WORKS
WASTEWATER TREATMENT FACILITY
SANITARY SEWERAGE ENGINEERING
STANDARDS

Revised

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PUBLIC WORKS DEPARTMENT
Wastewater Division

SANITARY SEWERAGE ENGINEERING

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CHAPTER S1 - GENERAL REQUIREMENTS

S1-01 GENERAL

These Engineering Standards set forth minimum standards for the planning, design, and construction of sanitary sewerage collection facilities.

The Sewer Use Ordinance currently adopted and Chapter 158 of the Town of Merrimack Code, is the basis for these engineering Standards and State of New Hampshire Department of Environmental Services (NHDES) Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities Env-Wq 700 effective October 15, 2014 or most current revision.

Although these standards are intended to apply to physical development within the Town, the standards will not apply for all situations. Compliance with these standards does not relieve the designer of the responsibility to apply conservative and sound professional judgment. These are minimum standards and are intended to assist, but not substitute for competent work by design professionals. The Town may at its sole discretion due to special conditions and/or environmental constraints, require more stringent requirements than would normally be required under these standards.

S1-02 DEFINITIONS

The following terms as used in this document shall be defined and interpreted as follows:

a. “Contractor”

The person, partnership, firm or corporation contracting to do the work under these Documents. The term shall also include the Contractor's agents, employees and subcontractors.

b. “Details or Additional Drawings”

All details or drawings prepared to further explain or amplify the plans, or for the revision of the same, all as herein provided.

c. “Developer”

Any individual, company, partnership, joint venture, corporation, association, society or group that has made, or intends to make, application to the Town for permission to construct a sanitary sewer system connection, or extension, to the Town's sanitary sewerage system.

d. “Engineer”

The Town of Merrimack Director of Public Works or his duly authorized assistants, which includes Consultant Engineer and/or Inspectors.

e. “Equipment”

The machinery, accessories, appurtenances, and manufactured articles to be furnished and/or installed under the Project.

f. “Material or Materials”

These words shall be construed to embrace machinery, manufactured articles, materials of construction (fabricated or otherwise) and any other classes of material to be furnished in connection with the Project.

g. “Or Equal”

Any manufactured article, material, method, or work which, in the opinion of the Engineer, is equally desirable or suitable for the purposes intended in these standards, as compared with similar articles specifically mentioned herein.

h. “Plans”

All official drawings or reproductions of drawings made or to be made pertaining to the work provided for in the permit or developer extension agreement.

i. “Project”

The structure or improvement to be constructed in whole or in part.

j. “Reference Specifications”

Reference specifications shall mean the technical specifications of other agencies incorporated or referred to herein.

k. “Specification”

The specifications shall mean the prescribed directions, requirements, explanations, terms and provisions pertaining to the various features of the work to be done, or manner and method of performance. They also include directions, requirements, and explanations as set forth on the plans.

l. “Standard Details”

State of New Hampshire standard detail drawing and any additional details required by the Town of Merrimack.

m. “Standard Specifications”

New Hampshire Department of Environmental Services (NHDES), Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities Env-Wq 700 effective October 15, 2014, or most current revision.

n. “Words and Phrases”

Whenever the words, “as directed”, “as required”, “as permitted”, or words of like effect are used, it shall be understood that the direction, requirement or permission of the Engineer is intended. The words, “sufficient”, “necessary”, “proper”, and the like shall mean sufficient, necessary or proper in the judgment of the Engineer. The words, “approved”, “acceptable”, “satisfactory”, or words of like import shall mean approved by or acceptable to the Engineer.

o. Work

The work necessary to manufacture and deliver machinery, equipment and material and/or the furnishing of all labor, tools, material, equipment, construction equipment, working drawings, where required, and other, necessities for the construction or erection of the structures shown and called for in the plans, specifications and permit/Developer Extension Agreement, and the act of constructing or erecting said structures complete.

S1-03 REFERENCES

Wherever references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user, the following acronyms or abbreviations which may appear, shall have the meanings indicated herein:

AASHTO	American Association of the State Highway and Transportation Officials.
ANSI	American National Standards Institute, Inc.
NHDES	New Hampshire Department of Environmental Services
APWA	American Public Works Association
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
DOH	Department of Health

S1-04 GOVERNMENTAL AGENCY REQUIREMENTS

All construction on Town or State roads or right-of-way shall be done in accordance with the agency's standards and requirements and in accordance with the franchise and/or permit requirements. The Contractor is responsible to determine these requirements prior to construction.

Where conflict exists between these Standards and permit requirements, the most stringent permit requirements shall take precedence.

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CHAPTER S2 - DESIGN DRAWING SUBMITTAL

S2-01 GENERAL

Following these standards to design the sanitary sewerage system will help ensure a timely review of the proposed project.

S2-02 DEVIATIONS

S2-02.1 General

The Developer may propose a deviation from the Standards. A non-standard system may take longer to review. The Developer acknowledges these risks when submitting a non- standard system for review.

S2-02.2 Deviation Criteria

Requests for deviations which are site or project specific, shall be reviewed by the Town and its consultant. The Town's decision to grant, deny, or modify the proposed deviation shall be based upon evidence that the deviation request meets the following criteria:

- a. The change will achieve the intended result through a comparable or even superior design; and
- b. The change will not adversely affect safety and/or operation; and
- c. The change will not adversely affect maintainability.

S2-03 ERRORS AND OMISSIONS

Any errors or omissions in the approved plans or information used as a basis for such approvals may constitute grounds for withdrawal of any approvals and/or stoppage of any or all of the permitted work as determined by the Town. It shall be the responsibility of the Developer to show why such work should continue, and make such changes in plans that may be required by the Town before the plans are approved for construction.

S2-04 DESIGN DRAWINGS

S2-04.1 General

Sewerage construction plans shall be printed and submitted on 24"x36" sheets and electronic PDF format. All drawings shall be dimensioned in English units. Drawings shall contain the following information:

S2-04.2 Cover Sheet

A cover sheet shall be provided for sewer plans consisting of three or more pages or where project plans include water, street, or other improvements. The following information shall be provided on the cover sheet, or on the first page of the drawings where no cover sheet is used:

- a. Date
- b. Vicinity map showing location of project and overall sewer system.
- c. Schedule of quantities listed by size and pipe material.
- d. North arrow
- e. Project benchmark and basis of bearing. Benchmark elevation shall be referenced to the nearest existing manhole invert.
- f. General notes to include the following:
 1. Construction shall be performed in accordance with, Standard Specifications and Standard Drawings, as last revised.
 2. Contractor shall notify Department of Public Works forty-eight (48) hours in advance of construction.
- g. Design engineer's name, address, and signed stamp clearly showing the expiration date. Engineer shall be a registered professional engineer in the State of New Hampshire.
- h. Owner/Developer's name and address.

S2-04.3 Design Drawings , Technical Specifications, and Supporting Documentation

- a. Design drawings , technical specifications, and supporting documentation for proposed new or modified publicly or privately owned sewage and wastewater treatment facilities shall be submitted to the department for approval in accordance with these rules.
- b. Design drawings , technical specifications, and supporting documentation shall be submitted for any proposed sewerage which serves more than one building or which requires a manhole at the connection, and for any proposed pumping station which serves more than one building or has a capacity in excess of 50 gpm.
- c. Design drawings , technical specifications, and supporting documentation submitted to the department for review and approval action shall be prepared by, or under the direct supervision of, a New Hampshire licensed professional engineer.
- d. All design drawings shall bear:
 - 1. A title citing the project name, location, and owner;
 - 2. The scale;
 - 3. The north arrow; and
 - 4. The name and signature of the design engineer and land surveyor, and the imprint of his/her registration seal.
- e. The design drawings shall be clear, legible and drawn to a standard scale, which permits all necessary information to be plainly shown.
- f. The design drawings shall not be larger than 24 inches x 36 inches in dimension
- g. A vertical datum shall be indicated and, if different from the national geodetic vertical datum of the United States Geological Survey, its relationship thereto shall be noted.
- h. The locations and logs of any test borings shall be shown on the plans or included in the specifications.
- i. Sets of design drawings and technical specifications required to be submitted shall be as follows:
 - 1. One set for initial review. After final wastewater department approval two 24x36 printed sets, two copies of print cover sheet, three electronic sets of prints, technical specifications, and supporting documentation on three separate DVDs in PDF format, three complete sets of technical specifications and supporting documents printed in 8 1/2 x 11 format, a state sewer connection application, a cover letter, a Town of Merrimack Sewer

Connection application and a check to be submitted to the State of New Hampshire. (See Section S3-02.4 b).

- j. The following information shall be submitted by the engineer:
 - 1. A general map showing the location of the project with respect to municipal boundaries;
 - 2. Detail plan and profile sheets of all proposed sewerage and force mains;
 - 3. Details of construction of manholes, siphons, and other sewer appurtenances;
 - 4. General and detail plans for treatment plants and pumping stations;
 - 5. Technical specifications for all proposed construction; and
 - 6. Design calculations and parameters used for sizing the unit processes and components.
- k. The supporting documentation shall include:
 - 1. An explanation of the proposed boring and soil sampling methodology
 - 2. Calculations showing the estimated current flow in the sewerage and in the downstream sewerage and the impact of any proposed additional sewage flow to the sewerage and subsequent downstream sewerage
 - 3. Design flow and loading calculation, as applicable
 - 4. Flotation calculations for buried structures

S2-04.4 Design Drawings for Sewers
(Env-Wq 703.03 & Env-Wq 703.04)

Design drawings for proposed sewerage shall, in addition to the requirements above, include the following:

- a. The topography and elevation of existing or proposed streets;
- b. The locations of all streams and water surfaces, including their direction of flow and high/low water surface elevations;
- c. Contour lines;
- d. The boundary lines of the municipality, sewer district or other area to be sewered;

- e. The location, size, and direction of flow of all existing and proposed sanitary sewerage;
- f. A title block located in the lower right hand corner of the sheet to include:
 - 1. The title;
 - 2. The name of the owner;
 - 3. The name of the consultant;
 - 4. The date of the original issue and all revisions; and
 - 5. The initials of the designer, draftsman, checker, and responsible engineer.
 - 6. Plans must be stamped and signed by an engineer and land surveyor certified in the State of New Hampshire.
- g. Insets and detail sections with the scale shown directly beneath their subtitles;
- h. Plan and profile views in which the plan view is placed at the top;
- i. Plans shall show the title, date and scale, and shall show clearly the location of:
 - 1. All existing structures affecting the project and all existing or proposed sewerage;
 - 2. Treatment works;
 - 3. Existing and proposed sewerage outlets;
 - 4. The north arrow; and
 - 5. The boundary lines.
- j. The locations of existing, proposed and future sewerage as differentiated by appropriate symbols or designations;
- k. All topographical symbols and conventions used shall be as employed by the United States Geological Survey;
- l. The horizontal distance or stationing between manholes, grades in feet, slope of pipe, and sewer pipe sizes, types, and class, shall be shown. Arrows shall be drawn to indicate the direction of flow;

- m. All sewerage appurtenances shall be depicted by symbols and referenced by a legend. Detail drawings of all sewer appurtenances shall accompany the detail sewerage plans;
- n. Profiles shall indicate:
 - 1. All manholes with manhole identification numbers;
 - 2. Existing and proposed utilities with elevations;
 - 3. Siphons;
 - 4. Pumping stations; and
 - 5. In the case of stream crossings, the elevations of streambeds, normal flow lines, high and low water elevations, and the type of pipe.
- o. The sizes and gradients of sewerage, surface elevations, first floor house elevations, and sewerage inverts shall be shown at or between each manhole;
- p. Profiles shall include borings and groundwater level and, except for special details, they shall be drawn to standard scales with a ratio of 10 horizontal to 1 vertical, which shall be indicated on each sheet.
- q. Finish grade elevations shall be shown. Elevations of manhole inverts shall be shown to the nearest 0.01 foot;
- r. All elevations shall be referenced to a standard datum, and the datum used shall be indicated on the plans;
- s. The engineer shall specify any special precautions or methods of construction necessary to prevent surface water pollution.

S2-04.5 Design Drawings for Sewage Pump Stations
(Env-Wq 703.05)

- a. A location plan shall be submitted for projects involving construction or revision of pumping stations.
- b. The location plan shall include the following information:
 - 1. The location and extent of the tributary area;
 - 2. Any municipal boundaries within the tributary area; and

3. The location of the pumping station and force main, and all elevations.
- c. Detail plans shall be submitted including the following:
1. A contour map of the proposed pump stations site;
 2. Existing pumping station, location, and elevations;
 3. Proposed pumping station, including provisions for installation of future pumps or ejectors; and
 4. Elevation of high water at the site and maximum elevation of sewage in the collection system.

S2-04.6 Profile View

Profile views shall be provided for all sewer main line. Profile views shall be on the same sheet as the associated plan view and shall include the following information.

- a. Class of backfill;
- b. Size, slope, length, and class of pipe
- c. Manhole rim and invert elevations;
- d. Horizontal and vertical scale [maximum horizontal scale 1" = 50', vertical exaggeration as appropriate to show detail];
- e. Utility crossing with vertical distance between proposed sewer and existing or proposed utility shown;
- f. Existing ground profile;
- g. Match line when profile covers more than one page;
- h. Profile stationing to coincide with plan stationing.
- i. GPS locations of each manhole;
- j. List pipe length, size, material and slope to 4 decimal places (ft per ft), e.g. 150 L.F. - 8" PVC S=0.0125. Pipe material can be listed in Table in lieu of listing on profile. Slope is based on I.E. OUT of upstream manhole, I.E. INTO downstream manhole and horizontal distance between center of manholes.

S2-04.7 Plan View

Plan views shall be provided for all sewerage main lines. Plan views shall be on the same sheet as the associated profile view and shall include the following information:

- a. Drawing scale, maximum scale, (1" = 50');
- b. Map block and tax lot numbers for areas to be served and adjacent properties. For subdivisions or partitions, the tax lot number of the parcel to be divided should be shown;
- c. Existing utilities, wells, and structures;
- d. Street names, right-of-way centerlines;
- e. Property lines and easements. Easements should show all bearings and distances and a book and page reference;
- f. Distance from sewer centerline to centerline of right-of-way. Manholes shall be referenced to the centerline of the right-of-way and the road station;
- g. Sewer stationing shall begin at the lowest downstream manhole. Sewer mains within the right-of-way may use road stationing with offsets. Outside the right-of-way sewer stationing should be independent of the road stationing;
- h. Manholes shall be numbered in consecutive order, starting from the downstream manhole, and shall be referenced by sewer stationing that coincides with the profile stationing; 0+00 should be at manhole where connecting to existing system occurs;
- i. New manholes over existing mains shall be dimensioned to the closest downstream manhole.
- j. Location of all service laterals, referenced by sewer station;
- k. Town limits, zoning boundary, if applicable;
- l. Legend (utilities and other lines shall be differentiated by using varying line types and thickness);
- m. Proposed finished floor elevations;
- n. Boring hole locations, if applicable;
- o. List pipe length, size, and material along side of pipe, e.g. 150 L.F.- 8" PVC. Pipe length is to be based on horizontal distance between center of manholes;
- p. Indicate direction of flow with arrows on end of pipe entering manhole.

S2-04.8 Sanitary Sewerage General Plan Notes

The following is a listing of General Notes that should be incorporated on the first sanitary sewerage plan sheet. All the notes on the list may not pertain to every project. The Developer should include only those notes that are relevant to the project and may omit non-relevant notes. However, do not renumber the remaining General Notes. If additional notes are needed for specific aspects, they should be added after the General Notes.

Sanitary Sewerage General Notes:

1. A Preconstruction conference shall be held on all projects by the Town of Merrimack Community Development Department, at least fifteen (15) days prior to any construction work being performed. No construction will be allowed to start until this requirement is met. Contractor shall have all permits and requirements in place prior to meeting. Contractor should bring copies of all permits, etc., to meeting. All utilities involved should be represented at meeting. Also, contractor, developer, and site superintendent should attend
2. All work shall conform to Town of Merrimack Standards and the (NHDES) State of New Hampshire Standards for Sewerage and Wastewater Treatment Facilities latest revision.
3. All new manholes shall have a minimum inside diameter of 48" and shall conform to the State of New Hampshire Standard Details.
4. Sanitary sewer pipe shall be PVC conforming to ASTM-D3034 SDR 35. Bedding and backfill shall be as shown in the Standard Details.
5. All lateral sewers shall be 6" diameter pipe at a minimum 2% slope. Laterals from property line to home shall be 4" with cleanout at property line. All commercial laterals are 6" from main to building with cleanouts as directed by Building Inspector.
6. Lateral sewer stations are referenced from nearest downstream manhole.
7. Lot corners must be set and side sewerage locations verified in the field prior to construction. Property owner must be involved in final location.
8. All lateral sewer stubs shall be capped with a watertight plug. Plug location shall be marked with a 2 x 4 stake, 2 feet long, with one end buried at depth of the plug invert and extending at least 3 feet vertically out of the ground. The portion of stake above ground shall be painted green and marked with the word "SEWER" and the depth from pipe invert to ground surface. Connect pipe to stake with an 8-gauge wire at or above finished ground level.
9. The locations of all existing utilities shown hereon have been established by field survey or obtained from available records and should therefore be considered approximate only and not necessarily complete. It is the sole responsibility of the contractor to independently verify the accuracy of all utility locations shown, and to further discover and avoid any other utilities not shown hereon which may be affected by the implementation of this plan.
10. All testing and connections to existing sewer mains shall be done in the presence of a representative of the Town of Merrimack.

11. All trenches shall be compacted prior to testing sewerage lines for acceptance.
12. Lateral sewer lines shall be tested for acceptance at the same time the main sewerage line is tested.
13. Tops of manholes within public rights-of-way shall not be adjusted to final grade until just prior to paving. Manholes cannot be left below grade over winter.
14. All manholes in unpaved areas shall include a concrete seal around adjusting rings per Standard Detail and shall be a minimum of 6" above the finish grade.
15. Contractor shall adjust all manhole rims to flush with final finished grades, unless otherwise instructed.
16. All sewerage main extensions within the public right-of-way or in easements must be "staked" by survey for "line and grade".
17. Contractor shall install, at all connections to existing downstream manholes, screens or plugs to prevent foreign materials from entering existing sanitary sewer system. Screens or plugs shall remain in place throughout the duration of construction and shall be removed along with collected debris at the time of final inspection and in the presence of a representative of the Town of Merrimack.
18. Surface restoration of existing asphalt pavement shall be as required by the right-of- way use permit.
19. Contractor shall maintain a minimum of ten feet (10') horizontal separation between all water and sewer lines. Any conflicts shall be reported to the Utility and the Engineer prior to construction.
20. It shall be the contractor's responsibility to insure that no conflicts exist between sanitary sewer lines and proposed or existing utilities prior to construction.
21. Minimum cover over sewerage pipe shall be six feet in road and four feet cross- country.
22. Before commencement of trenching, the Contractor shall provide appropriate sediment control in downhill storm drain inlets and catch basins that will receive runoff from the project site. The Contractor shall periodically inspect the condition of all controls and replace as necessary. For all construction downhill basins and inlets must be protected with catch basin inserts. Simply placing filter fabric under the grate is not acceptable.

23. Lateral sewer demolition shall be performed prior to removal of building foundation. The lateral sewer for each building shall be excavated and removed from the house connection to the edge of the public right-of-way, or property line. The Contractor shall cap the end of the lateral sewer to remain in place. Lateral sewer demolition shall be performed in the presence of the Town of Merrimack Sewer Inspector.
24. Avoid crossing water or sewerage mains at highly acute angles. The smallest angle measure between utilities should be 45 to 90 degrees.
25. At points where existing thrust blocking is found, minimum clearance between the concrete blocking and other buried utilities or structures shall be 5 feet.
26. Where new utility line crosses below an existing AC main, the AC pipe shall be replaced with DI pipe to 5 feet past each side of the trench. Alternatively, where directed by the Engineer, the trench shall be backfilled with controlled density fill (CDF, also known as flowable fill) from bottom of trench to bottom of the AC main.

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CHAPTER S3 - DESIGN STANDARDS

S3-01 APPLICABILITY

S3-01.1 General

- a. If public sewer is located within 200 feet of the proposed/existing building, the owner is required to extend and connect onto the public system.
- b. If public sewer is not available, the owner is required to acquire necessary Health Department approval prior to a building permit being issued by the Town.
- c. Sanitary sewerage shall be designed to serve all lots, including lateral connections between the trunk sewerage and the property line being served.
- d. A Preconstruction conference shall be held on all sewerage projects by the Town of Merrimack Community Development Department at least fifteen (15) days prior to any construction work being performed. The contractor's superintendent/foreman shall also attend this meeting. If superintendent/foreman cannot attend, then the developer or contractor's representative shall submit a letter to the Town that the superintendent/foreman has been informed of items discussed at this meeting.
- e. Under no circumstances shall storm water, surface water, ground water, roof runoff, subsurface drainage, geothermal discharge, or untreated industrial process water be discharged into any public sanitary sewer system.

S3-02 GENERAL DESIGN CRITERIA

S3-02.1 Serve to Extreme of Property

Ensure adjacent properties can be provided sewerage service (extend to extreme of property and design for the ultimate development of the tributary areas).

Sewerage service shall be provided by a gravity system (unless approved by the Town).

S3-02.2 Demand Projections

Demand projections shall be elevated by the design engineer and all calculations submitted for review.

a. Unit Demands

Residential	-70 gallons per capita per day (GPCD)
Commercial	-20 GPCD

b. Population Densities

3.5 People per single-family unit
2.0 People per multi-family unit

c. Peaking Factors

The peaking factor will be determined by using the State of New Hampshire Standards of Design and Construction for Sewage and Wastewater Treatment Facilities.

S3-02.3 Infiltration/Inflow (I/I) Allowances

- a. The Inflow/Infiltration will be determined by using the State of New Hampshire Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities.
- b. On existing sewerage systems, I/I allowance shall be determined through analysis. ie; metering

S3-02.4 Wastewater Application Permit

- a. All potential users must complete a wastewater application permit. The application may be obtained through the Sewer Inspector at the Merrimack Wastewater Treatment Facility located on Mast Road, telephone 883-8196 or found on line at the Town of Merrimack website, Permits and Forms.
- b. Upon final approval from the wastewater department any connection that meets the NHDES requirements (see below) must submit a discharge permit request. The requirements are as follows:
 - 1. Any proposed wastewater connection in excess of 5,000 gal./day.
 - 2. Engineering designs for new sewerage facilities, whether public or privately owned and regardless of design flow, must be submitted to New Hampshire Department of Environmental Services for review/approval action at least 30 days prior to construction. Design submittals must be accompanied by fee payment as based on project design flow rate – \$0.10 per gal./day for design flows up to 10,000 gal./day, and an additional \$0.05 per gal./day for any flows in excess thereof. Checks should be made out to Treasurer State of New Hampshire.

