

KENNEBUNK SEWER DISTRICT

**SEWER EXTENSION DESIGN
SPECIFICATIONS**

**MARCH 2010
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SECTION 1 - DESIGN CRITERIA

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A.** Guides for the Design of Wastewater Treatment Works, TR-16, New England Interstate Water Pollution Control Commission 1998. Gravity Sanitary Sewer Design and Construction, Water Environment Federation (WEF) -Manual of Practice-No. FD-5, 1982.

1.02 DESCRIPTION OF WORK

- A.** Design of extensions to the Kennebunk Sewer District system shall generally follow the recommendations given in TR-16, unless noted below as an exception or otherwise permitted by the District in writing.
- B.** These guidelines and specifications have been prepared to assist owners, their consulting engineers, and contractors to design and construct sewer system extensions that are acceptable to the District. These specifications are consistent with the system as originally planned and constructed and will minimize the cost to the Owner to design and construct, and will minimize the cost to the District to operate and maintain these extensions.
- C.** These guidelines apply to most subdivision-type sewer extensions. If, in the opinion of the District, the proposed project exceeds the scope of these guidelines, the Owner and his Engineer shall seek specific guidance from other sources.

1.03 EXCEPTIONS

- A.** The following items are exceptions to the recommendations contained in TR-16 and MOP No. FD-5. Drawings shall be submitted according to the following guidelines:
- 40 feet = 1 inch or 50 feet = 1 inch for horizontal profile and plan,
 - 5 feet = 1 inch or 10 feet = 1 inch for the vertical profile,
 - 1/4 inch = 1 foot or 1/2 inch = 1 foot for details
 - Elevations based on USGS MSL; (1929 DATUM)

For new sewer planning, average flows shall be calculated based on 250 gallons per day (gpd) per residential unit including infiltration. Determination of peaking factors for application to average design flows shall be taken from TR-16 Figure 2-1. For average flows less than 0.1 million gallons per day (mgd), the curve shall be extrapolated in a straight line.

Allowable manhole spacing shall be a maximum of 350 feet. Minimum design pump capacity for any pump station shall be 80 gallons per minute (gpm) per pump, or a minimum force main velocity of 3 feet per second (ft/sec).

Head calculations for pump sizing shall use one of the following factors for calculating force main friction:

- Ductile Iron Pipe - Hazen-Williams C=100
- Plastic Pipe = Hazen-Williams C=130

Friction losses in valves and fittings shall be computed using the equivalent length method. Other methods may be used to calculate the pumping head conditions, however, the use of other methods will increase the time and cost to review. Regardless of the method used to calculate pumping head conditions, submit the complete calculations and manufacturer's data on proposed equipment to the District for review and approval.

B. Size the wetwell using following criteria

1. Maximum Number of Pump Starts per Hour:

Pump Size (hp)	Starts per Hour
<1.0	6
<5.0	5
>5.0	4

2. For pump stations without emergency power, provide a minimum of 2 hours wetwell storage between high-level alarm elevation and invert of lowest incoming sewer. Use average design flow rate for station.

- C. Junction boxes for pump station power and control wiring shall be located outside the wetwell. Pump station alarm system shall consist of ultrasonic level control with float switches as backup, an alarm light, and radio telemetry system. The telemetry shall connect to District's security system.

END OF SECTION

SECTION 2 - GENERAL CONDITIONS

PART 1 - PROJECT COORDINATION

1.01 RESPONSIBILITIES - OWNER

- A. The Owner shall require that his engineering consultant be responsible for the following:
- Preparation of complete construction drawings, details and specifications;
 - The stakeout of the system and benchmarks for elevations (based on USGS MSL 1929 DATUM) before construction;
 - Field decisions related to and regarding the design of the system.