3. All proposed discharges of industrial waters to a municipal sewer are subject to NHDES review and industrial permit requirements regardless of quantity or quality. This application is separate from a connection permit and must be obtained from the Merrimack Wastewater Pretreatment Manager.
4. The application must be completed and submitted through the Wastewater Treatment Facility along with a check for the State of NH, two (2) sets of 24x36 stamped plans and specifications, two plan cover sheets, and three sets of electronic plans & specifications in PDF format on three separate DVDs.

S3-02.5 Existing Sewerage Adequacy

The adequacy of the existing sanitary sewerage system receiving flows from the proposed project shall be determined at the preliminary stage to preclude unnecessary revisions to construction plans.

The designer shall provide calculations for the sanitary sewerage system (on-site and off-site for both existing and proposed conditions as required) to the points of connection to the Town's sanitary sewerage system. This requires the developer to model the system from the Project to the Merrimack Waste Water Treatment Facility.

S3-02.6 Tributary Population

Sewerage facilities shall be designed for the estimated ultimate tributary population. Consideration shall be given to domestic, commercial, institutional, and industrial wastes in determining the capacity of the system. The design shall be based on approved estimates of anticipated populations and flows for a period of 50 years hence, or the entire watershed shall be assumed to be completely developed according to the Sewer Master Plan developed by Wright-Pierce and accepted April 2013 .

S3-02.7 Sewage Flow

- a. Determining the average design flow shall be the first step in the sizing of sanitary sewerage systems. Actual design quantities may be substituted for the average design flows, provided supporting data is furnished to and approved by the Director of Public Works.
- b. Sewerage shall be designed to carry a peak flow when full as determined by applying the appropriate peak flow factor to the average design flow.

S3-02.8 Location of Sewerage and Manholes

- a. In general, sewerage lines and manholes shall be located within legally established public streets or right-of-way wherever possible. If sewerage cannot be located in right-of-way or public streets, then access easements to all manholes, sewer line and laterals shall be provided.
 1. Manholes should be located along the centerline of streets when possible but always beyond the spread of stormwater gutter flow.
 2. The horizontal and vertical separation between sewers and waterlines shall be in accordance with the requirements of State of New Hampshire Design and Construction Standards, and Merrimack Construction Standards (See Section S3-13).
 3. Sanitary sewerage shall be designed such that they do not create skewed crossings with other utilities with an acute angle of less than 45 degrees, 90 degrees is preferred. Where skewed crossings are unavoidable due to existing utilities and involves any pipe larger than 24 inches in diameter, the crossing must be specifically designed and construction details provided.
 4. A table of bearings and distances shall be provided on all construction drawings for sanitary sewerage construction, in order to accurately locate the utility. The table of bearings and distances is not required on early submissions, but is required prior to final plan approval. The engineer or surveyor will supply cut-sheets for the installation of all sewerage systems.
 5. The deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90 degrees .
 6. A table of lateral elevations at cleanout invert and minimum building sewer elevations shall be included in plans. Building sewerage elevation shall be a minimum of two feet above cleanout invert elevation.
- b. Manholes for access to sewerage lines shall be provided at:
 1. All points of change in alignment;
 2. All points of change in grade.
 3. At the terminal end of the sanitary sewerage line.

4. At intervals not exceeding 300 feet.
 5. A sampling manhole will be required for all non-residential users. The sampling manhole may be used in lieu of the required cleanout at the property/easement line.
- c. The connection of sanitary sewerage lines shall be made only at manholes. The type of material must be the same from manhole to manhole. Connections to existing manholes shall be made by a method approved by Engineer.
 - d. Sewerage lines shall not be located within stormwater management impoundment areas unless there is no alternative. The Public Works Director may approve sewerage lines within a stormwater management impoundment area only if such sewerage lines are designed and constructed to site-specific conditions that will protect the sewerage line for a period of 100 years.
 - e. Sewerage located in areas of unstable soil conditions or other special circumstances may need to be encased in concrete, relocated, or redesigned as required by the Public Works Director.

S3-02.9 Sanitary Sewer Lateral Cleanouts

- a. Sanitary sewer cleanouts will be:
 1. Located at the property line or sanitary sewer easement line contiguous to the property.
 2. A traffic bearing type cleanout box is required if located in pavement areas.
 3. Minimum slope for service lateral shall be 2 percent. Maximum slope of service lateral shall be 45 degrees within public easements or right-of-ways.
 4. The offset angle of the lateral to run off the sewer main shall not exceed 45 degrees.

S3-03 GENERAL DESIGN STANDARDS

- a. All lengths and dimensions shall be horizontal distances, no slope distances on plans.
- b. If working in existing streets, indicate type of pavement restoration required, or refer to right-of-way permit.
- c. Dimension existing and new main locations from construction baseline using stations and offsets.
- d. Determine how surrounding development will affect design (e.g. serve to extreme of property).
- e. On plans show existing manholes or give reference distances to existing manholes near project including manhole number and invert/rim elevations.
- f. Existing sewerage lines to be abandoned shall be filled completely with controlled density fill; or removed. Any abandoned asbestos lines shall be removed and disposed of as required by OSHA Construction Standard 29CFR1926.1101.
- g. Manholes connected to lines being abandoned, shall be replaced or rechanneled by rebuilding invert.

S3-04 MAIN LINES

S3-04.1 Design Details

- a. Sewerage shall have a uniform slope and alignment between manholes.
- b. At all manholes where a smaller diameter sewerage discharges into a larger one, the invert of the larger sewerage shall be lowered so that the energy gradients of sewerage at junction are at the same level. Generally, this condition will be met by placing the 0.8 depth of flow or diameter in each sewerage at the same elevation.
- c. Sewerage shall be designed to be free-flowing with the hydraulic grade below the crown and with hydraulic slopes sufficient to provide an average velocity of not less than 2.0 feet per second when running full to maintain cleansing flow. Computations of velocity of flow shall be based on a PVC pipe coefficient of roughness “n” in the Manning formula of $n = 0.013$.

- d. In no case shall terminal lines with less than 20 residential connections have a slope of less than one percent unless approved by the Public Works Director .
- e. The maximum permissible velocity occurring with average flow shall be ten (10) feet per second (before applying peak flow factor).
- f. In general, the following are minimum slopes in feet per hundred feet to be provided for pipes flowing at full depth to one-half of full depth:

Sewer Size (Inches)	Minimum Slope (Feet per 100 Feet)
8	0.005
10	0.0028
12	0.0022
15	0.0015
16	0.0014
18	0.0012
21	0.0010
24	0.0008
27	0.0007
30	0.0006
36	0.0005
42	0.0004
48 & larger	0.0003

- g. All sewerage mains and service laterals shall have a minimum cover of six (6) feet in roadway and four (4) feet in cross-country sewerage.
- h. In general, the maximum allowable depth to inverts of various types and sizes of pipe is dependent on different types of bedding, earth loading, and live loading. Pipes with less than minimum cover and pipe with cover greater than eighteen (18) feet require pipe strength calculations to be submitted with the design. The maximum depth for all types of pipe shall be in accordance with manufacturer's specifications and recommendations.

i. Slope Anchorage

Concrete anchors shall be placed on sanitary sewer lines with grades of 15 percent or greater. Minimum anchorage shall be provided such that anchors are not located over 36 feet center to center on grades from 20 to 35 percent. The maximum grade for sanitary sewers shall be 35 percent with anchorage unless otherwise approved in writing by the Public Works Director .

- j. In general, the pipe diameter of sewers shall increase continually with increase in tributary flow. Where steep slopes would permit the use of reduced pipe size the pipe size may be reduced one size at a manhole; however, appropriate hydraulic allowances shall be made for head loss of entry, increased velocity, and the effect of velocity retardation at the lower end where the flow will be on a flatter slope. Prior written approval of the Public Works Director is required for reduction in line sizes. Requests should be accompanied by calculations.

S3-05 SANITARY SEWER FORCE MAINS

(Env-Wq – 704.04, 704.07, 704.08, 704.09, & 704.10,)

- a. The minimum size for force mains shall be four inches except when using grinder pumps.
- b. At pumping capacity, a minimum velocity of two feet per second shall be maintained.
- c. An air relief shall be placed at the necessary high points in the force main to release trapped air.
- d. Maximum velocity shall be eight feet per second.
- e. All force mains shall connect to a cleanout with a drop stack connection at the right-of-way or easement line. From there the flow shall be gravity into the public system.
- f. All pipe used for force mains shall be pressure type with pressure type joints.
- g. Anchorage shall be provided where deemed necessary by the Director of Public Works.
- h. Receiving gravity flow sewage system shall be analyzed for adequacy to handle peak force main discharges.
- i. Locator wire shall be installed with all force main PVC pipe. Minimum U.S. standard gauge 12 solid copper. Public Works Director may require heavier gauge wire in depths of greater than 6 feet.

- j. Force main & low pressure sewers will be treated as gravity mains for purposes of installation & testing. (See Env-Wq 704.06 b).
- k. Low pressure sewerage systems will be considered on a "case by case" basis but shall at no time be allowed "wholesale" to avoid installing a gravity based system or standard pumping station and gravity sewers.

S3-06 SEWAGE PUMP STATIONS

S3-06.1 Sewage Pump Stations (Env-Wq 705)

- a. Private sewage pump stations (i.e., those stations not accepted into the Town sewer inventory and privately maintained) may be approved by the Public Works Director under the following conditions:
 - 1. Private sewer pump stations shall meet the construction requirements of the BOCA Code and may only accept flows from private sewer systems limited to:
 - i. Building laterals
 - ii. Collector laterals
 - iii. Private sewer systems entirely on a single lot of record
 - iv. Meet all CMOM requirements
- b. Public sewage pump stations shall be required whenever the pump station accepts flow from more than one lot of record or as required to be reviewed by State of New Hampshire DES Standards of Design and Construction for Sewage and Wastewater Treatment Facilities, latest revision. Public sewage pump stations must conform to the following:
 - 1. Pump stations will not be allowed where an acceptable alternative gravity route exists.
 - 2. All public pump stations shall be located on Town property.
 - 3. The design criteria and equipment specifications must meet the requirements of the State of New Hampshire standards of Design and Construction for Sewage and Wastewater Treatment Facilities, latest revision.

4. The design calculations for the sewage pump station and force main shall be submitted for review. This design shall address:
 - i. Design flow from the subdivision and ultimate sewer shed
 - ii. Force main TDH and velocities
 - iii. Pump Curve
 - iv. Wet well size
 - v. Holding times in wet well and force main relative to septicity
 - vi. Piping configuration
 - vii. Specifications including electrical
 - viii. Operating conditions and setting of pump station between initial and ultimate flows.
5. Minimum of 2 hours of storage at average flow must be provided.
6. Pump station design shall be Gorham – Rupp suction or equivalent.
7. Pumping Station Design Criteria

Station Type	Influent Flow Range (gpm)	Maximum TDH**	Maximum Motor Horsepower
Packaged Wet Well	Up to 3000 gpm	Up to 45 feet	100 HP @ 1450 rpm
Vertical Centrifugal	No restrictions	No restrictions	No restrictions
Submersible	Up to 2000 gpm	Up to 160 feet	100 HP @ 1800 rpm

8. Tandem pumping may be allowed where low flow, high TDH conditions exist, with expressed written permission from the Director of Public Works.

** TDH = Total Dynamic Head – Submittal of calculations required.

9. All pumps, regardless of station type, will be non-clogging, capable of passing a minimum 3" diameter sphere. VFD control for centrifugal pumps where possible.
10. Lift stations are not allowed in the street right-of-way.
11. Provide a 12' wide access road with a 14' wide rolling gate preferred where possible, to allow service vehicle to parked off the street and clear of any sidewalks. Turnarounds are required for stations constructed along heavily traveled streets. Provide service vehicle access to wet well.
12. Provide a reinforced concrete base slab sized adequately to counteract buoyancy. Provide supporting calculations.
13. Provide a single surface pad over the site that incorporates lift station access, wet well access and supporting generator and fuel supply tanks, as necessary.
14. Provide restrained flexible couplings on all outlet piping within 2 feet of the station wall.
15. Provide reinforced concrete supports for pipes between wet wells, where appropriate.
16. Wet well size will be based on good sanitary engineering practices. Minimum of 2 hours of storage at average flow must be provided. Provide resilient-seat gate valve on-line to wet well.
17. Provide 6" PVC emergency by-pass system consisting of a suction line and a discharge line and a standpipe equipped with a cap and cam-lock connector. Bypass will be located in a vault. Standpipe connects to force main through an AWWA resilient seat gate valve with stainless steel trim and a check valve. The suction and discharge lines will have gate valves for isolation. Adequately support all piping.
18. Provide 1" minimum water service with reduced pressure backflow preventer and piping insulation.
19. Provide re-keyable locks for all padlock and door applications.
20. Provide fall protection device for ladders that include winch and center post. Winch will be Miller M 52-50ss or approved equal. Center post will be Uni- Hoist Arm #UH 504-24 with top and back rollers or approved equal. Provide non-skid surface on ladder.

21. Provide spare pump and air release valve prior to acceptance.
22. Provide calculations to determine the need for hydrogen sulfide suppression in force main.
23. All hardware in wet wells should be 316SS, piping, hangers, brackets, nuts, bolts, etc.

S3-06.2 Pumping Equipment

- a. Provide a minimum of two (2) pumps and controls to alternate lead and lag pumping. Where required by the Director of Public Works, 3 or more pumps may be required in a lead, lag standby arrangement.
- b. For each type of pump, provide one spare rotating mechanism to replace each pump type.
- c. Provide one set of routine service replacement parts such as wear rings, bearings, flapper valves and seals for the pumps.
- d. Provide calculations used to determine the capacity of wet well and the specifications for the pumps.
- e. Provide hour meters for each pump that records pump run time, only if the motor is operating.
- f. Provide a magnetic flow meter on the discharge of the pump station. Meters may be in an approved vault. Display will be installed in pump station.

S3-06.3 Packaged Wet Well

Above ground Gorman-Rupp suction lift or equal or in ground duplex pump system such as PSI or equal will be accepted on a case by case basis. Contact Town prior to plan submission for allowed type. Contact Merrimack Wastewater Treatment Facility for more details.

S3-06.4 Wet Well Level Measurements

Submersible Level Transducer and Transmitter: LE/LT

- a. Provide submersible pressure transducers, as indicated in the Instrumentation Schedule, with the following requirements.

Transmitter:

- Type: Submersible with Integral Pressure Measuring Element
- Power: 24 VDC Loop Power
- Accuracy: 0.25% full span
- Analog Output: 4 to 20 mA DC
- Enclosure Rating: NEMA 4X, IP68
- Communications Protocol: None
- Measuring Range: Per Instrumentation Schedule

Measuring Element:

- Type: Submersible Elastomeric Diaphragm Pressure Sensor
- Applications: Wastewater
- Materials:
 - Housing: Stainless Steel or PVC
 - Diaphragm: Teflon
 - Cable: Teflon or Polyurethane
 - Cable Gland: Viton
 - Measuring Cell Fluid Fill: Silicone Oil
- Diaphragm: Minimum 0.89" diameter non-clogging
- Operating Temperature: 32 to 122 °F (compensated over entire temperature range)

- Burst Pressure: 2X Full Span
- Atmospheric Pressure Reference: Atmospheric reference tube with sealed breather system.

Accessories and Spare Parts:

- Provide a stainless steel mounting rack with an adjustable cable stop for each submersible pressure transducer.
- Process fluid shall directly act on the outer diaphragm. The pressure from the process fluid shall be transmitted to the pressure measuring element by the silicone oil fill fluid.
- Power and signal cable shall be a factory-attached watertight cable with stiffeners to allow the sensor to be freely supported by the cable. Cable length shall be sufficient to extend from the transmitter to closest junction box plus an additional 6 ft.
- Transducers and shall be intrinsically safe and be protected by a suitable intrinsically safe barrier, suitable for use in a Class I, Div. 1 area. Refer to Instrumentation Schedule for hazardous area requirements.
- The cable will be extended to a NEMA 4X junction box located in a non-hazardous area. The signal cable shall be spliced in the junction box, per manufacturer's recommendations, and extended to the respective control panel. Atmospheric reference tube shall be terminated in the junction box per manufacturer's recommendations.

Mounting:

- Provide a 12-inch long section of 316 stainless steel pipe, $\frac{3}{4}$ to 1-inch diameter, with NPT threads to mount to the transducer. The transducer and pipe shall be suspended using a stainless steel PVC-coated cable with stainless steel clamps and bolts with friction nuts. Provide a stainless steel float rack for mounting the float switches and transducer cable. The transducer shall be mounted six inches from the bottom of the well.

- Submersible pressure transducers that are 2-inch in diameter or smaller shall be installed in a stilling well. Stilling well shall be constructed of 3" or 4" PVC and suspended from the wall of the wet well by stainless steel pipe clamps.

Equivalent to:

KPSI Model 705
Siemens Model A1000i
Contegra Model SLX130
Or equal

Ultrasonic Measurement for Level: LE/LIT

Provide an ultrasonic transducer with separate transmitter, as indicated in the Instrumentation Schedule, with the following requirements.

Transmitter:

- Type: Remote wall mount
- Display: Backlit LCD
- Power: 120 VAC
- Accuracy: 0.02% full span
- Analog Output: One 4 to 20 mA DC
- Discrete Output:

Three SPDT relay individually configurable
Contact Rating: 5 amps at 120 VAC or 24 VDC

- Enclosure Material: Polycarbonate
- Operating Temperature: -5 to +122 °F
- Electrical Connections: Field drilled
- Temperature Compensation: Internal through ultrasonic transducer

- Enclosure Rating: NEMA 4X, IP65
- Communications Protocol: None
- Memory: Battery backed with capacitor for backup during battery replacement
- Configuration: Handheld programmer or onboard keypad
- Mounting: Per Field Instrumentation Enclosures in this Section

Measuring Element:

- Type: Non-contacting ultrasonic continuous level measurement
- Applications: Wastewater Wet Wells
- Materials:
Housing: PVDF
Radiating Face: CSM
- Enclosure Rating: NEMA 4X, IP68
- Operating Temperature: -4 to 150 °F
- Mounting: 2" NPT

Contractor to provide a stainless steel mounting bracket for mounting of the transducer.

Contractor shall not install sensor within blanking distance of highest anticipated water level.

Contractor shall not install sensor in location where 3dB sensing cone is infringed upon.

- Measuring Range: As required to measure the full range of depths in the wet well.

Transducers shall be explosion proof and shall carry the required Factory Mutual approval. Refer to Instrumentation Schedule for hazardous area requirements.

- Accessories and Spare Parts:
One handheld programmer for transmitter configuration as required
Submergence shield
Equal to:
Siemens HydroRanger 200 with Echomax series transducer
Pulsar Ultra 3 with dB series transducer
Endress & Hauser FMU90 transmitter with FDU series transducer
Or Equal

- Field Instrumentation Enclosures:

All transmitters for field instrumentation located indoors can be direct-mounted on a wall in an appropriately rated space.

All transmitters for field instrumentation located outdoors shall be back panel mounted in a stainless steel or fiber reinforced plastic NEMA 4X enclosure.

Each enclosure shall be provided with a padlocking door handle, front window kit to allow the operator to view the measured process variable, and drip shield. Screw tightened door clips around the enclosure are not acceptable.

The enclosure shall include terminals, circuit breakers, surge protection on power, and a thermostatically controlled heater. 120 VAC power for each field instrument will be backed up from the UPS in the associated control panel or a UPS power panel. 120 VAC power for each heater will be provided by a second power source separate from the UPS backed power source.

Each enclosure shall have a warning label that indicates 120 VAC power is provided from multiple sources.

Each enclosure shall be provided with a sun shield that shields the enclosure from direct sunlight.

INSTRUMENTATION SCHEDULE

TAG	TYPE	DESCRIPTION	LOCATION	RANGE	UNITS	SERVICE	POWER
LE/LT-##	SUB	<i>Submersible Pressure Transducer</i>	<i>Wet Well</i>	<i>As needed for wet well depth</i>	<i>Ft</i>	Class I, Div 1, Gr C&D Submersible	24 VDC Loop
LE/LIT-##	ULT	<i>Ultrasonic Level Transmitter/Transducer</i>	<i>Wet Well</i>	<i>As needed for wet well depth</i>	<i>Ft</i>	Sensor: Class I, Div 1, Gr C&D Transmitter: NEMA 4X	120 VAC

ULT-
Ultrasonic

SUB - Submersible

S3-06.5 Lift Station Piping and Valving

- a. All internal lift station piping will be flanged, except as discussed in b.
- b. All lift station pipes will have flexible connections (Victaulic or Dresser) to allow for disassembly. Piping, hangers, and hardware within wetwell shall be 316 SS.
- c. All main piping will have manual vents and drains to allow draining of sewage prior to piping disassembly.
- d. Resilient seat gate valves in manholes will be used for station wet-well isolation.
- e. Cast iron non-lubricated eccentric plug valves with worm gear operators will be used for pump isolation valves. Valves will have stainless steel bearing, nickel seats, neoprene faced plugs and nitrile-butadine packing. If space does not permit isolation valves for each pump, use 3-way valves.
- f. Main pump check valves will be cast iron swing checks with external lever return. Check valve will not be installed in the vertical. Disc will be 316 stainless steel or cast iron with bronze trim. Pivot arm and bearing will be 316 stainless steel or cast iron with bronze trim. Pivot arm will be 316 stainless steel or bronze. Seat will be field replaceable with neoprene facing.

S3-06.6 Electrical Equipment

- a. Free standing electrical service and transfer switch will be heavy duty electrical weatherproof enclosure mounted in a manner acceptable to the Director of Public Works a minimum of 24" above the ground. Provide a concrete pad around steel supports. Enclosure and equipment to be provided by Tesco, Challenger, Cutler- Hammer, or Square D. Provide 110-volt duplex, GFI, receptacle in a weatherproof box. The box will have 316 stainless steel hinges and hardware and will be factory primed and field painted per Town of Merrimack requirements. Enclosures to be epoxy-coated.

- b. Provide Killark connector for mobile generator with manual transfer switch. Generator plug will be a minimum of 36-inches above ground.
- c. Provide an exterior light in accordance with current electrical codes. Provide 12" diameter pole mounted luminaries at 120V, 70W HPS.
- d. Provide OSHA approved mat in front of all indoor control panels.
- e. Provide ability to operate station with one pump removed for maintenance, by utilizing a local-remote switch and no parallel switching in order to allow for proper lockout procedures. Provide local disconnect at motor per NEC.
- f. Provide 25% additional spare wires and 2" conduits or oversize conduits to meet ultimate station capacity.
- g. Drivers will be Allen-Bradley or approved equal and provided with solid-state smart type motor starters with a pump control option used to provide ramp starting and stopping for motors. The controller will have the following start modes: soft start with selectable kick-starters, current limit and full voltage. Provide building temperature thermostat and wiring to connect to PLC with building temperature ability at the town telemetry system.

S3-06.7 Telemetry

All control panels will have the following general features:

- a. Panels and enclosures will have NEMA ratings as shown on the drawings. In general the NEMA ratings will be
 - 1. NEMA 3 316 SS for outside installations. Include sun shield.
 - 2. NEMA 12 for protected installations inside buildings.
- b. Panel design will incorporate the following features:
 - 1. Provide lamp with switch.
 - 2. Provide a 120 VAC duplex convenience outlet.
 - 3. Provide heating and cooling to maintain internal components within operating tolerances and to avoid condensation.
 - 4. Provide 120 VAC uninterruptible power supply (UPS) or an equivalent. DC voltage system sized for 150% of peak load for all internal panel components for a minimum of 30 minutes runtime.

5. Provide radio communications system compatible with the Town's current telemetry system. See Wastewater Treatment Facility personnel for specific frequency and any changes.
6. Provide high temperature switch (alarm) for the control panel.

S3-06.8 Programmable Logic Controller (PLC)

Provide a programmable logic to perform monitoring and control of the facility. Provide a large or small PLC as shown on the drawings or specified in the contract documents.

- a. For PLC applications, provide Allen-Bradley SLL 5/05 or latest generation available.
- b. All PLC's will utilize the following features:
 1. All analog inputs will be isolated with 4-20 ma current signal isolators.
 2. All analog outputs will be isolated with 4-20 ma current signal isolators.
 3. Provide an operator interface panel.
 4. Provide input and output points as defined in the specifications and drawings.
 5. Provide 205 spare analog and digital I/O's.

S3-06.9 Panel Mounted Devices

- a. 24 VDC Power supplies: Power supplies will be linear, open frame supplies with a minimum capacity of 3.0 Amp. Manufactured by Acopian, Power One, or Solo.
- b. Relays: Relays will be SPDT with a minimum 10 Amp rating by Idec, Potter & Brumfield, Tuck or Allen-Bradley.
- c. Signal Insulators: Current isolators and converters will be by M-Systems, Wago, or Wilkerson.
- d. Terminal Block System: Terminal blocks, fuse blocks, and disconnect blocks, will be by M-Systems, Wago, Wilkerson, or Allen-Bradley.
- e. Temperature Switch: Temperature switch will be used to monitor internal panel temperature for high temperature conditions. Range will be 0–250 degrees F. Provide cooling fan.

- f. Interior Lighting: Provide all control panels with a fluorescent interior light of the same approximate width of the control panel located along the top of the panel. Provide light with a separate light switch.
- g. UPS: Provide an Uninterruptible Power Supply sized for 150% of calculated load with sufficient battery backup time for 30 minutes of operation. Provide American Power Conversion or Best Power Products.
- h. Selectors and Pushbuttons: Provide corrosion resistant selectors and pushbuttons by Allen-Bradley or Square-D.

S3-06.10 Record Drawings and Operations & Maintenance Documentation

- a. As-Built Drawings: Provide as-built drawings showing physical location of components. Provide loop drawings (end-to-end wiring diagrams) meeting the ISA S5.4 standards with minimum required items plus optional items. Provide 3 copies of all drawings and an electronic version.
- b. Provide O & M Manuals for Hardware
 - 1. Cover equipment comprising the system in the hardware instruction manuals for all equipment including third party equipment, provide as part of the SCADA system. Provide instructions for operation and maintenance of the installed system, as well as operation and maintenance instructions for the individual equipment units comprising the system.
 - 2. Standard hardware manuals will be acceptable, provided that errata sheets are included to reflect the specific equipment provided.
 - 3. Electronic CD-ROM hardware manuals are acceptable.
 - 4. Provide 3 copies of O&M manuals plus an electronic copy when available.
- c. Provide O&M manuals for software.
 - 1. Provide complete, organized, and standardized documentation for operation centers, RTUs, PLCs, and other software provided as part of the SCADA system. In general, structure the documentation such that each level develops a different degree of detail. Begin with a broad approach (systems manual), focus on smaller pieces of the overall system (system documentation) and finally pinpoint the finest detail (program detail).
 - 2. Fully annotate every PLC program.
 - 3. Provide three (3) copies of software O&M manuals plus an electronic copy when applicable.

S3-06.11 Testing Requirements

- a. Factory Acceptance Test (FAT): Fully test all SCADA at the contractor's facilities prior to shipping, installing, reprogramming, or reconfiguring the Town's SCADA equipment. The purpose of the testing is to verify compliance with the specifications and to correct deficiencies at the contractor's facility and not in the field. Insofar as practical, test the functional, performance, and interface requirements. Test each control loop from terminal strips to the PLC.
- b. Site Acceptance Test (SAT): After installation, fully test all SCADA components to verify compliance with specifications. Insofar as practical, test the functional, performance, and interface requirements. Test each control loop from the instrument or terminal strip, through the PLC, to the Town's SCADA system. Tune all control loops. Test all control strategies.
- c. Operational Availability Demonstrations (OAD): The OAD is a 90-day period of time during which the SCADA system will be utilized by the Town in day-to-day operations. Its purpose is to test the SCADA system stability and completeness over time. Start the OAD upon written notice from the Town and after successful completion of field-testing. The OAD is considered successful if the system availability is 99.8 percent or better. The OAD will be restarted or repeated if availability is less than 99.8 percent. Final completion will not be granted until OAD is passed.

S3-06.12 Programming and Configuration Services

- a. Configure the PLCs based on the configuration drawings, P & Ids, the Process Control Narratives and functionality as specified in other sections. Include all necessary constant and variables required to meet the specifications whether shown on drawings or not. Provide a fully functioning control system.
- b. The Contractor will conduct coordination meetings at the town site during the configuration and programming program on a periodic basis as needed but at least twice during the project. The purpose of the meetings is to solicit input from and coordinate activities, a forecast of future activities, and discuss any problem areas.

- c. Use diagrams in ladder rung format for the PLC program documentation system. Show all input devices near the left “power rail” and all outputs near the right “power rail”. The diagrams will show all device codes and functional descriptions shown on the drawings and will also show PLC reference codes and I/O assembly codes, module numbers, and terminal numbers. Provide source code for all operator interface programming; amply annotate to explain the operation. Include I/O tag numbers in rung or device annotations. Use control strategy numbers to identify PLC program sections. Alternative programming techniques may be used if approved in writing by the Director of Public Works.
- d. Organize and structure all PLC programs to aid in software maintenance and modification. Organize each PLC program into a three level “outline” structure consisting of strategies, equipment items (or sub-strategies), and “functions”. Each PLC strategy consists of the logic associated one piece of mechanical equipment (or “functions” will be the smallest subdivision of programs and will consist of functions, subroutines, or short algorithms requiring roughly five to ten rings of ladder logic. Ladder logic will be used for all PLC programming unless otherwise approved in writing by the Town.
- e. PLC programming will be thoroughly documented. Each contact, coil, timer, function block, or other rung item will be annotated in the program listing with the internal item number (i.e., coil number, contact number, etc.); and a brief description of the items function. External tags will be the input or output tag number from the PLC I/O schedule or for points created in a PLC and transmitted to (or from) the central computer system, the tag number used in the central computer.

S3-06.13 Standby Generator

Provide permanently installed, natural gas fueled Kohler (or propane should natural gas not be available) or approved equal generator with automatic transfer switch, manual transfer switch, and load bank connection. Provide Crouse Hinds E0400-1686 Posi-lok load bank receptacles to test generator for output and generator break in. The design engineer must verify gas pressure and fuel demand with generator manufacturer prior to review of submittal. The engine manufacturer must certify that the engine is designed to operate on natural gas and propane.

- a. Submit generator-sizing calculations for Town approval. Sizing calculations will assume loading based on lead pump running, lag pump starting and full operation of all electrical at the site. Generator will run at 100% of nameplate current for 4 hours on primary fuel supply using Town owned bank.

b. Provide the following instrumentation:

1. Generator voltage, frequency, and amp meters;
2. Oil pressure gauge;
3. Battery voltmeter;
4. Temperature gauge;
5. Hour meter;
6. External battery with trickle charge;
7. Dry contacts for telemetry – showing generator running.

c. Provide automatic shut-off and alarms:

1. Low engine oil pressure;
2. High engine temperature;
3. Over speed;
4. Over crank.

d. Locate exhaust away from dry well ventilation and provide stainless steel rain cap. Insulate exhaust stack from generator enclosure or roofing material.

e. Provide sound attenuation as necessary to meet or exceed Town noise standards for location. Attenuation may include silencers, insulation and/or enclosure. Provide ambient noise measurements and calculations demonstrating compliance.

S3-06.14 Gas Monitoring System

- a. Provide a permanent gas monitoring system.
- b. Monitoring system will monitor for lack of oxygen, lower explosive limit, and hydrogen sulfide.
- c. The monitoring system will be tied to the telemetry system alarms.
- d. Manufacturer will be MSA or an approved equal.

S3-06.15 Details Required on Improvement Plans

- a. Site plan location of power pole, transfer switch, emergency generator, emergency fuel supply, control panel, wet well, ground slab, driveway, fencing, water service, emergency suction / discharge boxes. Provide site grading and drainage details.
- b. Wet well: Influent piping (standard inside drop manhole); suction piping (min. 6" off bottom of manhole); emergency suction line; bubbler line including connection hardware; water/alarm levels (pump on, off, low level, high level), redundant high water float switch.
- c. Emergency Power: Electrical details specified to include size and material of conduit, switchgear, telemetry compatibility. Electrical details will include power source, meter location, cabinetry. Wiring diagrams will depict connection to and between PG&E, transfer switch, emergency generator as shown in the attached single-line diagram.
- d. Force main discharge details.

S3-06.16 Record Drawings and Manuals

- a. Provide three (3) copies of record drawings and an electronic copy in PDF latest version.
- b. Provide three (3) copies of O&M Manuals plus an electronic copy

S3-07 LATERAL SEWERS

S3-07.1 Design Details

- a. Lateral sewer stub shall extend from main line to property line. 6" pipe shall be used inside the public right-of-way (unless expected flows require larger size line).
- b. 4" minimum pipe may be used inside private property, for residential lateral sewers from end of 6" stub to building, for a single connection contained within the lot.

Commercial lateral sewers shall be a minimum 6" pipe.

For multi-family developments, lateral sewers for each separate building must be at least 6-inches in diameter. For those buildings serving over ten units or for lateral sewers serving more than one building, lateral sewers shall be a minimum of 8-inches in diameter and must connect to a manhole.

- c. Lateral sewer shall have minimum 6' of cover at property line. Greater depths may be required where elevation of lowest floor to be served is lower than surface elevation at property line. Ensure that stub can serve all property by gravity flow.
- d. Provide a single stub to “low” end of each lot, and show invert elevation of each stub on the plan. Uniform Plumbing Code requires a backwater valve. Stub location should also be coordinated with homeowner.
- e. Lateral sewers shall connect to main sewerage with a wye rather than a tee, unless otherwise approved by the Town Engineer or Sewer Inspector. Lateral sewer stubs shall run perpendicular to the sewerage main, in the right-of-way. On plan, indicate station of lateral sewer wye from nearest downstream manhole. Also indicate length of lateral sewer stub from main to plug at end of line. Call out invert at plugged-end of stub.
- f. Minimum side sewer slope shall be 2 percent.
- g. All lateral sewer clean-outs on commercial and multi-family projects shall include at-grade access with covers. Cleanouts shall be same diameter as lateral.
- h. Maximum distance between lateral sewer clean-outs shall be 100 feet.

S3-08 MANHOLES

S3-08.1 Design Details

- a. Maximum distance between manholes shall be 300 feet.
- b. All manhole covers shall be set flush with ground surface, except where otherwise designated by the Town Engineer or Sewer Inspector.
- c. Existing and Terminal Manholes:
 - 1. When connecting to an existing manhole, all requirements of these Engineering Standards must be met. The design shall call-out all necessary revisions to the existing manhole, or if the existing manhole cannot be renovated to meet the standards, the manhole shall be removed and replaced with a conforming structure.

2. When there is a potential for future main line extension from terminal manhole, position side sewer connections to manhole to avoid conflict with future main line connection to manhole.
 3. Terminal manholes shall not be channeled.
 4. Benches in terminal manholes are not required.
- d. Where sewer connects to manhole, invert of sewer shall be equal to or above main sewer crown, but not to exceed 18" above invert of main sewerage.
 - e. Manholes for sewerage up to 16 inches in diameter shall not be less than four feet inside diameter (except inside drops, see 3 above). Manholes for sewerage up to 36 inches shall have an inside diameter of not less than five feet. If hydraulic characteristics do not permit use of a four-foot inside diameter manhole, then a five-foot diameter manhole or special manhole detail must be provided.
 - f. All new sanitary sewer manholes shall be reinforced precast concrete in accordance with **ASTM-C478** consisting of precast concentric riser reinforced sections, an eccentric conical or flat top section, and a base section conforming with the typical manhole, per State specifications. Exterior asphaltic damp proof coatings are not required except in special circumstances.
 - g. Invert elevation across manhole shall be from 0.1 ft to 0.2 ft. In areas with sewer main slopes less than 0.005 ft/ft, lesser drops are allowed, to be determined by the Director of Public Works. Maximum allowable drop in invert elevation across the manhole shall be 1.0 ft.

The minimum angle between the incoming and the outgoing pipe shall be 90°; pipe shall be radial with the center of manhole.

The above configurations shall provide adequate shelves and room for maintenance and performing video inspections.

- h. Channels shall be centered in manhole.
- i. Any manhole less than 6' deep (rim to invert) shall be a flat top H20 loading. All other manholes shall be provided with eccentric cone.
- j. Frames and Covers – 48" manholes shall have a 30" clear opening. 60" manholes with an inside drop shall have a clear opening of 36". Also, any manhole 14' deep or greater shall have 36" clear opening.

S3-08.2 Drop Manholes

When it is necessary, due to steep slopes, increased velocity, or invert elevation differences equal to or greater than 24 inches, a drop connection shall be employed. The maximum difference in elevation between the influent and effluent flows within the manhole itself shall be six inches. The minimum diameter manhole for use with an inside drop connection shall be five feet. Only one inside drop shall be installed per five-foot diameter manhole. Two inside drop connections may be made in a six-foot diameter manhole.

a. Drop Manholes

1. External drop manholes are not allowed.
2. Minimum height of drop is 2.0'.
3. An Inside drop is allowed on connections to existing manholes, with prior approval.

b. Internal Drop Schedule

1. For 4'-0" diameter existing manholes, one 8" internal drop pipe.
2. For 5' diameter manholes, one 15" diameter or two 8" diameter pipes.
3. Larger diameter manholes will be reviewed on an individual basis.

S3-09 INVERTED SIPHONS

Inverted siphons shall not be less than two (2) barrels, with a minimum pipe size of six inches (6) and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall be designed to facilitate cleaning; and, in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be arranged so that normal flow is diverted to one (1) barrel so that either barrel may be removed for service or cleaning. Top of structures on either end of siphon shall be above the 100yr flood plain. Access with maintenance equipment is required. (See Env-Wq 704.18). An access road shall be constructed so as to allow access with a sewer vacuum truck.

S3-10 PIPE CLASS - PROTECTION – COVER

- a. PolyVinyl Chloride (PVC) pipe class designation:
 - 1. All sewerage pipes shall be SDR 35 PVC conforming to ASTM D3034-08, unless otherwise determined by the Town.
 - 2. Depth of cover over SDR 35 PVC pipe shall be 6' minimum and 15' maximum. Pipe depths outside this range will require use of pressure class PVC conforming to AWWA C900 (dimension ratio 18 or less) or DI pipe.

- b. PVC pipe shall be encased in a steel or ductile iron casing when crossing under improvements where the ability to remove and replace pipe without disturbance to the improvement is needed.

Casings shall extend a minimum of 5' past each edge of the improvement, or a distance equal to the depth of pipe, whichever is greater. The carrier pipe shall be supported by casing spacers where casing length exceeds 10'.

Minimum clearance between bottom of structure and top of pipe or casing shall be 2'. The trench shall be backfilled with crushed rock ½" when clearance is less than 3'.

- c. Ductile iron pipe, class 52, shall be used only where required by the Town and shall comply with Env-Wq 704.05. Pipe shall be U.S. Pipe with Protecto 401 coating or equivalent.

S3-11 CONNECTIONS TO EXISTING SYSTEM

- a. New sewerage mains (8" and larger) shall connect to existing sewerage main at existing manholes, or with new manhole on existing sewerage.
- b. When connect to existing manhole, core opening for pipe and re-channel manhole base.
- c. If manhole has stub, remove and use new pipe, or as directed by Engineer.
- d. When designing new sewerage to tie into existing sewerage, the connection shall be made by one of the following methods:

1. Connection to an existing manhole – Connection to the existing manhole must be configured so that the invert of the new tie-in is not established lower than the existing invert.
 2. New in-line manhole – The new manhole shall be set after removal of the existing pipe and installation of proper bedding material. The invert of the base section shall match the slope of the removed pipe. Outlet pipe shall be connected to the manhole boot. Inlet connection shall be made with a 6-foot pipe stub connected to the manhole boot and to the existing pipe by a Fernco coupling or approved equal. This method will require pumping of existing flows during installation. Testing shall be by the vacuum test method.
- e. Connections to end of existing pipe:
1. If end of pipe is known to have a bell, and new pipe is same material as existing, plans can specify connection by inserting spigot of new pipe into existing bell end, with “donut” gasket.
 2. If existing line is plain end, or must be cut, plans shall specify use of a coupling to connect new and existing lines.
- f. Approved couplings for use on sewer mains include:
1. Ductile iron mechanical couplings (equal to ROMAC) on ductile iron, concrete, vitrified clay, or pipes with differing materials or diameters.
 2. On PVC or PE mains, PVC or PE couplings with compatible dimension ratio and gaskets to connect new and existing pipes shall be used.
 3. Where a section of existing PVC pipe is replaced by “dropping-in” a new section of PVC pipe, the connections to existing pipe shall be made with PVC closure couplings (slip couplings).

S3-12 FATS, OILS, GREASE SEPARATION (per Sewer Use Ordinance)

S3-12.1 Oil/Water Separator

Whenever an industrial or commercial business generates mineral/petroleum oils to be discharged to the sanitary sewer, pretreatment is required. An oil/water separation device shall be installed by the property owner as specified on various Standard Details. Selection and sizing of an oil/water separator shall be subject to approval of the Town. Water discharged from any oil/water separator to the sanitary sewer system shall not contain petroleum oil, non-biodegradable cutting oil or mineral products, and shall be in compliance with the Town of Merrimack regulations for discharge to the sanitary sewer.

- a. Sizing of a separator facility shall be based upon maximum available flow to the separator and provision of a forty-five minute retention time in the separator at that flow, with a minimum capacity of at least 100 gallons.
- b. The oil/water separator shall be covered with removable sections. Access and inspection covers, weighing not more than 30 lbs. and with suitable handholds, are to be provided directly above inspection “tee” and oil/grit collection compartments.
- c. Allowable materials for construction are as follows:
 - 1. Tank – concrete
 - 2. Baffles – concrete, steel plate
- d. The separator shall be located within 20 feet of drive for access by maintenance vehicle.
- e. A sampling tee shall be located on the outlet with a minimum 18-inch drop below the invert. Access to the separator shall be maintained free for inspection and compliance determination sampling at all times.
- f. When pretreatment is no longer required, the inlet and outlet pipes shall be permanently plugged, the separation chambers pumped out, and the vault removed, or filled with compacted crushed rock or controlled density fill.

S3-12.2 Grease Interceptor

Whenever a commercial and/or retail food preparation operation, regardless of size, generates animal/vegetable fats, oils or grease (F.O.G.) waste, which causes a visible sheen or accumulations in the effluent, to be discharged to the sanitary sewer, pretreatment is required. A grease interception device as specified by various Town of Merrimack, and/or the owner shall install other biological, chemical, or other pretreatment approved by the Town of Merrimack. Effluent discharged from any grease interceptor shall not contain a visible sheen or accumulations of F.O.G., and shall be in compliance with the Town of Merrimack regulations for discharge to the sanitary sewer.

- a. Size and design of the grease interceptor shall conform to the uniform plumbing code, and shall be subject to approval by the Building Inspector/Plumbing Inspector. Minimum capacity shall be 1000 gallons except as noted by the Town of Merrimack.

- b. Fixtures in the kitchen area, which discharge wastewater containing grease, are to be connected to the grease interceptor. Such fixtures include dishwashers, pot sinks, range woks, janitor's sink, floor sinks. Toilets, urinals, and wash basins shall not flow through the interceptor.
- c. The interceptor shall be located outside the building within twenty feet of drive for access by maintenance vehicles.
- d. The interceptor shall be filled with clean water prior to start-up of system.
- e. Allowable materials for construction are as follows:
 - 1. Tank – concrete
 - 2. Baffles – concrete, plastic
- f. Access to the interceptor shall be maintained free for inspection and compliance determination sampling at all times. Interceptor shall be cleaned regularly to prevent bypass of F.O.G.
- g. When pretreatment is no longer required, the inlet and outlet pipes shall be permanently plugged, the separation chambers pumped out, and the vault removed, or filled with sand.

S3-13 CLEARANCES - OTHER UTILITIES

All clearances listed below are from edge-to-edge of each pipe.

- a. Water services and sewer stubs shall have at least 10' horizontal clearance and 18" vertical.
- b. Check for crossing or parallel utilities. Maintain minimum vertical and horizontal clearances. Avoid crossing at highly acute angles (the smallest angle measure between utilities should be between 45 and 90 degrees).
- c. Horizontal clearances from sanitary sewer:

Cable TV	5'
Gas	5'
Power	10'
Storm	5'
Telephone, Fiber Optic	10'
Water	10'

d. Vertical clearances from sanitary sewer:

Cable TV	18"
Gas	18"
Power	18"
Storm	18"
Telephone, Fiber Optic	18"
Water	18"

e. Where sewer crosses above or below water main, one full length of sewer pipe shall be used with the pipes centered for maximum joint separation. Depending on circumstances, use of DI pipe and concrete encasement may be required.

f. Send letter and preliminary plan to existing utilities to inform them of new construction. Request as-built information and incorporate into plans. At minimum the following utilities should be contacted:

Cable
television
Natural
gas Power
Storm drainage
(Highway)
Telephone, Fiber
Optic Water
Wastewater

S3-14 EASEMENTS

- a. Show easements on all plans and identify bearings and distances.
- b. Show easements on all private property. If easement is defined as a constant width on each side of sewer main, then show a segment of the easement and label as typical (typ).
- c. All easements shall be a minimum of 20' in width, or twice the depth of pipe, whichever is greater. Temporary "construction easements" may be required beyond the 20-foot permanent easement.
- d. Also see "Building Setback Requirements".