The Owner should be aware that the costs incurred by the District are directly related to the time it takes an engineer and contractor to design and construct the proposed system. To keep the District's resultant charges to a minimum, the Owner should assure himself through appropriate inquiry that his/her engineer is registered in Maine. Additionally, his/her contractor shall be licensed by the District and financially qualified to perform the work in a competent and timely manner. The design and construction shall conform to District's Rules and Regulations and the approved Drawings.

The Owner shall supply to the District, accurate, Mylar reproducible record drawings of the completed construction. The Owner shall also provide an electronic copy of the drawings in AutoCAD (version to be specified at time of submittal). The record drawings should indicate any changes to the Drawings made during construction, ledge encountered, and location ties to buried utilities such as house service connections.

1.03 RESPONSIBILITIES - DISTRICT'S ENGINEER

- A. Conduct a pre-construction conference to establish the chain of command between the Owner and his engineering consultant, the Owner's Contractor, the District and the District's engineer.
- B. District's engineer will provide a resident engineer to observe the sewer construction for conformance with the technical requirements of the District's Rules and Regulations as well as the Contract Drawings.

- C. District's engineer will not be responsible for the Contractor's means, controls, techniques, sequences, procedures of construction, its jobsite safety programs or practices, including occupational health and safety, or failure to perform the work in accordance with the Contract Documents.
- D. The District's engineer is not at the site to assume the function(s) or responsibilities of the Owner or his consultants and shall not be responsible for making direct field decisions that affect the construction. The District's engineer is there to observe the conformity of the construction with the technical requirements of the District's Rules and Regulations and the Contract Documents.
- E. Should the resident engineer observe faulty or non-specified materials being used in the work, or construction work which does not meet the requirements of the District's Rules and Regulations or the Contract Documents, he shall inform the Contractor's supervisor by means of a handwritten field memo that the work or materials do not comply and that the District shall not permit the connection of the project into the public sewer. Copies of this memo shall be given to the District for their file and for transmittal to the Owner and the Owner's Contractor. If the faulty materials are not replaced or the improper construction corrected, the resident engineer shall inform the District and recommend that the District formally notify the Owner and his Contractor that connection of the project into the public sewer shall not be permitted until the materials are replaced or the construction corrected.

PART 2 - APPLICABLE CODES

2.01 DESCRIPTION

Comply with current edition of all local, State, and national codes applicable to the proposed construction including but not limited to the following:

- A. Town of Kennebunk - Street and Sidewalk Excavation Ordinance.
- B. Subdivision Standards of the Planning Board of the Town of Kennebunk, Maine.
- C. Maine Department of Transportation.
- D. Kennebunk, Kennebunkport, Wells Water District.
- E. Maine Department of Environmental Protection.
- F. OSHA - National Occupational Safety and Health Act.
- G. BOCA - Building Officials and Code Administrators - "Basic Building Code"

- H. Associated General Contractors of America - "Manual of Accident Prevention in Construction".
- I. "Dig Safe"
- J. National Electrical Code
- K. Where a conflict exists between two different ordinances or codes having jurisdiction, the more stringent of the two shall apply.

PART 3 - SHOP DRAWINGS, PROJECT DATA, AND SAMPLES

3.01 DESCRIPTION

- A. Submit Shop Drawings, Operation and Maintenance Manuals, Manufacturer's Certificates, Project Data, and Samples if required by the District.

3.02 SHOP DRAWINGS

- A. Detailed Shop Drawings, data, and literature for fabricated materials or equipment to be incorporated in the work shall be submitted for review for general compliance with the District's Rules and Regulations and the Contract Documents.

3.03 OPERATION AND MAINTENANCE MANUALS

- A. When the Owner transfers ownership to the District, the Owner shall furnish the District 3 copies of a complete instruction manual for installation, operation, maintenance, and lubrication of each item of equipment or system specified.
- B. Manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, equipment numbers, shop drawings corrected to as-built conditions, wiring diagrams, and assembly drawings which shall describe location, operation, maintenance, lubrication, operating weight, lubrication charts showing manufacturer recommended lubricants for each rotating or reciprocating unit, and other necessary information for the District to establish a complete maintenance program. The submittal shall also include details of all replacement parts; "Nameplate" data for all equipment; detailed instructions for start-up, normal operation, shutdown procedures, and control techniques; and a guide to troubleshooting the system.