- e. An easement must be provided over any public sanitary sewer when it is installed outside a public right-of-way. Easements must be built to allow access by maintenance equipment such as a vactor truck.
- f. The easement must be a minimum of 20' wide if it only contains a sewer main or 40' wide (or wider) if it contains another facility, such as water, storm drain, or other utility. The easement will be a dedicated as a "public sewer easement" if it contains sewer only. It will be dedicated as a "public utilities easement" if it contains other facilities as well. Should it be wider based on depth of pipe also see c. above
- g. Easements must be configured to encompass all publicly maintained appurtenances, and will be generally centered over the facility. Separate access easements may be required depending on site conditions. When sanitary sewers are to be installed along a property line the easement will be laid out on the property line dividing the easement equally on each property.
- h. All property restrictions placed as a result of dedication of easements will be so noted on the supplemental sheet of the Subdivision plans, or on the Easement Deed if the easement is not dedicated as part of a subdivision. Typical required notes as applicable are:
 - 1. No structures may encroach on, above, or below the surface of the ground in any public easement. This includes footings of foundations, eaves from the roof of any adjacent structure, pools, ponds, or outbuildings on slabs or foundations. Decks, sheds, fences, or other structures are not allowed in the easement.
 - 2. No trees may be planted in a public sewer easement . Trees may be allowed on the edge of the easement to the extent that damage to the sewer system does not occur from root intrusion and adequate access can be provided for maintenance and repair vehicles.
 - 3. The Town of Merrimack will take due caution when performing maintenance or repair of sewer systems in easements, but will not be responsible for repairs or replacement of trees, landscaping or structures within the easement.

S3-15 MAINTENANCE ACCESS ROADS FOR CROSS-COUNTRY SEWER

- a. Clear access must be provided and maintained to all structures on the sewer system:
 - 1. All-weather vehicle access roads are required to every structure on the sewerage system. Access roads must be a minimum of 20' in width and must be provided with turnarounds when the backup distance for any maintenance vehicle exceeds 100'. These roads are to be provided for all cross-country sewerage lines.

2. The design of access roads must be included with the sewer system design plans. At a minimum, the design will conform to the requirements of Standard for Gravel Roads. Access roads across landscaped areas(lawns) may have a permeable surface road such as turf block pavers put in place for aesthetics and must be able to handle loadings from maintenance equipment. Include adequate drainage measures in the design to prevent damage to the access roads from storm water.
3. Gates must be provided for access to a public sewer easement. Vehicular access is required for maintenance, a minimum 20' wide gate must be provided with sliding gates preferred.
4. The maximum grade allowed at any point on an access road is 15%. The maximum cross-slope for any access road is 5%.
5. Manholes are required every 300'.

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CHAPTER S4 - SEWERAGE MATERIALS

S4-01 GENERAL

- a. All materials shall be new and undamaged. The same manufacturer of each item shall be used throughout the work.
- b. Where reference is made to other specifications, it shall be the latest revision at the time of construction, except as noted on the plans or herein.
- c. All materials not specifically referenced shall comply with applicable sections of ASTM, AWWA or the APWA/Standards of Design and Construction for Sewerage & Wastewater Treatment Facilities, 1997 or latest revision.
- d. All materials used must meet NH Department of Environmental Services regulations and Town of Merrimack requirements latest revisions.

S4-02 GRAVITY SEWERAGE PIPE & FITTINGS (Env-Wq 704.05)

S4-02.1 6" to 15" Diameter PVC Pipe

- a. All PVC pipe and fittings shall be integral wall bell and spigot, rubber gasket joint, unplasticized Polyvinyl Chloride (PVC) pipe. All PVC pipe shall have a minimum "pipe stiffness" of 46 psi at 5 percent deflection at 73 degrees F when tested in accordance with ASTM D2412-11, external loading properties of plastic pipe; and a minimum impact strength based on ASTM D3034-08.
- b. All PVC sewer pipe and fittings manufacture and installation shall meet or exceed the ASTM D3212-07(2013) recommended specifications, unless otherwise specified, and all installation shall be in strict compliance with the manufacturer's directions. All pipe shall be clearly marked with the date of manufacture. All pipes shall be provided with a reference mark for proper spigot insertion. Joint gaskets shall be fabricated from a compound of which the basic polymer shall be a synthetic rubber consisting of styrene, butadiene, polyisoprene or any combination thereof and shall meet the requirements of ASTM D-3212.

S4-02.2 18" to 27" Diameter PVC Pipe (ASTM F679-03)

- a. All PVC pipe and fittings shall be integral wall bell and spigot, rubber gasket joint, unplasticized Polyvinyl Chloride (PVC) pipe. All PVC pipe shall have a minimum "pipe stiffness" of 46 psi at 5 percent deflection at 73 degrees F when tested in accordance with ASTM D2412-08, external loading properties of plastic pipe; and a minimum impact strength based on ASTM F679-13a.
- b. All PVC sewerage pipe and fittings manufacture and installation shall meet or exceed the ASTM recommended specifications F679-13a for thickness class T-1, unless otherwise specified, and all installations shall be in strict compliance with the manufacturer's directions. All pipes shall be clearly marked with the date of manufacture. There shall be no reduction in pipe wall thickness at the bell as a result of bell formation. All pipes shall be provided with a reference mark for proper spigot insertion. Joint gaskets shall be fabricated from a compound of which the basic polymer shall be a synthetic rubber consisting of styrene, butadiene, polyisoprene or any combination thereof and shall meet the requirements of ASTM D3212-07(2013).

S4-02.3 AWWA C900 PVC Pipe

- a. Where indicated on the plans, gravity sewerage pipe shall be manufactured in accordance with AWWA Standard, with the following additional requirements or exceptions:
 1. 4" through 12" nominal diameter PVC pipe shall be furnished in cast iron pipe equivalent outside diameters.
 2. C900 PVC pipe shall be pressure class 150 (DR 18) unless otherwise called for in the plan. Pipe joints shall be manufactured using an integral bell with an elastomeric gasket push-on type joint. Elastomeric gaskets shall conform to ASTM F477. All fittings shall be PVC, compatible with C900 PVC pipe class called for in the plan, unless otherwise approved. PVC fittings shall conform to AWWA C900 with respect to joint dimensions and physical properties.

S4-03 PRESSURE SEWERAGE PIPE (Env-Wq 704.07)

PVC pressure pipe shall conform to Env-Wq 704.07 and ASTM D2241-09 or ASTM D1785-12 unless otherwise called for in the plan. Joints shall be made up as recommended by the pipe manufacturer for pressure pipe.

S4-04 PLUGS

All open ends shall be sealed with a plug or material and gasket material approved by the Town. The plug shall be able to withstand all test pressures without leakage.

S4-05 BOLTS IN PIPING

- a. Bolts shall be malleable iron, Cor-ten, or stainless steel.
- b. Bolts and nuts for flanged pipe and fittings shall conform in size and length with ANSI/AWWA C115/A21.15. T-bolts shall be malleable iron Cor-ten in accordance with ANSI/AWWA C111/A21.11. Stainless steel bolts shall meet the requirements of ASTM A-307, Grade A. Shackle rods, nuts and washers shall be hot-dipped galvanized in accordance with AASHTO M 232 and coated thoroughly with asphaltic material.
- c. Stainless steel nuts, bolts and washers shall be type 304.

S4-06 FLANGE GASKETS

Gasket Material shall be neoprene, Buna N, chlorinated butyl, or cloth inserted rubber.

S4-07 MANHOLES

- a. Manholes shall be precast reinforced concrete sections with a confined O-ring rubber gasket joints per ASTM C-478-12a with a precast base made from a 3,000 psi structural concrete. All structure shall be reinforced concrete.
- b. Concrete adjustment rings shall conform to the ASTM C-32-13, Grade MA.
- c. Mortar used shall be composed of one part cement to two parts of sand.

S4-08 MANHOLE FRAME & COVER

- a. Ductile iron and cast iron frames and covers shall conform to the standard specifications, as modified herein. All covers shall have SEWER written in 3" letters. Use of India frames and covers or equivalent shall not be allowed on any structures.

- b. Casting shall conform to the requirements of ASTM A48/A48M-03(2012) Grade 80-55-06 for ductile iron and ASTM-A30, Class 25 for cast iron, and shall be free of porosity, shrinkage cavities, cold shuts, or cracks, or any surface defects which would impair serviceability. Repair of defects by welding or by the use of smooth-on or similar material will not be permitted.
- c. Manhole frames and covers shall be machine-finished or ground-on seating surfaces so as to assure non-rocking fit in any position and interchangeability.
- d. Manholes less than 14' deep and having no inside drop shall have a cover with a 30" clear opening. The cover shall be Neenah Foundry #R-1743 or equal. All structure 14' or deeper or structure with an inside drop, requires a clear opening of 36". The cover supplied shall be Neenah Foundry #R-1742 or equal as approved by the Sewer Inspector.
- e. All covers used on cross-country manholes and manholes not in a paved surface shall be locking, watertight, and hinged. The cover supplied shall be EJ Iron works # ERGO 32 or equal as approved by the Sewer Inspector.

S4-09 CONCRETE BEDDING & BLOCKING

Bedding, blocking, or encasement concrete shall be mixed from materials acceptable to the Engineer and shall have a 30-day compressive strength of not less than 2,500 psi. The mix shall contain five (5) sacks of cement per cubic yard and shall be of such consistency that the slump is between 1 inch and 5 inches. All concrete shall be mechanically mixed.

S4-10 OIL/WATER SEPARATOR

- a. Oil/Water separator vaults shall be of precast concrete construction.
- b. Cement concrete shall have a minimum 28-day compressive strength of 4500 pounds per square inch.
- c. Deformed bars for steel reinforcement shall be in accordance with ASTM A615, grade 60. Welded-wire fabric reinforcement shall be in accordance with ASTM A185, grade 65. All interior piping shall be PVC sized to match side sewerage line size. Baffles and weir shall be 1/2- inch thick steel plates galvanized in accordance with ASTM A123. Vault cover shall include one (1) 24-inch square diamond plate access door and two (2) 12-inch square diamond plate inspection covers centered over outlet tee and inlet. Cover shall be designed for AASHTO H- 20 load. See the Standard Details for vault sizes and miscellaneous details.

S4-11 GREASE INTERCEPTOR

- a. Grease Interceptor Vaults shall be of precast concrete construction. Cement concrete shall have a minimum 28-day compressive strength of 4500 pounds per square inch.
- b. Deformed bars for steel reinforcement shall be in accordance with ASTM A615, grade 60. Welded-wire fabric reinforcement shall be in accordance with ASTM A185, grade 65. All interior piping shall be PVC sized to match side sewerage line size.
- c. Interior baffle shall be precast reinforced concrete, 4 inches thick. Concrete baffle shall be secured in place by slotted vault walls or with stainless steel angels as shown in the Standard Detail.
- d. Vault cover shall include 32-inch clear opening manhole covers and frames located over inspection tees. Manhole covers shall not allow passage of air or gases. Vault cover shall be designed for AASHTO H-20 load with 30% impact factor.

S4-12 BACKWATER VALVE

Backwater check valve installed on 4" to 6" diameter lateral sewers shall be rubber flapper swing type check valve. Flapper shall be constructed from steel reinforced rubber with 45-durometer standard rubber hardness. Valve seat shall be at 45° angle to direction of flow. Flow area through valve shall equal full pipe area. Backwater valve will be installed on the exterior of the building within two feet of the wall unless authorized by Public Works Director. The backwater valve shall be Clean-Check model or equal as approved the Sewer Inspector.

S4-13 BARRIER FENCE

- a. Barrier Mesh shall be manufactured from Low Density Polyethylene, stabilized against U.V. degradation, and with a special selection of pigments to ensure optimum visual performance under harsh weather conditions.
- b. Barrier Mesh shall be corrosion-free and resistant to salt water and most chemicals.
- c. Barrier Mesh shall present a visual target area of approximately 0.5 square meter per square meter of mesh.

S4-14 GRAVEL

- a. Bedding gravel shall consist of either clean sand/gravel mixture as specified in State of New Hampshire specifications.
- b. Select Trench Backfill shall be as specified in **Env-Wq 704.11** “Standards of Design and Construction for Sewerage and Wastewater Treatment Facilities”, latest revision.

S4-15 CONTROLLED DENSITY FILL (FLOWABLE FILL)

- a. Controlled density fill (CDF aka, flowable fill) shall be a mixture of Portland Cement, aggregates and water. It shall be proportioned to provide a grouty, non-segregating, free flowing, self-consolidating and excavatable material that will result in a non-settling fill, which has measurable unconfined compressive strength.
- b. Materials testing shall be with unconfined compressive test cylinders. Test data may be either laboratory trail batch test data or field test data.
- c. Alternate mix designs may be required at the Engineer's discretion.
- d. The unconfined compressive strength at 28 days shall be a minimum of 50 psi and a maximum of 100 psi. Material shall be sand/grout slurry proportioned to be hand-excavatable after long- term strength gain.
- e. Materials shall meet the requirements of the following sections of the Standard Specifications:
 - 1. Portland Cement
 - 2. Fine Aggregate for Portland Cement Concrete
 - 3. Admixture for Concrete
 - 4. Fly Ash
 - 5. Water

- f. Controlled density fill shall meet the following requirements: Controlled Density Fill

<u>Ingredients</u>	<u>Amount per Cu. Yd.</u>
Portland Cement	50 lb.
Aggregates Class 1 or 2	3300 lb.
Air Entrainment Admixture	Per Manufacturer's recommendations
Fly Ash Class F	300 lb.
Water	300 lb. (maximum)

- g. The material consistency shall be flowable (approx. slump 3-10 inches). If requested by the Contractor, the proportions may be adjusted with the approval of the Engineer.

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CHAPTER S5 - SEWERAGE METHODS OF CONSTRUCTION

S5-01 GENERAL CONSTRUCTION REQUIREMENTS

S5-01.1 General

- a. The improvements shall be constructed as shown on the plans and in accordance with these Standards, Standard Details, and Standard Specifications.
- b. Manufacturer's equipment shall be installed in compliance with specifications of the manufacturer, except where a higher quality of workmanship is required by the plans and specifications.
- c. All materials and work shall be in strict accordance with any applicable regulations of the State, and local authorities.
- d. The Contractor shall arrange for such inspection by these agencies as may be required and shall submit evidence of their approval, if requested by the Town Engineer/Sewer Inspector.

S5-01.2 Alignment & Staking

- a. All work done under a Project shall be to the lines shown on the plans, or to approved revisions.

S5-01.3 Inspections & Tests

- a. The Town Engineer/Sewer Inspector shall, at all times, have access to the work for the purpose of inspecting and testing, and the Contractor shall provide proper facilities for such access and such inspection and testing.
- b. If any work is covered up without approval or consent of the Town Engineer/Sewer Inspector, it must, if required by the Town Engineer/Sewer Inspector, be uncovered for inspection.
- c. Before a performance test is to be observed by the Town Engineer/Sewer Inspector, the Contractor shall make whatever preliminary tests are necessary to assure that the material and/or equipment are in accordance with the plans and specifications.
- d. Written notice of deficiencies, adequately describing the same, shall be given to the Contractor upon completion of each inspection and the Contractor shall correct such deficiencies within seven days of the notice and before final inspection will be made by the Engineer, unless otherwise approved.

S5-02 PROCEDURES FOR REVISION OF APPROVED PLANS

- a. Any deviation from the approved plans or specification affecting capacity, flow or operation of units shall be approved in accordance with these rules in writing before such changes are made.
- b. Plans or specifications so revised shall be submitted at least thirty (30) days in advance of any construction work which will be affected by such changes, to permit time for review and approval.
- c. Structural revisions or other changes not affecting capacity, flows, or operation are permitted during construction but only as approved changes in accordance with these rules.
- d. As-built plans shall be submitted to the division at the completion of work with GPS locations of all structures and ends of laterals installed and shape files compatible with the Town's GIS system.

S5-03 PRECONSTRUCTION PHOTOS FOR ALL PROJECTS

- a. Before commencing any construction work as described in the plans and specifications, the Contractor shall provide photographs of pre-existing conditions of the area that will be disturbed during construction operations.
- b. Photographs will be obtained as follows:
 - 1. Every 25 feet interval in easements.
 - 2. Every 50 feet interval in paved areas.
 - 3. And any other location as directed by the Engineer.
- c. The photographs shall be taken, printed in 5" x 7" color prints, contained in albums, catalogued, and cross-referenced.

S5-04 GRADE ESTABLISHMENT

- a. Sewer grades shall be established by means of laser beam, lines, poles, plumb bobs or other means approved by the Design Engineer. The grades shall be checked at periodic intervals as directed by the Engineer and at completion of each run of pipe.
- b. If the Contractor chooses to use a laser beam the equipment and methods shall meet the approval of the Engineer. Laser beam alignment and grade shall as a minimum be verified at a point 50 feet from the laser.

- c. The Contractor shall replace all monuments, right-of-way markers, property stakes, etc., that are removed or disturbed, to the satisfaction of the Town Engineer.

S5-05 PIPE LINE CONSTRUCTION

S5-05.1 Pipe Laying

- a. Pipe laying shall be in accordance with the following.
- b. Each pipe shall be laid with bells upgrade with the invert of the pipe to the alignment and grade shown on the plans. Care shall be exercised to insure close concentric joints and a smooth invert. Open ends of pipe and fittings shall be temporarily blocked and covered when laying is not in progress.
- c. Water shall not be allowed in the trench during the pipe laying, joint making, and as long thereafter as is necessary, in the judgment of the Town Engineer/Sewer Inspector, for the type of joint being used.
- d. Existing sewage flow shall be diverted away from the segment being worked on by method approved by the Town Engineer.
- e. Adjustment to the line and grade shall be done by scraping away or filling in and tamping material under the body of the pipe. Adjustment to the line and grade by wedging and blocking shall not be permitted.
- f. The pipe shall be lowered into the trench by methods recommended by manufacturer or any other suitable means. The pipe shall not be dropped or handled roughly. The pipe shall be checked for cracks and defects prior to use and any defective pipe rejected.
- g. Wyes, and standing services shall be installed as shown on the Standard Details and at such locations as are shown on the plans or as otherwise directed by the Engineer. These items shall not be backfilled until the Contractor has recorded their exact location.
- h. Pipe laying shall start from the lowest point unless otherwise approved by the Engineer.
- i. Slip lining shall be performed as per recommended procedure by manufacturer, as per details and as approved by the Engineer.

S5-05.2 Alignment Tolerance

- a. The maximum tolerance from true line and grade shall be as follows:
- b. Maximum deviation from established line and grade shall not be greater than one thirty-second ($1/32$) inch per inch of pipe diameter and not to exceed one-half ($1/2$) inch.
- c. No adverse grade in any pipe length will be permitted.
- d. The difference in deviation from true line and grade between any two successive joints shall not exceed $1/3$ of the amounts specified above.

S5-05.3 Joints

- a. Joint material shall be used in accordance with the recommendations of the manufacturer. Pipe handling after the gasket has been affixed shall be carefully controlled to avoid bumping the gasket and, thus knocking it out of position or contaminating it with dirt or other foreign material. Any gasket so disturbed shall be removed cleaned, re-lubricated and replaced.
- b. Care shall be taken to properly align the pipe before joints are forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling, as required to minimize lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Pipe deflection and straightening shall be held to a very minimum once the joint is home to prevent creep of the joint.
- c. Sufficient pressure shall be applied in making the joint to assure that the joint is home as defined in the standard installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied to the line to assure the joints once home are held so, by tamping fill material under and alongside the pipe or otherwise. At the end of the day's work, the last pipe shall be blocked in such a manner as may be required to prevent creep during down time.

S5-05.4 Pipe Bedding

- a. Pipe shall be placed on a prepared subgrade of imported material at least 6 inches deep below the barrel of the pipe and filled around the pipe to the spring line for all pipe sizes of 27 inches in diameter and smaller, and 8 inches deep for all pipe sizes of 30 inches and larger. Pipe in ledge requires 12". After preparation of the subgrade, bell holes shall be excavated so the pipe, when laid, will have a uniform bearing under the full length of the pipe. The Contractor shall be responsible for adequate support and bedding for the pipe. The trench shall be hand backfilled and compacted from the spring line of the pipe to six inches above the top of the pipe. The material shall be placed in 6-inch layers and compacted to no less than 95 percent of the maximum theoretical density as measured by ASTM D-1557 prior to placement of the next layer.
- b. Where the undisturbed trench below the 6 inch bedding is unstable, the unstable materials shall be removed and backfilled with foundation gravel and/or bedding gravel as necessary to produce a stable foundation upon which to place the bedding. The Contractor shall be responsible for providing a stable foundation for placing of the bedding.
- c. Boulders, rocks, and other obstructions (except roots of existing trees to be saved) shall be entirely removed or cut out the full width of the trench and to a depth 6 inches below the pipe bottom and backfilled as provided above.
- d. Whenever the trench is excavated below the depth required for proper bedding, it shall be backfilled with bedding gravel and compacted, as provided above for bedding gravel.
- e. Use Concrete Encasement in accordance with the Standard Detail only upon direction of the Engineer.

S5-06 PRESSURE SEWERAGE MAINS AND VALVES

S5-06.1 Pressure Main Installation

- a. Pressure pipe as specified on the plans shall be installed as recommended by the pipe manufacturer. Pressure sewerage mains shall be laid so that no high point exists except at the discharge manhole or an air release assembly.

S5-06.2 Valve Installation

- a. Before installation, valves shall be cleaned of all foreign material. Such blocking as the Engineer may deem necessary shall be provided. The valve and valve box shall be set plumb with the valve box centered on the valve. Valves shall be opened and shut under pressure to check operation without leakage. Where valve operating nut is more than three feet below finished grade, a stem extension conforming to the Water Standard Detail must be installed
- b. The top of the valve box base section shall be located a minimum of 6" and maximum of 9" below finished grade. A polyethylene sheet, 8-mils thick, shall be placed between the top and base valve box sections to prevent metal-to-metal contact where the sections overlap.
- c. Valve box top sections shall be adjusted flush with the finished pavement and, in those areas to be excavated for future roadway grades, enough adjustment shall be provided in the valve box to allow the top of the box to be adjusted to the required grade.

S5-06.3 Valve Box Marker Installation

- a. Concrete marker posts shall be painted with two coats Rust-Oleum No. 2766 Hi-Gloss white paint. The marker shall be set on a line through the valve at right angles to the centerline of the road. The marker shall generally be set on the property line unless the Engineer decides another location is safer or more conspicuous. Distance to the valves shall be nearly stenciled on the post with 2-inch numerals. Valve markers shall be installed only in unimproved or unpaved areas.

S5-07 LATERAL SEWERS

- a. Lateral sewer locations as shown on the plan are approximate only. Exact location to be coordinated with property owner.
- b. All existing services shall be maintained during construction.
- c. All existing lateral sewers shall be reconnected or replaced immediately after the trunk is laid. When replacing an existing trunk, lateral sewers shall be reconnected after the main is tested, when feasible.
- d. Where applicable, all specifications contained herein for sewer materials and construction shall be held to apply to lateral sewers. Invert of the lateral sewer at the end of the stub shall be as shown on the plan or as directed by the Engineer.