3.04 PROJECT DATA

- A. Manufacturer's standard schematic drawings:
 - 1. Modify drawings to delete information that is not applicable to the project.

2. Supplement standard information to provide additional information applicable to project.
- B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.
 1. Clearly mark each copy to identify all pertinent materials, products or models, or information.
 2. Show dimensions and clearance required.

PART 4 - TEMPORARY FACILITIES

4.01 DESCRIPTION

A. Work Included:

1. Provide such temporary enclosures and facilities as the work may warrant.
2. Facilities include, but not limited to:
 - a. Field office and storage facilities
 - b. Shelter for crews including sanitary facilities conforming to local codes and OSHA requirements
 - c. Yard lighting
 - d. Fire protection
 - e. Safety equipment
 - f. Construction warning, protection, and control devices for maintenance and safety of vehicular and pedestrian traffic
3. Completely remove all temporary equipment and materials upon completion of the work and repair all damage caused by the installation of temporary utilities.
4. Make all necessary applications and arrangements for electric power, light, water, and other utilities with the local utility companies. Notify the local electric power company if unusually heavy loads, such as welders will be connected.

B. Other requirements:

1. Obtain permits as required by local governmental authorities.
2. Obtain easements, when required, across private property other than that of the Owner for temporary power service.

4.02 MATERIALS

- A. Contractor's facilities shall be of size and content for his adequate administration of the contract, storage of materials required for installation, and provision for personnel shelter.
- B. Equipment required for personal safety of workmen shall be furnished in full compliance with specific safety requirements of local, state, and Federal agencies, including OSHA.

4.03 PERFORMANCE:

- A. Field Office and Storage Trailers or Buildings: Sited in approved locations and properly set up for all anticipated weather conditions.
- B. Sanitary Conveniences:
 - 1. Provide and maintain in sufficient numbers, for the use of all persons employed on the work, and properly screen from public observation, at suitable locations, in accordance with State and local ordinances.
 - 2. Rigorously enforce the use of the approved sanitary facilities provided.
 - 3. When no longer required, remove from the site and dispose of the contents in a satisfactory manner.

PART 5 - DUST CONTROL

5.01 DESCRIPTION

- A. Furnish and apply water or calcium chloride on the roadways or haul roads for dust control when requested by the District.

PART 6 - MAINTENANCE OF TRAFFIC

6.01 DESCRIPTION

- A. Schedule work in such a manner that it shall be carried on to provide safe passage at all times for public traffic and with a minimum of obstruction to traffic.
- B. Maintain at least one-way traffic over the area during the working day, and provide all of the necessary warnings, signs, flags, and flagmen to accomplish this.
- C. Leave the area in a satisfactory state at the end of each day so that two-way traffic may flow during the night and over the weekend.

- D. All traffic controls shall be in accordance with the MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND

HIGHWAYS published by the U.S. Department of Commerce in
1961 and coordinated with the proper local authorities

End of Section

SECTION 3 - EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work Included:

1. Trench excavation in earth and ledge.
2. Structure excavation work for the removal of earth and ledge for the installation of structures.
3. Removal of paving in trenches and at other sites as indicated on the approved Drawings and specified herein.
4. Earthwork for site work and subgrade preparation.
5. Backfilling in trenches, for structures, and other excavations.
6. Bedding for pipes.
7. Subgrade materials for structures and pavements.
8. The compaction of all backfill and bedding materials.