- e. Ends of the lateral sewer stubs shall be marked with a 2 x 4 stake, 2 feet long, with one end buried at the depth of the stub-end invert and extending vertically out of the ground. The portion of the stake above ground shall be painted green and marked with the word "SEWER" and the depth from pipe invert to ground surface.
- f. Slope of lateral sewers shall not be less than two percent (2%). All lateral sewer plugs shall be blocked.
- g. Where change in slope is greater than two inches per foot, standard 1/8 bends shall be used.

S5-08 MANHOLE CONSTRUCTION

S5-08.1 Excavation

- a. Excavation for precast manholes shall be sufficient to provide a minimum of 12 inches between the manhole and the side of the excavation.
- b. The excavation shall be kept free from water until jointing has been completed.
- c. Surface water shall be diverted so as not to enter the excavation.
- d. The contractor shall maintain sufficient pumping equipment on the job to insure that these provisions are carried out.

S5-08.2 Manholes

- a. Manholes shall be constructed as shown in the Standard Details for standard manholes and drop manholes. Manholes shall be of precast reinforced concrete. Manhole ring and covers shall be adjusted to the elevation required by the Engineer prior to final acceptance of the work.
- b. The manhole base slab shall be placed on firm soil. If the foundation material is inadequate, the Contractor shall use foundation gravel or bedding concrete under the normal base to support the manhole.
- c. The outside and inside of manhole adjusting bricks and the joints of any non-gasketed precast concrete sections shall be thoroughly wetted and completely filled with mortar, and troweled smooth with 3/4" of mortar in order to attain a watertight surface.

- d. Mortar shall be placed between each level of adjusting bricks, riser rings, top of cone section, and bottom of iron ring.
- e. All lift holes, if any, on precast items shall be completely filled with nonshrink mortar, smoothed both inside and out, to insure water-tightness. All steel loops, if any, on precast section must be removed, flush with the manhole wall. The stubs shall be covered with mortar and smoothed. Rough, uneven surfaces will not be permitted.
- f. Channels shall be made to conform accurately to the sewer grade and shall be brought together smoothly with well-rounded junction, satisfactory to the Engineer. The channels shall be built using all brick and mortar poured after the inlet and outlet pipes have been laid and firmly grouted into place at the proper elevation. Allowances shall be made for a minimum of one-tenth foot (0.1') drop in elevation across the manhole in the direction of flow. The maximum allowable drop in invert elevation across the manhole in the direction of flow shall be 1.0 foot. Channel sides shall be carried up vertically from the invert to top of the various pipes. The shelf shall be warped evenly and sloped 1" per foot to drain. Rough, uneven surfaces will not be permitted. Channels shall be constructed to allow the installation and use of a mechanical plug of the appropriate size.
- g. All rigid pipe entering or leaving the manhole shall be provided with flexible joints within twelve inches (12") of the manhole structure and shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which pipes enter the structure are completely and firmly filled with mortar from the outside to ensure water-tightness. All PVC pipe connections to manholes shall be made with gasketed coupling as approved by the Town Engineer/Sewer Inspector.

S5-09 CONNECTION TO EXISTING MANHOLE

- a. Connection to existing manhole shall be accomplished in such a manner that all existing services are maintained, that no refuse, broken brick, concrete or other extraneous matter enter into the existing sewer. The outfall shall be plugged or screened throughout the contractors operation at the Engineer's option.

- b. A circular opening shall be carefully core drilled in the manhole barrel on the proper alignment so that the new sewer will be in line with the center of the manhole, and at the height which will allow the new sewer to be placed at the proper grade. The opening shall be of such size as to provide clearance of not less than one (1) or more than three (3) inches between the outside of the pipe and the manhole wall. Pipe connections, channel forming, grouting of pipe and backfilling shall be as specified previously for standard manholes.
- c. No additional pipe shall be connected until final set of the grout has occurred. When additional pipe is connected, care shall be taken to avoid shocks or other undue strains to the grouted pipe.
- d. Any opening resulting from removal of existing pipe shall be filled with mortar to provide a watertight seal, unless new pipe is to be reconnected to that opening.
- e. When any new sewer is connected to an existing manhole, the manhole shall be reconstructed to conform to current standards.
- f. Upward adjustments of old, existing manholes must be done with all new parts.

S5-10 FIELD QUALITY CONTROL

- a. All leakage tests shall be completed and approved prior to placing of pavement.
- b. All sewerage, manholes, and appurtenant work, in order to be eligible for approval by the Town Engineer/Sewer Inspector, shall be subject to tests that will determine the degree of water tightness and horizontal and vertical alignment.
- c. Thoroughly clean and/or flush all sewerage lines to be tested, in a manner and to the extent acceptable to the Town Engineer/Sewer Inspector, prior to initiating test procedures.
- d. Perform all tests only under the direct supervision of the Town Engineer/Sewer Inspector in accordance with local and state regulations.

- e. Perform testing by test patterns determined or approved by the Town Engineer/Sewer Inspector.
- f. Remedial Work
 - 1. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspection under the direct supervision of the Town Engineer/Sewer Inspector.
 - 2. Completely retest all portions of the original construction on which remedial work has been performed.

S5-11 CLEANING & FLUSHING

- a. Prior to pipe testing, all pipes shall be cleaned in the following manner:

All pipes shall be cleaned with a high pressure "jetter" and all materials shall be collected and removed from the pipes.

S5-12 TESTING REQUIREMENTS

S5-12.1 General

Inspection will be required during the installation of sewerage main, wyes, structures and building of inverts. All installation shall be in compliance with "State of New Hampshire Standards of Design for Sewerage and Wastewater Treatment Facilities", Env.-Wq 700.00 or latest revision.

- a. Final sewerage testing work includes the performance of testing and inspection each run of pipe, or each gravity main or force main and each item of appurtenant construction.
- b. Perform testing at a time approved by the Town Engineer/Sewer Inspector, which may be during the construction operation, after completion of a substantial and convenient section of the work, or after the completion of the laying of 1,000 feet of pipe.
- c. Provide all labor, pumps, connections, gauges, measuring devices and all other necessary apparatus to conduct tests. All equipment must be of appropriate calibration certification.

- d. Testing may be done by a qualified independent testing organization or by the contractor. In either case testing shall conform to the requirements outlined in the “State of New Hampshire Standards of Design for Wastewater Treatment Facilities”, latest revision, and the requirements of the Town of Merrimack contained herein.
- e. All portions of the sewerage system including sewerage, manholes, force mains and appurtenant work in order to be eligible for approval by the Engineer/Sewer Inspector, shall be tested for water tightness by the use of either water or low- pressure air. The rate of infiltration or exfiltration shall not exceed 100 gallons per inch of pipe diameter per mile of pipe, for sizes up to 48”: 200 gallons per inch of pipe diameter per mile over 48”. Each section of pipe shall meet the above criterion. There shall be no more than 1,000 feet of untested sewer constructed at any time. Force mains shall be tested in accordance with section 4 of the American Water Works Association Standard C 600 “Installation of Cast Iron Water Main”; at a pressure equal to 150% of the design cooperating dynamic head or 100psi minimum. Low-pressure air tests shall be to ASTM 1417-11a. As an alternative to the infiltration and exfiltration tests on manholes, a vacuum pressure test may be carried out to the criterion in Section S5.12.2 & S12.4, below.
- f. Immediately following the pipe cleaning, the pipe installation shall be tested with low- pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 pounds per square inch greater than the average backpressure of any groundwater that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

S5-12.2 Sewer Line Tests

- a. Each section of sewer shall be tested between successive manholes by plugging and bracing all opening in the sewer mainline and the upper ends of all house connections sewers.
- b. Gauges – The gauges utilized for the test shall be of a scale and range equivalent to 2.5 inch diameter, 0-15 psi range (0.2 psi maximum increments). Gauges supplied by the contractor shall be tested for accuracy and shall have a current certification of accuracy from an approved agency. The gauge for vacuum tests shall meet the above certification requirements also.
- c. Pneumatic Plugs – Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected. Also plugs shall resist internal test pressure.
- d. Central/Control Panel – All air used shall pass through a single central panel.

- e. Connect three individual hoses: From the control panel to the pneumatic plug for infiltration. From the control panel to the sealed sewer line for introducing the low-pressure air. From the sealed sewer line to the control panel for continually monitoring the air pressure rise in the sealed line. (See Env-Wq 704.07).

S5-12.3 Low-pressure Air Tests

- a. Low-pressure air tests shall be in compliance with ASTM F1417-98 and State of New Hampshire Standards for Sewerage and Wastewater Treatment Facilities and Uni-Bell PVC Pipe Association Uni-B-6.
- b. Low-pressure air test – The equipment used shall conform to the requirements in Section 5.05 above. The line shall be pressurized to 4.0 psi. The line will be allowed to stabilize to between 3.5 psi and 4.0 psi for a period of no less than five (5) minutes. If necessary, air shall be added to the line to maintain the pressure above 3.5 psi. After the stabilization period, the valve controlling the air shall be closed. When the line pressure drops to 3.5 psi, commence timing with a stopwatch. The stopwatch shall be allowed to run until such time as a line pressure drops to 2.5 psi, the watch shall be stopped and the time lapse compared with allowable time laps in these specifications for the pipe size and leakage allowance specified by the engineer (see Table 1 included). If the time lapse is greater than that specified, the section undergoing test shall have passed, and the test may be discontinued at that time. If the time is less than that specified, the line has not passed the test; and the contractor/developer will be required to correct the condition causing the failure and prepare the line for retest.
- c. If the pipeline to be tested is beneath the groundwater level, the test pressure shall be increased 0.0433 psi for each foot the groundwater level is above the pipe.

S5-12.4 Manhole Vacuum Test

- a. Manhole - Initial vacuum gauge test vacuum shall be 10" Hg. Test hold time for a 1" Hg. vacuum drop shall be as follows:

At least 2 minutes for a manhole < 10' deep;
At least 2 ½ minutes for a manhole 10' to 15'
deep; At least 3 minutes for a manhole 15' or > in
depth;.

S5-12.5 Deflection Test

- a. Deflection tests and test gauge diameter for plastic pipe, shall be 7 ½% of average inside diameter. A test shall be conducted after a minimum of thirty (30) days following installation.

- b. The deflection gauge diameter for this test (G), shall be determined by the following formula: $G = 0.925$ inches (nominal) where D is the average inside diameter given in applicable ASTM standard. In the cases where inside diameters are not given, they shall be determined by the following formula:

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

where t = maximum solid wall thickness
 D' = the average outside diameter

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

S5-12.6 Testing of Pressure Sewer Mains

- a. Prior to acceptance of the project, the pressure line shall be subjected to a test in accordance with Section 4 of the American Water Works Association Standard C 600 "Installation of Cast Iron Water Main"; at a pressure equal to 150% of the design dynamic head or at least 100psi.
- b. The Contractor before final acceptance of the project shall remedy any leaks of imperfections developing or occurring under the test pressure. Leakage shall be measured by approved means. Test pressure shall be maintained while the entire installation is inspected.
- c. The Contractor shall provide all necessary equipment and shall perform all work connected with the tests.
- d. Insofar as is practical, test shall be made with pipe joints and fittings exposed for inspection.
- e. Maximum allowable leakage shall be .05 gallons per hour per inch of pipe diameter per 100 feet of pipe. **Env.Wq 704.08**

S5-13 VIDEO INSPECTION

- a. The Developer shall provide the Town with a videotape inspection of all sanitary sewers prior to final project acceptance. The video shall include the following at a minimum; identify each manhole, distance to each lateral and total distance from manhole to manhole. The video shall be completed only after 30 days after the last run of pipe has been installed. The video shall be conducted by a NASSCO certified individual and reports shall be in NASSCO format.

- b. If defects are found during the two-year warranty period, the Town may also require that the Developer provide videotape inspection of any or all sanitary sewerage before expiration of the warranty.
- c. The Contractor shall correct all deficiencies found during television inspection.
- d. Town representative should be onsite to witness video.
- e. Pipe shall be cleaned by use of proper sewer cleaning equipment such as a vactor truck, etc. Flushing of line by running water is not acceptable. It is strongly suggested the cleaning take place while the video equipment is on site to ensure the pipe is clean enough for video acceptance.

S5-14 INSPECTION OF APPURTENANT INSTALLATIONS

- a. Completely inspect, at a time determined by the Engineer, all manholes and inlets to ascertain their compliance with drawings and specifications.
- b. Provide access to each manhole and inlet and check the following characteristics:
 - 1. Slope and finish of invert channels.
 - 2. Water-tightness and finish of masonry structures.
 - 3. Elevation and attachment of frames, covers, and opening.

S5-15 INSPECTION

Town engineering consultants will be used for inspection and shall be paid for by the Developer / Contractor. All inspections shall be approved by the Director of Public Works.

Table I
MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF

**PIPE INDICATED FOR
Q = 0.0015**

1 Pipe	2 Minimum	3 Length	4 Time	Specification Time for Length (L) Shown (min. : sec.)							
Diameter (in.)	Time (min:sec)	For Minimum Time (ft)	For Longer Length (sec)	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

S5-16 ACCEPTANCE OF SEWERAGE

Upon completion of the installation and testing of the sewerage system and the building of inverts, the Contractor/Developer will submit three (3) sets of "As-Built Plans" appropriately stamped by the engineer of record or the design engineer for the project, the results of all testing of manholes and sewerage lines, and the pipeline video. All structures, lateral ends, cleanouts, and other features shall be located by GPS/GIS and submitted to the Wastewater Department as a "shape" file compatible with the Towns GIS system. One set shall be in PDF and two sets in 24x36 printed format. Upon receipt of the above plans, the Town will conduct a review and the Director of Public Works will inform the Contractor/Developer of the acceptance or rejection of the system and in

the case of rejection the reason for said rejection. **No paving shall take place until the above has been completed. Note: One set of plans may be submitted as "Review plans".**

S5-17 OIL/WATER SEPARATOR

- a. Detailed shop drawings must be submitted for approval by Director of Public Works. Oil/water separators shall be constructed as shown on submitted plans. Excavation for precast vault shall be sufficient to provide a minimum of 12 inches between the vault and the side of the excavation. Vault shall be placed at proper depth to set vault cover flush with finish grade. If additional depth of cover is required over inlet or outlet piping, vault riser sections shall be installed to raise vault cover a maximum of 24 inches.
- b. The oil/water separator shall be placed on firm soil. If the foundation material is inadequate, the Contractor shall use foundation gravel or bedding concrete under the normal base to support the separator.
- c. Vault shall be placed and set plumb so as to provide vertical sides. The completed separator shall be rigid and watertight.
- d. Joints of precast concrete sections shall be thoroughly wetted and completely filled with mortar, plastered and troweled smooth with 3/4" of mortar in order to attain a watertight surface.
- e. All lift holes, if any, on precast items shall be completely filled with expanding mortar and smoothed both inside and out, to insure water-tightness. All steel loops, if any, on precast section must be removed, flush with the vault wall. The stubs shall be covered with mortar and smoothed. Rough, uneven surfaces will not be permitted. Precast vault shall be provided with 8-inch diameter knockouts at all pipe openings or have openings core-drilled prior to installation.
- f. All rigid pipe entering or leaving the structure shall be provided with flexible joints within twelve inches (12") of the manhole structure and shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which pipes enter the structure are completely and firmly filled with mortar from the outside to ensure water-tightness. All PVC pipe connections to vault shall be made with gasketed coupling as approved by the Town.

S5-18 GREASE INTERCEPTOR

- a. Detailed shop drawings must be submitted for approval by Director of Public Works. Grease interceptors shall be constructed as shown on plans submitted. Excavation for precast vault shall be sufficient to provide a minimum of 12 inches (12") between the vault and the side of the excavation.
- b. 32-inch (32") diameter manhole frame and cover shall be adjusted to the elevation required by the Engineer prior to final acceptance of the work. Adjusting rings shall be manufactured from precast reinforced concrete. Total height of rings shall be from 8 inches (8") minimum to 20 inches (20") maximum.
- c. The grease interceptor shall be placed on firm soil. If the foundation material is inadequate, the Contractor shall use foundation gravel or bedding concrete under the normal base to support the interceptor.
- d. Vault shall be placed and set plumb so as to provide vertical sides. The completed interceptor shall be rigid and watertight.
- e. The outside and inside of manhole adjusting rings, joints of precast concrete sections and the perimeter of precast baffle shall be thoroughly wetted and completely filled with mortar, plastered and troweled smooth with 3/4" of mortar in order to attain a watertight surface.
- f. All lift holes, if any, on precast items shall be completely filled with expanding mortar, smoothed both inside and out, to insure water-tightness. All steel loops, if any, on precast section must be removed, flush with the vault wall. The stubs shall be covered with mortar and smoothed. Rough, uneven surfaces will not be permitted.
- g. Precast vault and baffle shall be provided with 8-inch (8") diameter knockouts at all pipe openings or have openings core-drilled prior to installation.
- h. All rigid pipe entering or leaving the structure shall be provided with flexible joints within twelve inches (12") of the manhole structure and shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which pipes enter the structure are completely and firmly filled with mortar from the outside to ensure water-tightness. All PVC pipe connections to vault and baffle shall be made with gasketed coupling as approved by the Town.

S5-19 COMMERCIAL CLEAN-OUT WITH TEST SAMPLING TEE (if needed)

- a. Test sampling tees shall be placed outside the building no more than 24 inches (24") downstream of a clean-out extended to grade, enclosed in a cast concrete meter box. The enclosure shall be supported on minimum 2-inch thick gravel base. The capped orifice shall be a maximum of 4 inches (4") from finished grade. The sampling tee shall be installed so that it opens in a direction at right angles to and vertically above the flow of the pipe. The sampling tee shall be accessible at all times for compliance determination sampling.
- b. The clean out shall be brought to grade and provided with a cast iron ring and cover imbedded in class "C" concrete as shown in the Standard Detail.

S5-20 BACKWATER VALVES

S5-20.1 Sewage backflow

Sewer laterals will have a backflow preventer installed at the exterior of the building to prevent sewage and sewage gasses from entering the building.

S5-20.2 Material

All bearing parts of backwater valves shall be of corrosion-resistant material. Backwater valves shall comply with ASME A112.14.1, CSA B181.1 or CSA B181.2.

S5-20.3 Seal

Backwater valves shall be so constructed as to provide a mechanical seal against backflow.

S5-20.4 Diameter

Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed.

S5-20.5 Location

Backwater valves shall be installed so that access is provided to the working parts for service and repair.

*Acceptable designs are clean check system or equivalent as approved by the Sewer Inspector.

S5-21 TRENCH CONSTRUCTION

S5-21.1 Trench Excavation

- a. Before commencement of trenching provide pollution/sediment control for all downhill storm drain catch basins. Plastic sheeting must be available on-site. In case of rain any stockpiled material must be covered and secured.
- b. Clearing and grubbing limits may be established by the Engineer for certain areas and the Contractor shall confine his operations within those limits. Debris resulting from the clearing and grubbing shall be disposed of by the Contractor.
- c. Trenches shall be excavated to the line and grade designated by the Engineer and in accordance with the Standard Details. Trenches shall comply with OSHA and State of New Hampshire requirements regarding worker safety. The trench width at the top of the pipe shall be 30 inches for pipe up to and including 12 inch inside diameter and the outside diameter of the pipe barrel plus 16 inches for pipe larger than 12 inch inside diameter. Where higher strength pipe or special bedding is required because of excess trench width, it shall be furnished.
- d. The trench shall be kept free from water until joining has been completed. Surface water shall be diverted so as not to enter the trench. The Contractor shall maintain sufficient pumping equipment on the job to insure that these provisions are carried out. The Contractor shall perform all excavation of every description and of whatever substance encountered as part of his trench excavation cost. Unsuitable material below the depth of the bedding shall be removed and replaced with satisfactory materials as determined by the Engineer.
- e. Trenching operations shall not proceed more than 100 feet in advance of pipe laying except with written approval of the Engineer/Sewer Inspector.
- f. When trenching operations take place in the public right-of-way, the pavement, and all other improvements, shall be restored as required by the Right-Of-Way Permit.

S5-21.2 Sheeting and Shoring

- a. The Contractor shall provide and install sheeting and shoring as necessary to protect workmen, the work and existing utilities and other properties in compliance with OSHA and State of New Hampshire requirements. All sheeting and shoring above the pipe shall be removed prior to backfilling. Sheeting below the top of the pipe may be cut off and left in place.
- b. Removal of the sheeting and shoring shall be accomplished in such a manner that there will be no damage to the work or to the other properties.

S5-21.3 Dewatering

- a. When water is encountered to a degree that a successful trenching and pipe laying operation is hampered, dewatering will be the responsibility of the Contractor.
- b. Determination of the method to be used to dewater trenched areas will be the responsibility of the Contractor, but any method used must be in accordance with the specifications and requirements of the Town of Merrimack and State of New Hampshire and approved by the Public Works Director and or Sewer Inspector.

S5-21.4 Backfill and Compaction

- a. Compaction of backfill from the bottom of the trench to the top of the pipe shall be as specified under pipe bedding. Compaction of the remainder of the backfill shall, at the minimum, meet the requirements of the State of New Hampshire, and Town of Merrimack Construction Standards.
- b. Backfill shall not be deposited in the trench in any manner which will damage or disturb the pipe or the initial backfill. Compaction of the backfill may be obtained by tamping, rolling or otherwise, as specified by the Engineer. The Contractor shall provide the services of a testing laboratory acceptable to the Town Engineer to perform in place density tests to show that the specified density has been obtained. The approval of the compaction method and the achievement of the specified density shall, in no way, relieve the Contractor of responsibility for all repairs caused by settlement of the backfill prior to acceptance and during the two-year period after acceptance of the project.
- c. Where the excavated materials cannot be compacted as specified, the Contractor shall replace the excavated material with approved imported gravel. (Testing Certificate Required)

- d. Compaction of backfill material may be accomplished by mechanical tamper, by vibrating, by a combination of these methods, as approved by Town Engineer.
- e. Unless otherwise provided, compaction of backfill shall meet the following requirements:

Paved Areas

1. Trench restoration shall be either by a patch or overlay method as required and noted on the Right-Of-Way permit. When a patch method is used the trench limits shall be sawcut prior to the final patch.
2. All trench and pavement cuts shall be made by sawcuts. The sawcuts shall be a minimum of 1 foot (1') outside the trench width. If the permit requires an overlay then the Contractor may use a jackhammer for the cutting of the existing pavement.
3. All trenching shall be backfilled with either crushed surfacing materials conforming to Section 4-04 of the Standard Specifications. All trench backfill materials shall be compacted to ninety-five percent (95%) maximum dry density, as determined by ASTM D-1557, and State of New Hampshire Specifications.

If the existing material is determined by the Town Engineer to be suitable for backfill, the Contractor may use the native material.

Backfill compaction shall be performed in 8 to 12 inch lifts. The Contractor shall perform compaction tests in four-foot (4') increments maximum. The test results shall be given to the Engineer for review and approval prior to paving. Tests shall be performed at maximum intervals of 50 feet along the length of the trench.

Unimproved Areas

1. In trenches through unimproved areas, pipe shall be bedded as specified. The remaining backfill shall be compacted to a minimum of ninety percent (90%) of maximum dry density, as determined by ASTM D-1557, and State of New Hampshire Specifications.

S5-22 BORING AND JACKING STEEL CASING

- a. The Contractor shall verify the vertical and horizontal location of existing utilities. If required to avoid conflicts and maintain minimum clearances, adjustment shall be made to the grade of the casing.
- b. The pipe shall be bored and jacked where indicated. The Contractor shall remove or penetrate all obstructions encountered. If groundwater is found to be a problem during boring operations, the Contractor shall do all that is necessary to control the flow sufficiently to protect the excavation, pipe and equipment so that the work is not impaired. Any pipe damaged during the boring and jacking operation shall be repaired by the Contractor in a manner approved by the Town Engineer/Sewer Inspector.
- c. Special care shall be taken during the installation of the bored and jacked pipe to insure that no settlement or caving be caused to the above surface. Any such caving caused by the placement of the pipe shall be the Contractor's responsibility and he shall repair any area so affected as directed by the Town Engineer/Sewer Inspector.
- d. During the jacking operations, particular care shall be exercised to prevent caving ahead of the pipe which will cause voids outside of the pipe. If voids exist, the Contractor shall drill through the wall of the pipe and fill the voids with a pumped cement grout. All voids shall be filled to the satisfaction of the Town Engineer/Sewer Inspector.
- e. The carrier pipe shall be installed in the casing as shown on the drawings. Where length of the casing exceeds 10 feet, the Contractor shall support carrier pipe with casing spacers as shown in the Standard Detail. The casing pipe shall not be backfilled with sand and grout. The casing ends shall be sealed with manufactured rubber end seal device.
- f. Boring pits shall be backfilled with select native material and compacted to 95% maximum dry density as determined by ASTM D-1557. The Contractor shall provide sufficient select backfill material to make up for the rejected material.
- g. All disturbed ground shall be restored to its original condition or better.

S5-23 ADJUST EXISTING STRUCTURE TO GRADE

S5-23.1 Manhole and Clean-out Adjustment

- a. Existing manholes and clean-outs affected by the overlay as shown in the Plan shall be adjusted to grade. At no time shall more than 18" be allowed. If an adjustment more than that is necessary an additional riser ring must be added to the manhole.
- b. Adjustment of existing manholes shall be in accordance with State of New Hampshire specifications. Clean-outs adjusted to grade shall conform to the Standard Detail.
- c. Grade adjustment rings shall be sized to the opening of the manhole, not obstruct the access to the manhole, and conforming to ASTM C748.

S5-24 UNDERGROUND UTILITIES

- a. The plans show the approximate locations of various existing utilities known to the Engineer,
such as gas lines, water mains, storm drainage, power lines, telephone lines, television cables, and other obstructions based on information obtained from various sources. This information is not guaranteed to be accurate, and the Contractor is directed to check for interferences and obstructions by inquiry from the different utilities and by underground exploration ahead of his regular excavation.
- b. The Contractor shall request field locates and notify the owners of underground facilities about the scheduled commencement of excavation through DIG SAFE (1-888-344-7233), <http://www.digsafe.com>.
- c. If the Utility is not included in the one-number locator service, notice shall be provided individually to those owners of underground facilities known to or suspected of having underground facilities within the area of proposed excavation.
- d. Notice shall be made to owners of underground utilities not less than two (2) business days or more than ten (10) business days prior to scheduled date of commencement of excavation.
- e. The Contractor shall excavate around and under service pipes with special care and shall support and maintain them in service. Where it is necessary to cut, move or reconnect any service lines, arrangements shall be made with the respective utility and property owner.

S5-25 LAWN REMOVAL AND REPLACEMENT

- a. Any lawn damaged by the Contractor outside of limits shown on the plan shall be restored to conditions existing prior to construction; contractor shall take care to limit the area of disturbance.
- b. When lawn removal and replacement is called for, a sufficient width (at least 2' wider than outside width of backhoe wheels or tracks) of lawn turf shall be removed prior to beginning excavation so that heavy equipment does not run over the lawn.
- c. The area of the sod to be removed shall be laid out in squares or strips of such size as to provide easy handling and matching. The sod shall then be carefully cut along these lines to a depth of four (4) inches, taking care to keep cuts straight and strips of the same width. After the sod has been cut vertically, it shall be removed to a uniform depth of approximately three (3) inches with an approved type of sod cutter.
- d. This operation shall be performed in such manner as to ensure uniform thickness of sod throughout the operation.
- e. Prior to installation of new sod, the scalped area shall be carefully shaped to proper grade and be thoroughly compacted. Wherever the construction operations have resulted in the placement of unsuitable or poorer soils in the area to be resodded, the surface shall be left low and covered with topsoil.
- f. The finished grade, after shaping and compacting the topsoil, shall be thoroughly dampened prior to and immediately before replacing the sod. The sod shall be replaced to the required grade, taking care to butt each piece tightly against the adjacent one. Upon completion, the sod shall be dampened and rolled with a lawn roller.
- g. All tools used shall be of the type specially designed for the work and be satisfactory to the Engineer.
- h. Sod shall be a 4-way blend of Ryegrasses or equivalent approved by the Town Engineer

S5-26 DUST CONTROL

The Contractor shall sprinkle water as necessary to keep the dust down. This sprinkling shall be maintained until the project is accepted. Sprinkling shall be kept to a minimum and shall not produce runoff from the site. On paved streets, if dust becomes a nuisance when backfilling is completed, the Contractor shall vacuum sweep the portions of streets being used for traffic.

Flushing of streets shall not be permitted without prior Town approval.

S5-27 BARRIER FENCE

- a. Where indicated on the Plans, a bright orange safety fence shall be placed parallel to the silt fence, 2 feet nearer to the construction activity. Minimum fence material height shall be 2 feet. Top of fence shall be located 3 feet above ground.
- b. The barrier fence shall be supported as recommended by the manufacturer and as directed by the Town Engineer/Sewer Inspector.

S5-28 CONSTRUCTION ON EASEMENTS

All work on easements shall be performed strictly in accordance with easement provisions. Easements shall be restored equal to or better than original condition. The Contractor shall do no work on easement areas until specifically authorized by the Town Engineer/Sewer Inspector.

S5-29 STATE HIGHWAY AND RAILROAD CROSSINGS

Arrangements should be made directly by Contractor with the appropriate agency. Town should receive copies of all correspondence and permits or easements issued for our records. These documents should go to the Director of Public Works.

S5-30 ABANDONING FACILITIES

S5-30.1 Abandoning Pipe In Place

- a. The Contractor shall completely fill the pipeline to be abandoned with concrete or controlled density fill; or remove it.

- b. If the pipe is asbestos cement, Contractor must comply with all State regulations during removal and disposal process.

S5-30.2 Abandoning Structures

- a. Abandonment of structures shall be completed only after piped systems have been properly abandoned. Structures within the public right-of-way, a public easement or which is part of the publicly owned and maintained system must be:
 - 1. Removed completely according to Town requirement.

S5-31 WORKING WITH ASBESTOS CEMENT PIPE

When working with asbestos cement pipe, the Contractor is required to maintain workers' exposure to asbestos material at or below the exposure limit as prescribed in State of New Hampshire/Federal Guidelines and Certification. Contractor should check with State to obtain any State of New Hampshire permits and approval required. Copies of all information should be submitted to the Town.

S5-32 CONTROLLED DENSITY FILL (FLOWABLE FILL)

- a. CDF can be proportioned to be flowable, non-segregating, or excavatable by hand or machine. Desired flowability shall be achieved with the following guidelines:

Low Flowability	below 6-inch slump
Normal Flowability	6 - 8-inch slump
High Flowability	8-inch slump or greater

- b. CDF shall be placed by any reasonable means into the area to be filled.
- c. CDF patching, mixing and placing may be started if weather conditions are favorable, when the temperature is at 34 degrees F and rising. At the time of placement, CDF must have a temperature of at least 40 degrees F. Mixing and placing shall stop when temperature is 38 degrees F. or less and falling. Each filling stage shall be as continuous an operation as is practicable. CDF shall not be placed on frozen ground.
- d. Trench section to be filled with CDF shall be contained at either end of trench section by
bulkhead or earth fill.

- e. When used to support existing asbestos cement (A.C.) pipe, the flowable CDF shall be brought up uniformly to the spring line of the A.C. pipe, as shown on the plans, or as directed by the Engineer.
- f. Contractor shall provide steel plates to span utility trenches and prevent traffic contact with CDF for at least 24 hours after placement or until CDF is compacted or hardened to prevent rutting by construction equipment or traffic.

CHAPTER S6 - LATERAL SEWER REGULATIONS

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CHAPTER S6 - LATERAL SEWER REGULATIONS

S6-01 GENERAL

The following requirements govern lateral sewer construction in the Town of Merrimack. These standards apply to sewerage facilities from the point of connection to the public sewerage system (end of a lateral sewer stub, mainline tee, or a hole-cut into a sewerage main) to the property line.

S6-02 REQUIRED CONNECTION

Whenever connection to the Town system is required, the property owner shall remove any connection to a cesspool, septic tank, or other on-site wastewater disposal facilities and direct connection should be made to the Town system. Former facilities must be abandoned per Town Health Department regulations and New Hampshire Department of Environmental Services requirements.

S6-03 LATERAL SEWER PERMIT

S6-03.1 Requirements

- a. In making an application for a lateral sewer connection, the owner or lateral sewer contractor shall furnish the Town with a drawing showing:
 1. The size and location of structures on the property.
 2. The full course of the proposed lateral sewer from the public sewer in the street to the structure
- b. Any street opening permits required to complete installation of a lateral sewer must be obtained prior to acceptance of the permit application.
- c. The Applicant must show that any easements that may be required for installation of the lateral sewer have been obtained and recorded with the Town.
- d. All permit fees required by the Town must be paid prior to work starting.

S6-03.2 Restrictions

- a. Authorization for lateral sewer connection will be given before the public or private sewer system is accepted by the Town.

- b. No work shall be started on any private or lateral sewer without authorization.
- c. No permitted sewer contractor shall do any sewer work under any other person's permit.
- d. No lateral sewer work shall be done without approval and inspection by the Town.

S6-03.3 Old Lateral Sewers For New Buildings

- a. When an existing structure is removed and new structure is constructed, and any existing lateral sewer that does not meet the current requirements of the Town shall be replaced.
- b. A video of the lateral showing existing conditions of lateral shall be submitted to town for review and approval before connection is made.

S6-03.4 Posting Permits

Contractor must have all necessary permits on site before job starts and they should be made available upon request.

S6-04 HOLD HARMLESS

- a. Contractor shall protect, defend, indemnify and save harmless Town, its officers, employees and agents from any and all costs, claims, judgments or awards of damages, arising out of or in any way resulting from the negligent acts or omissions of Contractor, its officers, employees and agents.
- b. Town shall protect, defend, indemnify and save harmless Contractor, its officers, employees and agents from any and all costs, claims, judgments or awards of damages, arising out of or in any way resulting from the negligent acts or omissions of Town, its officers, employees or agents.

S6-05 GENERAL UTILITY NOTIFICATION REQUIREMENTS

All lateral sewer cleaning contractors and/or plumbers, lateral sewer contractors, and owners shall notify the Merrimack Wastewater Treatment Facility at 883-8196 of such operations prior to cleaning existing Lateral sewers (as distinguished from plumbing and septic tank facilities).

S6-06 GENERAL CONSTRUCTION REQUIREMENTS

S6-06.1 General

All materials and methods of construction for lateral sewers shall be equal to those used for sewerage mainline construction, unless otherwise listed herein.

S6-06.2 Restoration of Right-of-Ways

- a. It shall be the responsibility of the Contractor to cut the road surface, dig a trench, lay the pipe, make the connection to the wye or tee, backfill the trench and restore the roadway surfacing and vegetation within the limits of any thoroughfare or right-of-way, public or private.
- b. Such work shall be performed as quickly and with as little hindrance to traffic as possible, and in strict accordance with the requirements of the Town and Right-Of-Way Permit.

S6-06.3 Inspections

- a. After the sewer tie-in is authorized, arrangements for inspection of a sewer installation shall be made with the Wastewater Treatment Facility and Building Inspector's Office, 48 hours in advance by the sewer contractor. The Town reserves the right to set the time for inspections.
- b. An extra charge shall be made by the Town for each visit to any person who requests any inspection after regular hours on a workday, or on a weekend or holiday. The lateral sewer contractor will be billed for hours beyond that included in the permit fee.

S6-06.4 Site Safety

The following requirements shall apply to safety practices to be followed by licensed lateral sewer contractors while performing permitted side sewer work in the utility service area:

- a. Barricades - Before beginning excavation in a public area there shall be at the site sufficient barricades to properly protect the work. All shall be in compliance with Manual on Uniform Traffic Control Devices, latest revision.

- b. Trench Covering - All excavations or trenches within a public area or within four feet of a public area must be temporarily covered at night and during hours of work site inactivity.
- c. Ditch Pumps - During pipe laying, a pump shall be available at the site.
- d. Shoring - The Contractor shall have immediately available for use sufficient shoring to adequately protect workers where unstable ground conditions are encountered, in accordance with OSHA and State of New Hampshire requirements.
- e. Flagger - A flagger must be posted whenever work is underway in a public thoroughfare where a uniformed Police Officer is not required or as directed in Right- Of-Way Permit.

S6-06.5 Site Clean-up

The sewer contractor shall remove all debris and excess excavation and shall repair all damage, public or private, in kind immediately after backfilling.

S6-06.6 Failure to Restore Excavations

- a. If any excavation is left open beyond a reasonable length of time, the Town may cause the excavation to be backfilled and the public way restored.
- b. Any cost incurred in such work shall be charged to the owner or sewer contractor in charge of such work, and shall be payable immediately to the Town upon written notification of the amount thereof given to the contractor or posted at the location of the work.

S6-06.7 Failure to Complete Lateral Sewer Work

- a. If any work done under a sewer permit is not in accordance with provisions of the requirements of the Town and if the Contractor or person doing the work fails and/or refuses to properly construct and complete such work, notice of such failure or refusal shall be given to the owner or occupant of the property. The Town may cause the work to be stopped.
- b. If the work, in the opinion of the Town, constitutes a hazard to public safety, health or the public sewer, such work may be completed by the Town.
- c. The cost of such work and any materials and administrative services necessary therefore shall be charged to the owner and/or Contractor and shall be payable by the owner and/or contractor immediately upon written notice given by the Town of the amount thereof or by posting a notice thereof on the premises.

- d. Such cost shall constitute a civil debt owing to the Town jointly and severally by the persons who have been given notice as herein provided. The debt shall be collectable in the same manner as any other civil debt owing to the Town, including attachment of the contractor's sewer bond.

S6-07 LATERAL SEWER FITTINGS REQUIREMENTS

S6-07.1 Bends and Wyes

All changes of direction shall be made with bends, wye branches or a combination of wye branch and bends.

S6-07.2 Lateral Sewer Clean-Outs

The following specifications shall apply for all lateral sewer cleanouts:

- a. All changes of direction greater than forty-five degrees will be made with a wye branch and bends as required. Where wye branches are used, the straight through opening is to be used as the cleanout.
- b. Cleanouts, including those for commercial properties shall be installed at locations designated by the Town but in no case shall distance between cleanouts exceed one hundred feet.
- c. A cleanout shall be the same diameter as the pipe down grade to which it connects.
- d. On long runs of pipe, manholes may be installed, or be required, in lieu of cleanouts.
- e. Suitable rings and covers of a type designated by the Town shall be used for all cleanouts on commercial and multi-family property.
- f. All cleanouts not in paved areas shall extend to within a minimum of 18 inches of ground surface.
- g. Contractor shall provide swing ties to cleanouts and shall provide drawing to the Town, and should be shown on as-built plans.

S6-07.3 Lateral Sewer Acceptance

It shall be the responsibility of the sewer contractor to install all risers, cleanouts, casting, etc., required before the installation will be approved by the Town.

S6-08 CONNECTION REQUIREMENTS

S6-08.1 Pipe Cores (Saddle Connections)

- a. The sewer contractor shall make all other connections to main lines.
- b. The pipe core shall be carefully made and all broken pieces removed.
- c. If the pipe becomes cracked during the cut-in, the damaged section shall be replaced with a wye branch, or the section of pipe shall be replaced.
- d. Connections to ductile or cast iron will be accomplished by tee cut-ins using metallic mechanical couplings adaptable to the size and type of pipe on gravity mains.

S6-09.2 Connections

All connections must be clean and visible during inspection.

S6-09 EXCAVATIONS

S6-09.1 Main Sewerage Check

The licensed lateral sewer contractor must check the depth of the main sewerage at manholes on each side of wye location before starting to excavate for lateral sewer.

S6-09.2 Prospecting For Stub

- a. If the wye, tee, stub, or riser is not located at the measurements as furnished, the Contractor shall prospect four feet in all directions from the distance and depth given.
- b. If such prospecting fails to disclose the stub, the Contractor shall immediately contact the Town and report the circumstances.
- c. Upon receipt of such report, a Town representative will promptly visit the site and render further assistance.

S6-10 LAYING PIPE

S6-10.1 Grade

All sewers shall be layed true to grade with the bell up grade.

S6-10.2 Foundation Clearance

Lateral sewers parallel to the foundation wall of any building shall be laid not less than 36inches therefrom.

S6-11.3 Minimum Cover for Side Sewer

- a. Minimum cover required shall be 6' to property lines.
- b. On private property where less than minimum cover is required, approvals may be obtained from the Building Inspector for installing by using alternate pipe materials, approved by Town.

S6-11 INSPECTION AND TESTING

S6-11.1 Covering Work

No trench shall be filled nor any sewer covered until the work has been inspected and approved by the Town.

S6-12 SPECIAL REQUIREMENTS

S6-12.1 Gravity Flow

- a. In any structure in which the plumbing is too low to permit gravity flow to the utility system or private sewer, the sewage shall be lifted by artificial means and discharged into the utility system or private sewer.
- b. When only the lower floor of a structure is too low for gravity flow, the remaining floors must flow by gravity.

S6-12.2 Pumped Lateral Sewers

All pump installations must meet all building and plumbing codes.

S6-12.3 Hydraulic Gradient

In any structure a backwater valve is required per the Uniform Plumbing Code.

S6-12.4 Backwater Valves

- a. A backwater valve is required.
- b. The effective operation of the backwater sewage valve shall be the responsibility of the owner of the lateral sewer.
- c. Before any installation of this nature is made, the owner will be required to comply with provisions of this regulation concerning the agreement to save the Town harmless from damage or injury. (See section S4-12)
- d. Backwater valve shall be Clean-check brand or equal and installed outside the foundation.

S6-12.5 Sampling Manholes

- a. When required by the Town, the property owner shall install and maintain at their expense a manhole in the lateral sewer to facilitate observation, sampling, and measurement of the wastes therein.
- b. Such a manhole shall be located, if feasible, where it is accessible and safely entered from a public street.
- c. It shall be constructed and installed in accordance with plans approved by the Town and shall be arranged so that flow measuring and sampling equipment and a shutoff gate or a screen may be conveniently installed.

S6-13 LATERAL SEWER DEMOLITION

- a. Lateral sewer demolition shall be performed prior to removal of building foundation.
- b. The lateral sewer for each building shall be excavated and removed from the house connection to the property line or the main as specified by the Town.
- c. The Contractor shall cap the end of the lateral sewer to remain in place.
- d. Lateral sewer demolition shall be performed in the presence of the Town Sewer Inspector.

- e. The Contractor shall take measurement and a plan sketch showing location of remaining stub will be given to the Town, two copies (one to Wastewater Treatment Facility and one to Building Inspector's Office).

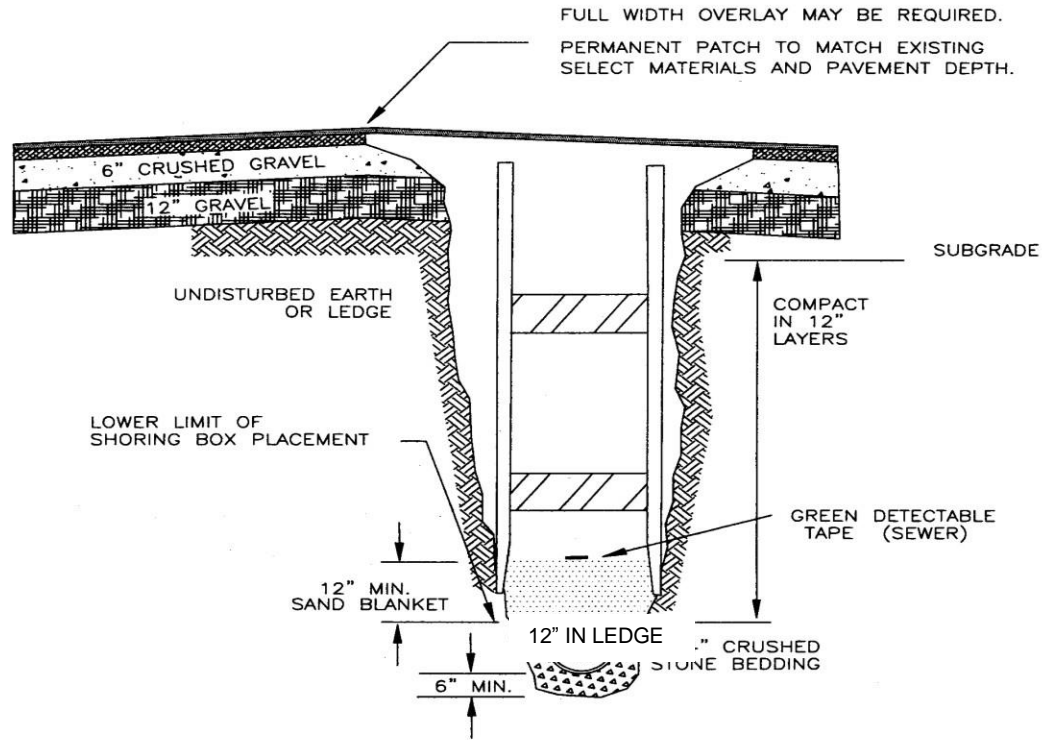
S6-14 SPECIFICATIONS NOT COVERED BY THESE REGULATIONS

In the event a construction or installation specification relating to sewers is not covered by this regulation, the Town may require compliance with other manuals or standards as it sees fit.