1.02 QUALITY ASSURANCE:

A. Codes and Standards:

1. Perform work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Soil Testing and Inspection Service:

1. Provide soil testing and inspection service for quality control testing during earthwork operations if required. Testing and inspection service is subject to acceptance by the District.
2. Tests for Proposed Soil Materials: Soil materials proposed for use in the work may be subject to the following tests:
 - a. One optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills. Determine maximum densities in accordance with ASTM D1557.
 - b. The testing service will determine the suitability of materials to be used.
 - c. For borrow materials, perform a sieve analysis (ASTM D422), plasticity index (ASTM D424), moisture-density curve (ASTM D1557), and frost susceptibility analysis.
3. Pavement Subbase Courses:
 - a. Maximum density test in accordance with ASTM D1557.

- b. Field density tests by sand and cone method in accordance with ASTM D1556, or at the option of Engineer, by use of nuclear devices in accordance with ASTM D2922 or by the water balloon test methods in accordance with ASTM D2167.
4. Test Report: If required, submit two copies of the testing service report to the District.

1.03 JOB CONDITIONS:

A. Existing Utilities:

1. Notify Dig Safe at least 72 hours before excavation.
2. Locate underground utilities in the areas of work.
3. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
4. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult with the Owner's engineer immediately for directions as to procedure.
5. Cooperate with the District and utility owners in keeping respective services and facilities in operation.
6. Repair damaged utilities to satisfaction of the utility owner.
7. Do not interrupt existing utilities, except when permitted in writing by the utility owner, and then only after acceptable temporary utility services have been provided.
8. Demolish and completely remove from the site existing underground utilities indicated. Coordinate with utility companies for shut-off of services if lines are active.

B. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work with warning lights.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect the public, structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.01 DEFINITIONS

- A. Cohesionless Soil Materials: Gravels, sand-gravel mixtures, sands, and gravelly-sands.

- B. Cohesive Soil Materials: Clay and silty gravels, and sand-clay mixtures, gravel-silt mixtures, clay and silty sands, sand-silt mixtures, clays, silts, and very fine sands.

2.02 SOIL MATERIALS:

A. Bedding and Backfill Materials (Pipes):

1. Bedding Material:

- a. The refilling of all excavation below the bottom of pipes and below the top of the pipes and at such other places as required in the construction documents, or when ordered by the District, shall be made with 3/4" crushed stone, meeting the following criteria:

<u>Screen Size Square</u> <u>Opening</u>	<u>Percent by Weight</u> <u>Passing</u>
1"	100
3/4"	90-100
3/8"	5-20
No. 4	0- 5

- b. Bedding shall be free from clay, loam, organic matter, and meet ASTM C33 Stone Size No. 67.
- c. Where ordered by the District to stabilize the trench bottom, use graded screened gravel or crushed stone 1/2 in. to 1 1/2 in. thick.

2. Sand Blanket:

- a. Use where insulation is installed over pipe or culvert and at such other places as required in the approved Drawings, or when ordered by the District.
- b. Clean sand, free from organic matter, so graded that 90-100 percent passes a 1/2-in. sieve and not more than 15 percent passes a No. 200 sieve.

3. Suitable Backfill Material:

- a. Natural material excavated during the course of construction approved by the District.
- b. Excluded from suitable backfill would be debris, pieces of pavement, organic matter, topsoil, all wet or soft muck, peat, or clay, all excavated ledge material, and all rocks over 6 in. in the largest dimension, or any material which will not provide sufficient support or maintain the completed construction in a stable condition.

B. Select Backfill:

1. Use where noted on approved Drawings or if natural excavated material is unacceptable, furnish and place in approved granular backfill material (Select Backfill) meeting ASTM Specification D3282-73 as revised, Classification A3 or better, for backfilling trenches and structures.

C. Backfill and Fill Material (Structures):

1. Granular Backfill Material:

- a. Clean granular material consisting of fine, hard durable particles resulting from the natural disintegration of rock.
- b. Free from organic matter.
- c. Wear: Not more than 60 percent.
- d. Gradation:

<u>Screen Size Square</u> <u>Opening</u>	<u>Percent by Weight</u> <u>Passing</u>
3"	100
No. 4	70-100
No.200	<15

2. Drainage Fill: Washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1 1/2 in. sieve and not more than 5 percent passing a No. 4 sieve.