CONSTRUCTION DETAILS

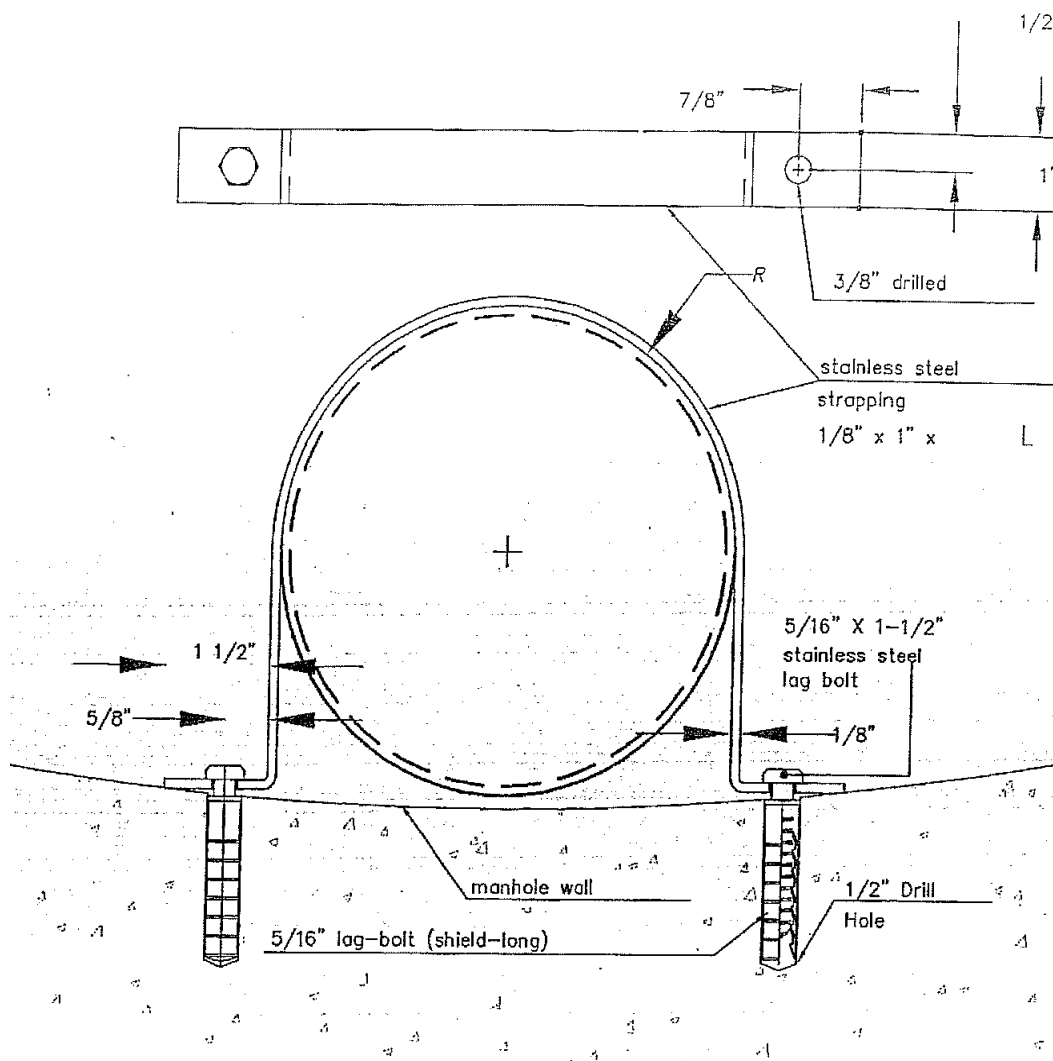
SANITARY SEWER

TRENCH SECTION



PVC PIPE INSTALLATION

NOTE: for sanitary sewers at depths greater than 15-feet; in questionable soils/groundwater issues; or for other specialized needs, ductile iron or other pipe materials may be required.



Pipe Size	L	R	C
4"	14.176"	2.125"	2.063"
6"	19.638"	3.188"	3.125"
8"	25.102"	4.250"	4.188"
10"	30.565"	5.313"	5.250"
12"	36.028"	6.375"	6.313"

STRAP DETAIL FOR INSIDE DROP CONNECTION

NOT TO SCALE

SANITARY SEWER

INSIDE DROP MANHOLE

NOTES:

DROP TO MATCH INLET DIAMETER

MANHOLES SHALL BE CONSTRUCTED IN ACCORDANCE TO THE CITY OF CONCORD STANDARDS FOR SANITARY MANHOLE CONSTRUCTION.

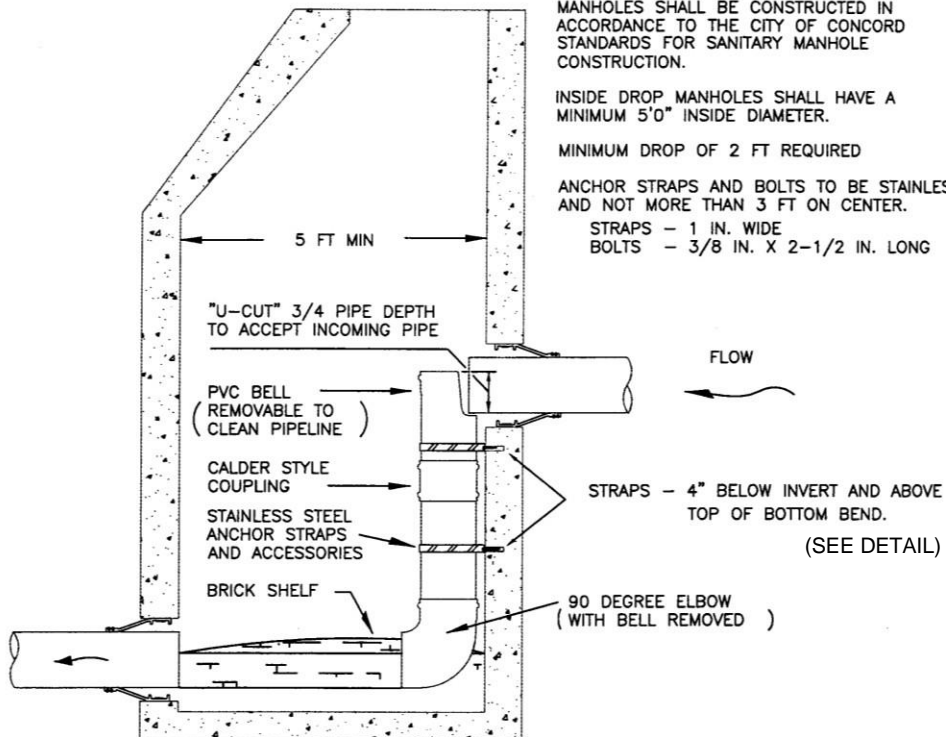
INSIDE DROP MANHOLES SHALL HAVE A MINIMUM 5'0" INSIDE DIAMETER.

MINIMUM DROP OF 2 FT REQUIRED

ANCHOR STRAPS AND BOLTS TO BE STAINLESS AND NOT MORE THAN 3 FT ON CENTER.

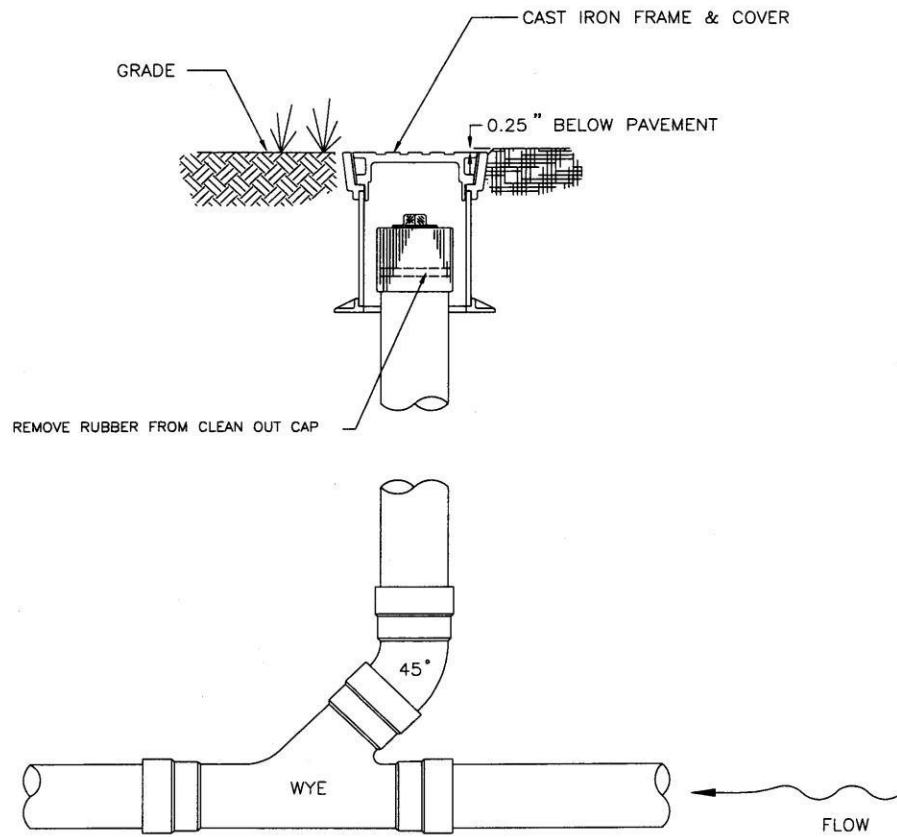
STRAPS - 1 IN. WIDE

BOLTS - 3/8 IN. X 2-1/2 IN. LONG



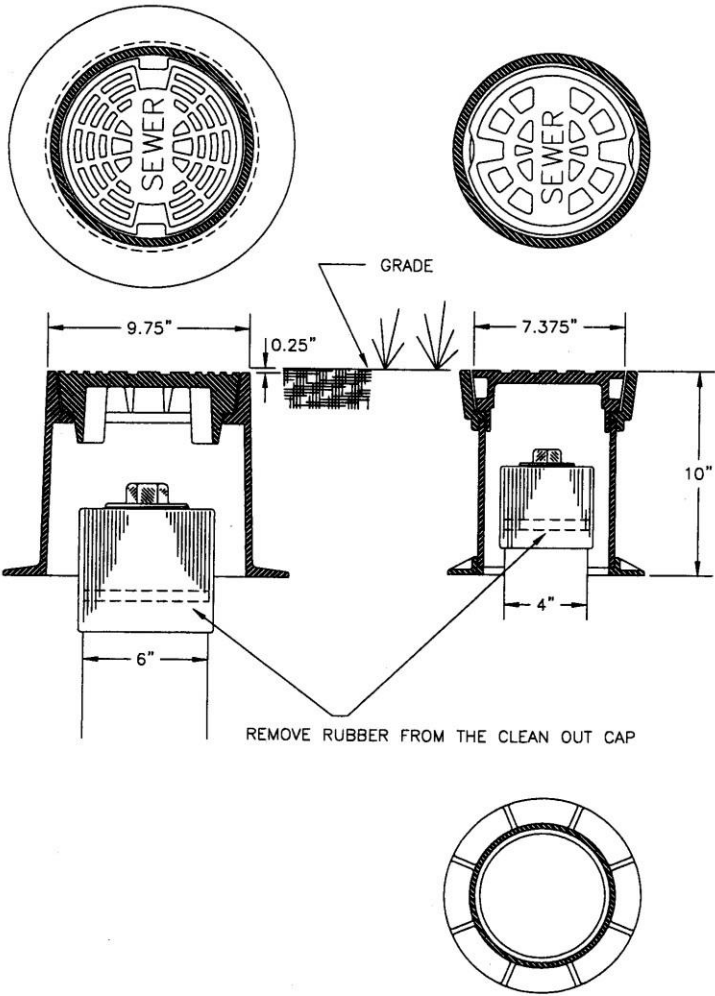
SANITARY SEWER

CLEAN OUTS ON SERVICE LATERALS



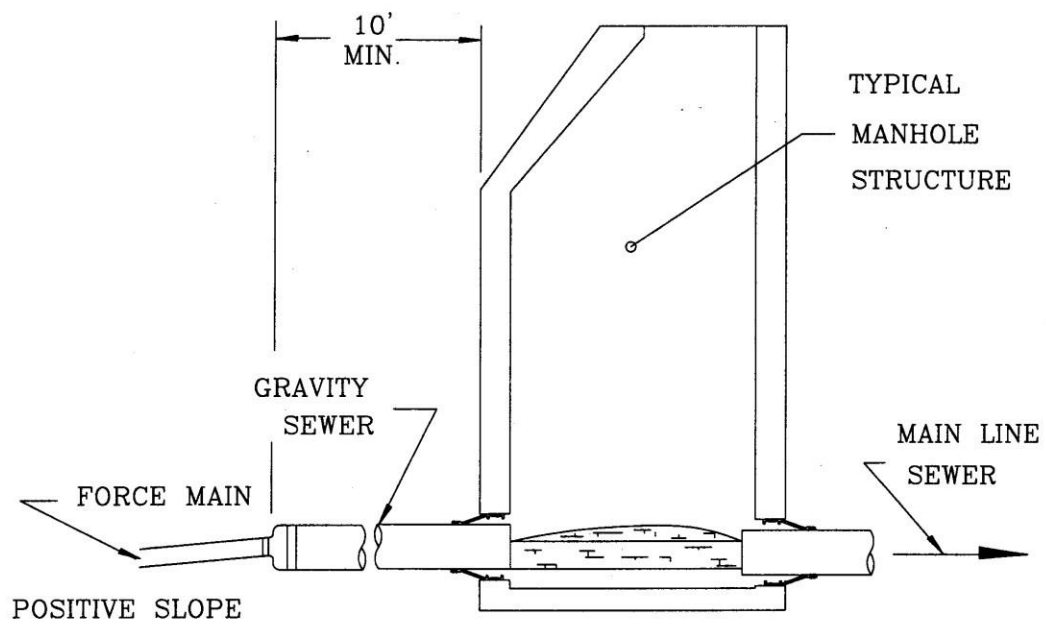
SANITARY SEWER SERVICE LATERAL

CLEANOUT COVERS



SANITARY SEWER

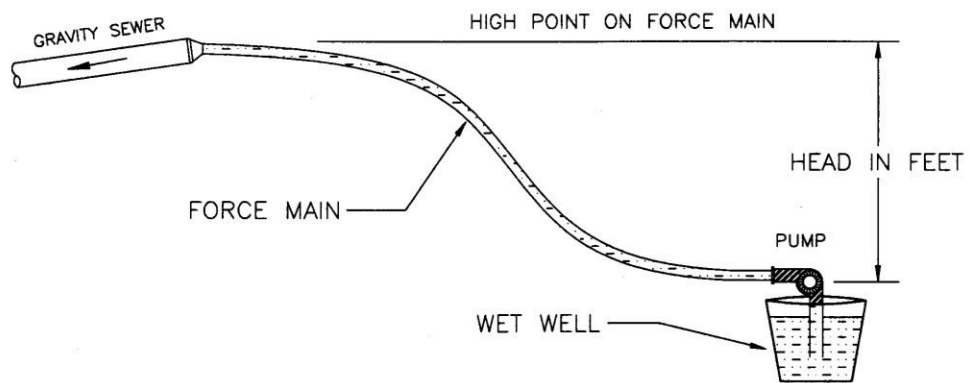
TYPICAL FORCE MAIN CONNECTION



SANITARY SEWER

FORCE MAIN TESTING

(PRESSURE TEST REQUIREMENTS)



$$\text{Pressure (PSI)} = \text{HEAD} \times 1.5 \text{ (Safety Factor)} / 2.31 \text{ feet per \#}$$

EXAMPLE:

$$\text{Head} = 80 \text{ FT}$$

$$80 \text{ FT} \times 1.5 / 2.31 \text{ ft per \#} = 51.95 \text{ PSI}$$

$$\text{Round up to nearest } 10\# = 60 \text{ PSI}$$

Force Main Test Pressure to be 60 PSI

Technical drawing of a manhole structure, showing side and top views with dimensions and labels.

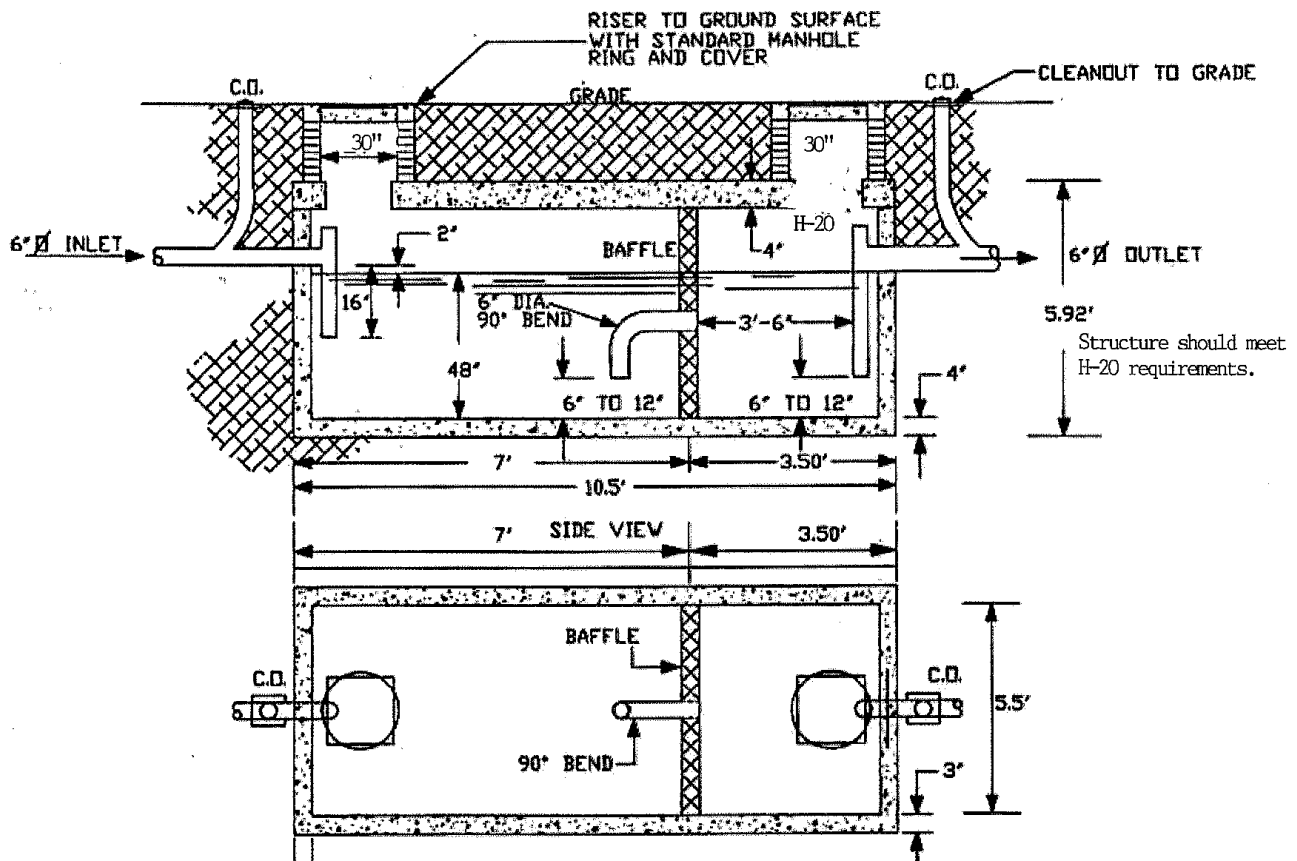
Labels:

- RISER TO GROUND SURFACE WITH STANDARD MANHOLE RING AND COVER
- C.D. (Center of Distribution)
- GRADE
- CLEANOUT TO GRADE
- MIN. (Minimum)
- BAFFLE
- H-20
- 6" DIA. 90° BEND
- 6" TO 12"
- 6" Ø INLET
- 6" Ø OUTLET
- STRUCTURE SHOULD MEET H-20 REQUIREMENTS.
- TOP VIEW

Dimensions:

- 30"
- 2'
- 16"
- 48"
- 3'-6"
- 6'
- 9'
- 3'
- 6' SIDE VIEW
- 4'
- 5.58'
- 4.5'
- 3'
- 3"

TYPICAL UNDERGROUND GREASE TRAP 1,500 GALLON 3,000 GALLON



Grease Trap Cleaning and Disposal Log

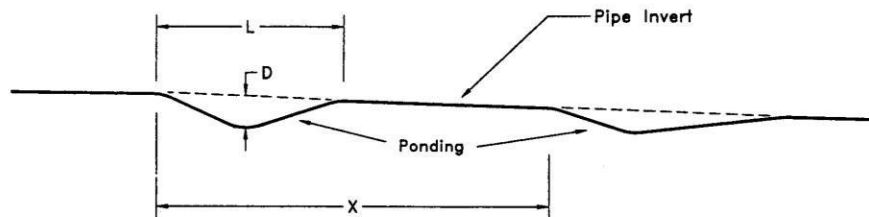
[illegible]

Grease Trap Maintenance Log

[illegible]

LIMITS OF SAGS
IN PVC
SANITARY SEWER PIPE

Pipe Diameter	Maximum Allowable Depth (D) of Sag	Maximum Allowable Length (L) of Sag	Minimum Allowable Distance (X) between Sags
4"	NONE	NONE	NONE
6"	NONE	NONE	NONE
8"	1/2"	4 FT	40 FT
10"	1/2"	6 FT	60 FT
12" & Larger	1/2"	8 FT	80 FT

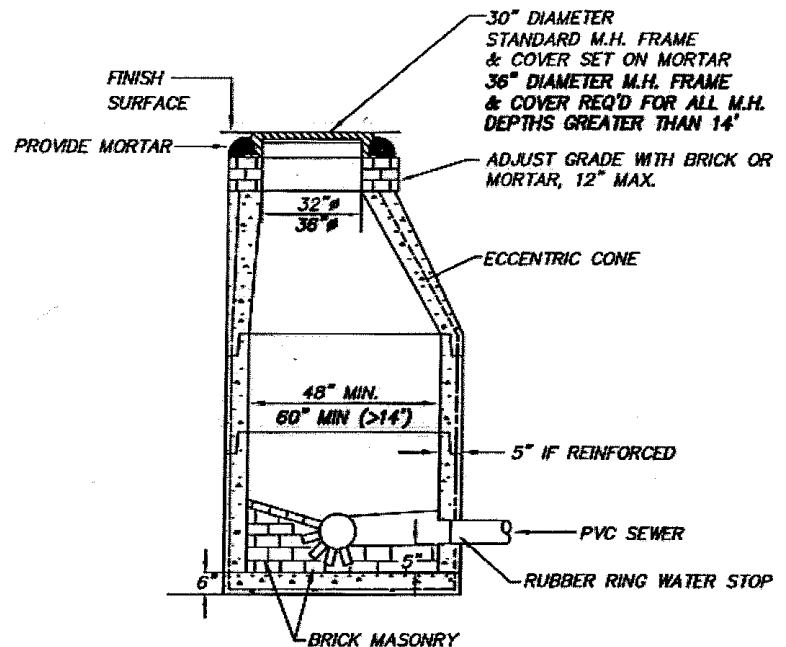


NOTE:

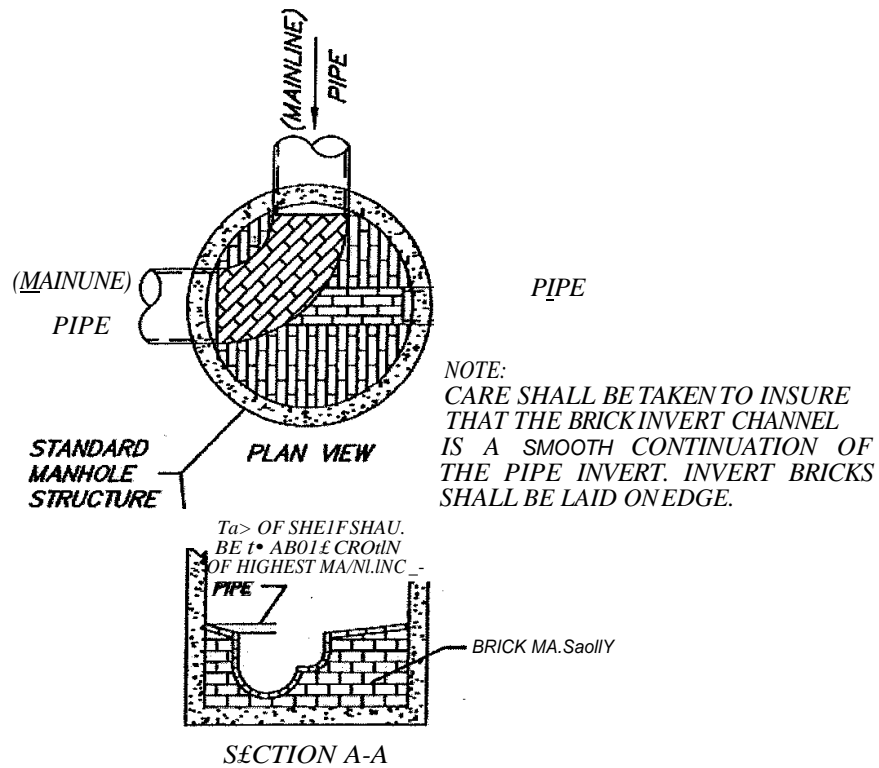
4" and 6" lines are typically used for service connections and are laid at a minimum of 1/4 inch and 1/8 inch per foot respectively to eliminate problems.