D. Backfill and Fill Material (Roadways and Site):

1. Aggregate Subbase Course - Gravel:

- a. Well graded consisting of hard, durable particles free from vegetable matter, lumps or balls of clay, and other deleterious substances.
- b. Gradation:

<u>Screen Size Square</u> <u>Opening</u>	<u>Percent by Weight</u> <u>Passing</u>
3"	100
No. 4	25-70
No.200	<12

- c. Maximum Size: Not exceeding 3/4 of the compacted thickness of the layer being placed.
- d. All materials approved by District.

2. Aggregate Base Course: Provide base course per Town of Kennebunk ordinances.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the District in writing of conditions detrimental to the proper and timely completion of the work.
- B. Before beginning excavation, grading, and embankment operations in any area, perform all necessary clearing in that area.

3.02 EXCAVATION

- A. Classifications:
 1. Earth Excavation: Removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions, and other materials encountered that are not classified as rock excavation or unauthorized excavation.
 2. Rock Excavation:
 - a. Removal and disposal of materials encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of hydraulic hammer or other special equipment except such materials that are classified as earth excavation.
 - b. Typical Materials: Boulders 1 cu. yd. or more in volume, solid rock, ledge, and rock-hard cementitious aggregate deposits.
 - c. Intermittent drilling performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
 3. Unauthorized Excavation:
 - a. Removal of materials beyond indicated subgrade elevations or dimensions without specific approval of the District.
 - b. Under footings or fill unauthorized excavation by extending the indicated bottom elevation of the

footing or base to the excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, only when acceptable to the District.

- c. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the District.

B. Stability of Excavations:

1. Slope sides of excavations to comply with local codes and OSHA Standards.
2. Sheet, shore, and brace where sloping is not possible either because of space restrictions or stability of material excavated.
3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

C. Material Storage:

1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill.
2. Place, grade, and shape stockpiles for proper drainage.
3. Locate and retain soil materials away from edge of excavations.
4. Dispose of excess soil and waste materials as specified hereinafter.

D. Excavation for Structures:

1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10' and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction required, and for inspection.
2. In excavating for structures, take care not to disturb bottom of excavation.
3. Trim bottoms to required lines and grades to leave solid base to receive concrete or drainage fill.

E. Test Pits:

1. Excavate at the location indicated on the Drawings or as requested by the District.
2. Used to locate underground facilities that are not precisely known and whose location is critical to the construction of the facility.
3. Excavate to appropriate size with equipment suitable for the location and character of the pit to be excavated.
4. Brace and shore or sheet and pump or as otherwise required for safe excavation and examination of the structures to be exposed.

5. Excavate all test pits before pipeline installation

F. Excavation for Pavements:

1. Comply with all the requirements of the Maine Department of Transportation - State Highway Opening Permit.
2. Where the State Highway has a concrete cap, i.e. bituminous paving over a reinforced concrete slab, neatly cut the pavement and concrete slab to the anticipated width of the trench or structure to be installed.
3. Where undermining of the concrete slab develops due to excavation, cut back the pavement and concrete slab to a point where the material under the concrete slab has not been disturbed.
4. Follow State of Maine Department of Transportation requirements for pavement replacement.

G. Trench Excavation:

1. General:
 - a. Unless otherwise specifically directed or permitted by the District, begin excavation at the low end of sewer lines and proceed upgrade.
2. Amount of Excavation
 - a. Trench Width: As shown on the Drawings.
 - b. Trench Depth: As shown on the Drawings.
 - c. Open Excavation: The extent of open excavation shall be controlled by prevailing conditions.
3. Shoring and Bracing:
 - a. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the State and OSHA safety standards.