CONSTRUCTION NOTES FOR MANHOLE CONNECTION

1. ALL GASKETS, SEALANTS, MORTAR, ETC. SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS' WRITTEN INSTRUCTIONS.
2. FOR BITUMASTIC TYPE JOINTS, THE AMOUNT OF SEALANT SHALL BE SUFFICIENT TO FILL AT LEAST 75% OF THE JOINT CAVITY.
APPROVED BITUMASTIC SEALANTS:
RAM-NEK; KENT SEAL NO. 2
3. PIPE TO MANHOLE JOINTS SHALL BE AS FOLLOWS:
 - A. ELASTOMERIC, RUBBER, SLEEVE W/WATERTIGHT JOINTS AT MANHOLE OPENINGS AND PIPE SURFACES.
 - B. JOINTS AT THE MANHOLE MAY BE CAST INTO WALL OR SECURED WITH STAINLESS CLAMPS. JOINTS AT THE PIPE SHALL BE SECURED 1/2" STAINLESS STEEL CLAMPS.
 - C. ELASTOMERIC SEALING RING CAST IN THE MANHOLE OPENING WITH SEAL FORMED ON THE SURFACE OF THE PIPE BY COMPRESSION OF THE RING.
 - D. NON-SHRINK GROUTED JOINTS WHERE WATERTIGHT BONDING TO THE MANHOLE AND PIPE CAN BE OBTAINED.
4. ALL MANHOLES GREATER THAN 14' IN DEPTH SHALL HAVE A MINIMUM INSIDE DIAMETER OF 60", WITH 36" DIAMETER MANHOLE FRAME AND COVER SET ON MORTAR.
5. PER TOWN OF MERRIMACK CONSTRUCTION STANDARD S4-07, MANHOLES SHALL BE PRECAST CONCRETE SECTIONS WITH A CONFINED O-RING RUBBER GASKET JOINTS PER ASTM C-47B AND ASTM C-443 WITH EITHER A PRECAST BASE OR A CAST IN PLACE BASE MADE FROM A 3,000 PSI STRUCTURAL CONCRETE. ALL STRUCTURES SHALL BE REINFORCED CONCRETE. CONCRETE ADJUSTMENT RINGS SHALL CONFORM TO THE ASTM C-32, GRADE MA.
MORTAR USED SHALL BE COMPOSED OF ONE PART CEMENT TO TWO PARTS OF SAND.
INSIDE DROP STRUCTURES SHALL BE CONSTRUCTED OF ASTM D3034, SDR35 PVC PIPE AND FITTINGS.



SEWER MANHOLE DETAIL
N.T.S.



NOTES: STANDARD MANHOLE

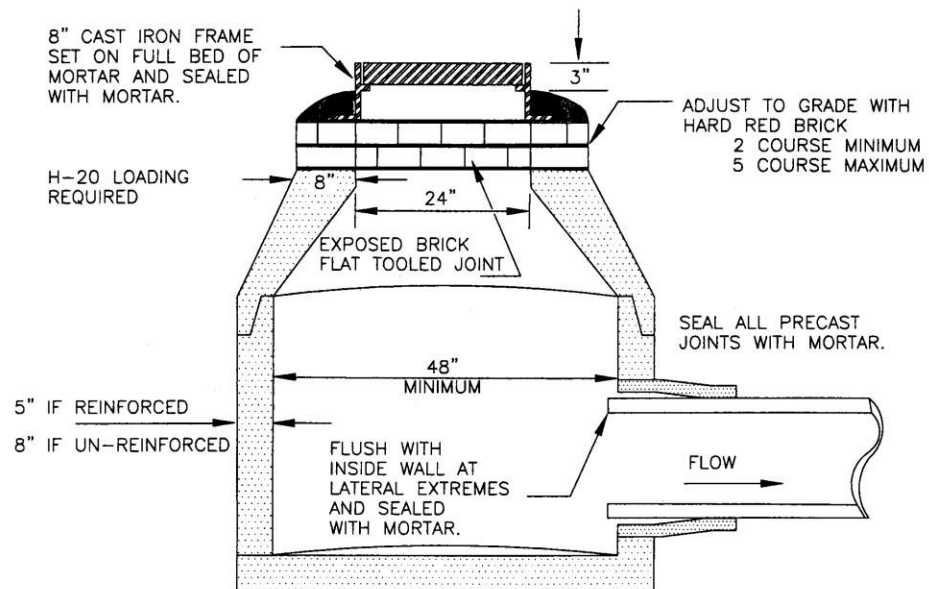
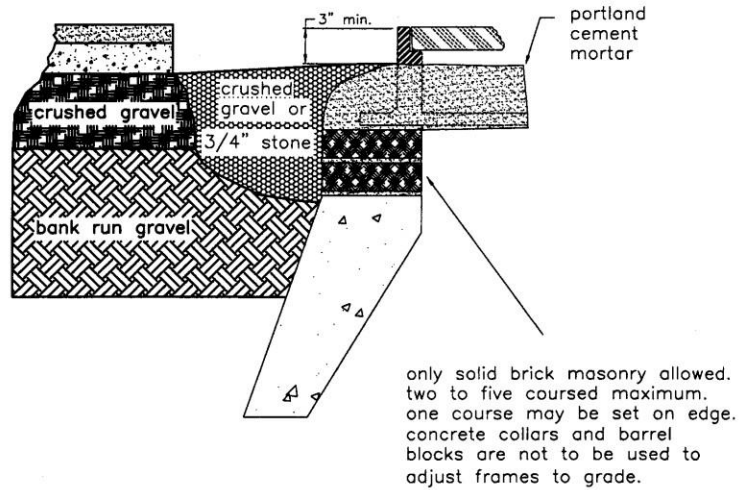
1. INVERTS AND SHELF SHAU HA VE A BRICK PAVED SHELF AND INVERT CONSTRUCTED TO CONFORM TO THE SIZE OF PIPE AND HOW AT CHANGES IN DIRECTION. THE INVERTS SHALL BE LAID OUT IN CURVES OF THE LONGEST RADIUS POSSIBLE TANGENT TO THE CENTER LINE OF THE SEWER PIPES. SHELVES SHALL BE CONSTRUCTED TO THE ELEVATION OF THE HIGHEST PIPE CROWN AND SLOPE TO DRAIN TOWARD THE FLOWING THROUGH CHANNEL. THE ENTIRE INVERT AND SHELF SHAU CONSIST OF BRICK MASONRY.

SANITARY MH INVERT CHANNEL AND PIPE SLEEVE
(N.T.S.)

CATCH BASINS / DROP INLETS

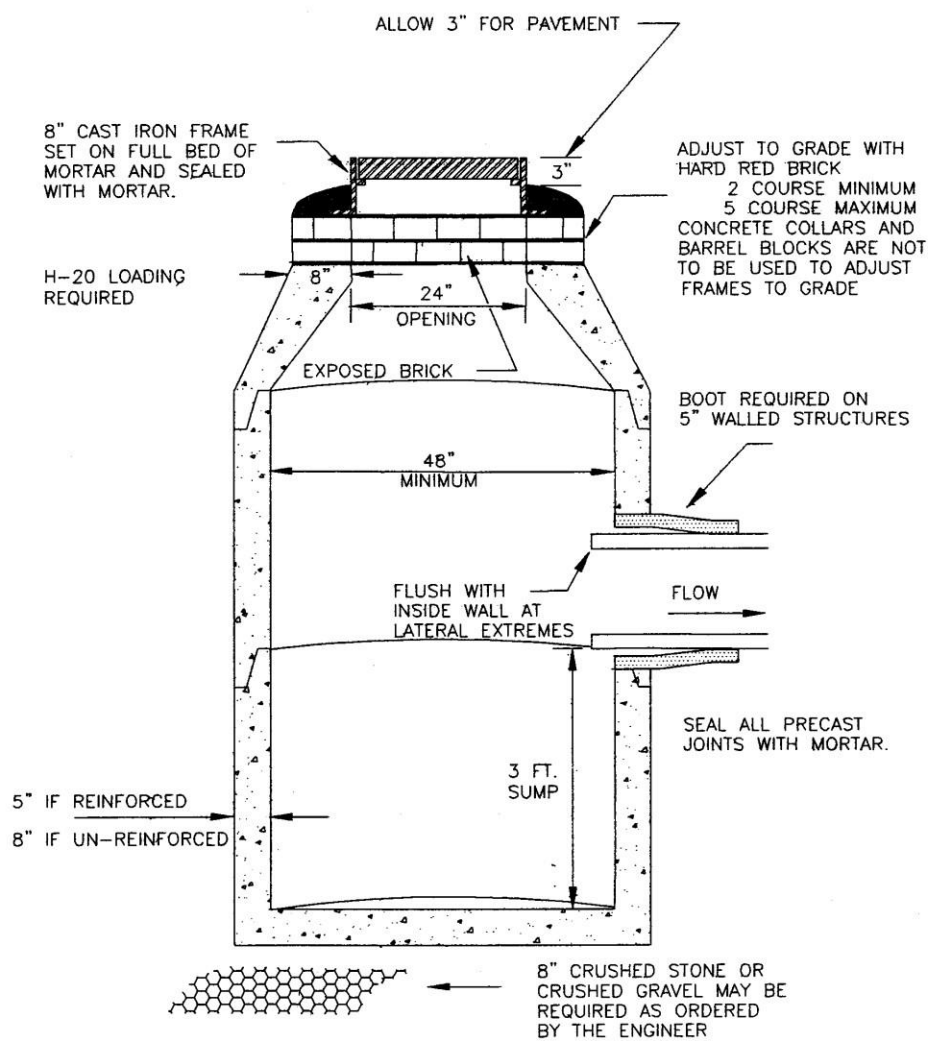
ADJUSTING FRAMES TO GRADE

catch basins to be $\frac{1}{4}$ " below pavement
manholes to be $\frac{1}{8}$ " below pavement



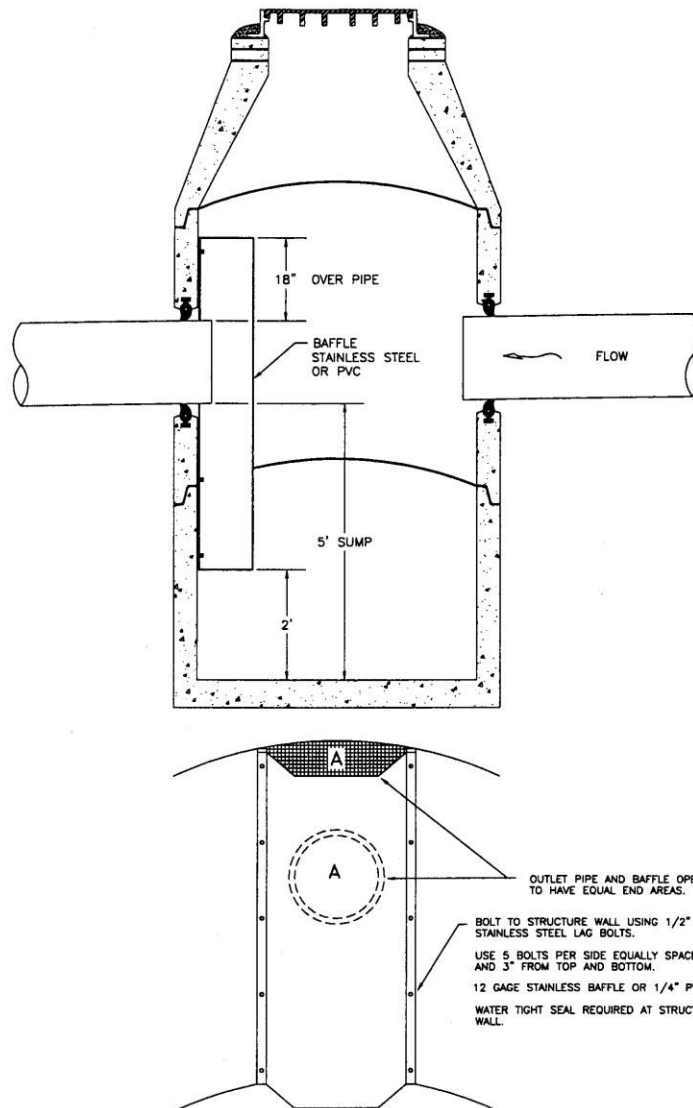
DROP INLET

CATCH BASIN

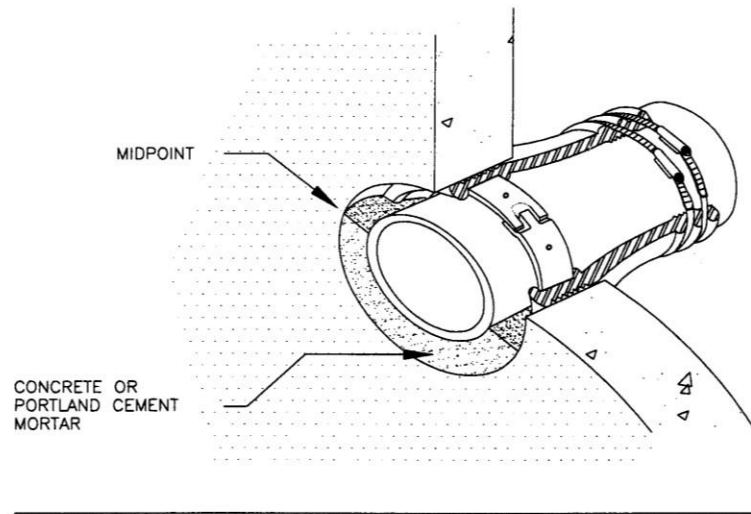


STORM DRAINAGE

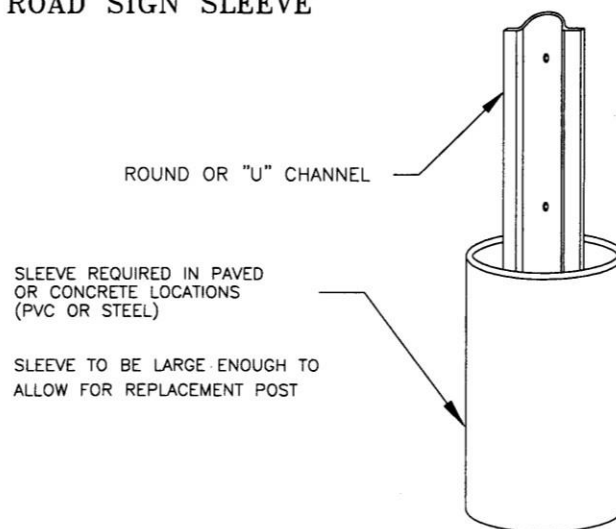
OIL & SEDIMENT CONTROL BARRIER (STORM DRAIN SYSTEMS)



FLEXIBLE SEAL
PIPE TO STRUCTURE
(STORM DRAIN ONLY)

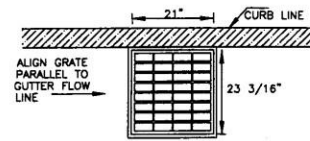


ROAD SIGN SLEEVE

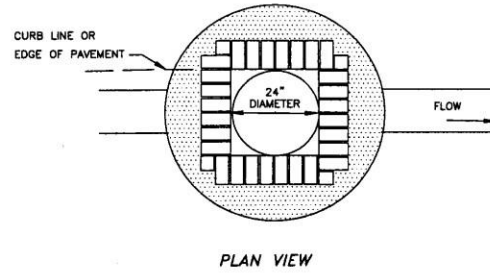


FRAME AND GRATE CONFIGURATION

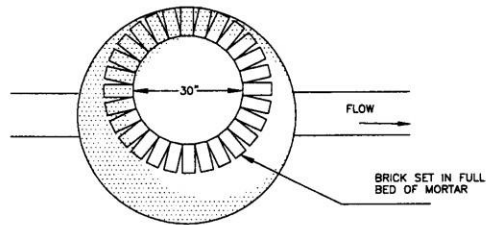
TYPE B ALTERNATE 1 FRAME & GRATE
3 FLANGED FOR CURB INSTALLATIONS



GRATE TO BE CAST IRON



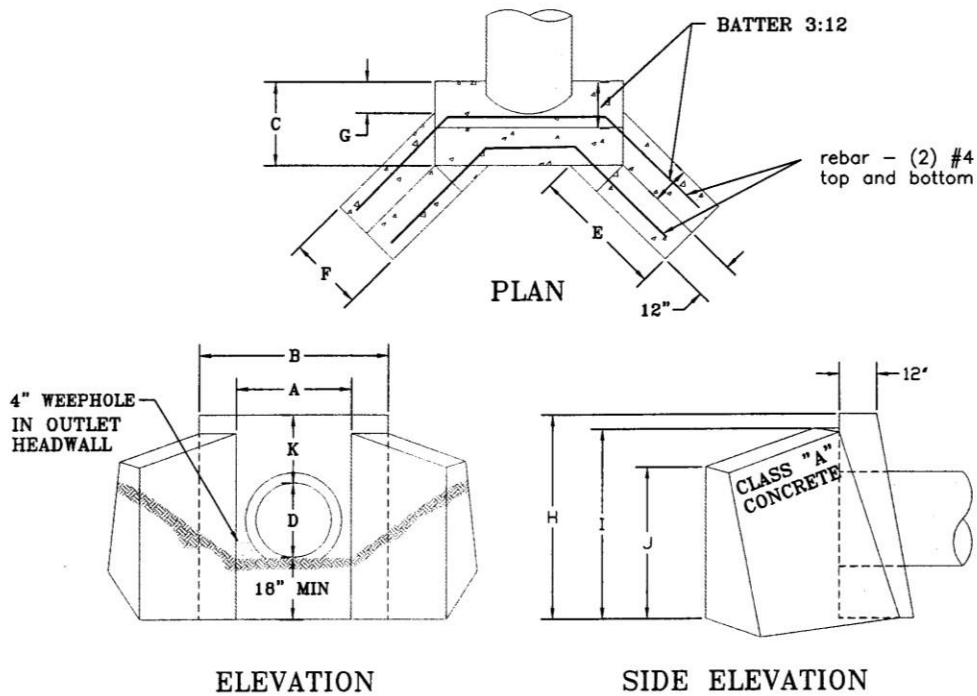
30 INCH COVER
BRICK WORK



PLAN VIEW

STORM DRAINAGE

HEADWALL WITH 45 DEGREE WINGS



	A	B	C	E	F	G	H	I	J	K
12"	1'-6"	4'-0"	2'-0"	3'-0"	1'-9"	8"	4'-0"	3'-8"	2'-8"	1'-3"
15"	1'-9"	4'-4"	2'-1"	3'-2"	1'-10"	7"	4'-2"	3'-10"	3'-0"	1'-6"
18"	2'-0"	4'-10"	2'-2"	3'-4"	1'-11"	6"	4'-6"	4'-0"	3'-4"	1'-6"
24"	2'-6"	5'-4"	2'-3"	3'-6"	2'-0"	5"	5'-0"	4'-6"	3'-10"	1'-6"
30"	3'-1"	5'-11"	2'-4"	4'-0"	2'-1"	4"	5'-6"	5'-0"	4'-1"	1'-6"
36"	3'-8"	6'-6"	2'-6"	4'-6"	2'-3"	3"	6'-0"	5'-6"	4'-4"	1'-6"
42"	4'-3"	7'-1"	2'-8"	5'-2"	2'-4"	2"	6'-9"	6'-0"	4'-10"	1'-9"
48"	4'-10"	7'-8"	2'-9"	5'-10"	2'-5"	1"	7'-0"	6'-6"	5'-1"	1'-9"
54"	5'-5"	8'-3"	2'-11"	6'-6"	2'-6"	0"	7'-9"	7'-0"	5'-4"	1'-9"
60"	6'-0"	8'-10"	3'-1"	7'-4"	2'-8"	0"	8'-3"	7'-6"	5'-8"	1'-9"
66"	6'-7"	9'-5"	3'-2"	8'-2"	2'-9"	0"	8'-9"	8'-0"	5'-11"	1'-9"
72"	7'-2"	10'-0"	3'-4"	9'-0"	2'-10"	0"	9'-3"	8'-6"	6'-3"	1'-9"