H. Removal of Unsatisfactory Soil Materials:

- a. Excavate unsatisfactory soil materials encountered that extend below required elevations, to additional depth directed by the District.
- b. Remove unsatisfactory soil and legally dispose of offsite.

I. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
2. Do not place fill or backfill on frozen soil or use frozen material or backfill.

3.03 COMPACTION

A. Percentage of Maximum Density Requirements:

1. Provide not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for the actual density of each layer of soil material-in-place. The Maximum density shall be determined in accordance with ASTM D1557.

Type	Description	Compaction
Structures	Top 12" of subgrade:	
	Cohesionless soils	95%
Lawn or Unpaved Areas	Top 6" of subgrade and each layer of backfill	
	Cohesionless soils	90%
Walkways	Top 6" of subgrade and each layer of backfill	
	Cohesionless soils	95%
Pavements	Top 6" of subgrade and each layer of backfill	
	Cohesionless soils	90%
State Highways	Top 18" of subgrade and each layer of backfill	
	Cohesionless soils	95%
State Highways	Cohesive soil material	90%
	As required by Highway Opening Permit	

B. Moisture Control:

1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface at such a rate as to avoid free water from appearing on surface during or subsequent to compaction operations.
2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by disking, harrowing or pulverizing, until moisture content is reduced to a satisfactory value, determined by moisture-density relation tests.

3.04 BACKFILL AND FILL:

- A. General: Place soil material in layers to required subgrade elevations.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance by the District of construction below finish grade, including insulation, damp-proofing and waterproofing.
2. Inspection, testing, approval, and recording locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of sheeting, shoring and bracing, and backfilling of voids with satisfactory materials.
5. Removal of temporary sheet piling by cutting below bottom of structures or pipes, and removing piling while preventing settlement of the structure or utilities. You may leave sheeting in place if directed by the District.
6. Removal of trash and debris.

C. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.
2. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
3. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

D. Placement:

1. Place backfill and fill materials in layers not more than 12" in loose depth. Place the final 18" of backfill in 6" lifts.
2. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content.
3. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and fill materials evenly adjacent to structures, to required elevations.
5. Take care to prevent wedging action of backfill against structures.

3.05 GRADING

A. General:

1. Uniformly grade areas within limits of grading under this section, including adjacent transition areas.
2. Smooth finish surface within specified tolerances, compact with uniform level or slope between points

where elevations are shown, or between such points and existing grades.

3. Grade areas to drain away from structures and to prevent ponding.
4. Finish:
 - a. Grassed Areas: Finish areas to receive topsoil to within not more than 0.10' above or below the required subgrade elevations.
 - b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10' above or below the required subgrade elevation.
 - c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than .05' above or below the required subgrade elevation.

3.06 PAVEMENT SUBBASE COURSE

A. General:

1. Subbase course consists of placing aggregate subbase material, in layers of specified thickness, over ground surface to support a pavement base course.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders:

1. Place along edges of subbase course to prevent lateral movement.
2. Construct of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer.
3. Compact and roll at least a 12" width simultaneously with compacting and rolling of each layer of subbase course.

D. Placing:

1. Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness.
2. Maintain optimum moisture content for compacting subbase material during placement operations.
3. When a compacted subbase course is shown to be 6" thick or less, place material in a single layer.
4. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" in thickness when compacted.

3.07 PAVEMENT BASE COURSE AND BITUMINOUS CONCRETE

- A. Base course and bituminous concrete pavement shall be installed per Town of Kennebunk ordinances.

3.08 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction:
 - 1. Testing service may be required to inspect and approve subgrade and fill layers before further construction work is performed thereon.
 - 2. If, in the opinion of the District, based on reports of testing service and inspection, subgrade or fills, which have been placed, are below specified density, provide additional compaction and re-test.

3.08 MAINTENANCE

- A. Protection of Graded Areas:
 - 1. Protect newly graded areas from traffic and erosion, and keep free of trash and debris.
 - 2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Reconditioning Compacted Areas:
 - 1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.09 DISPOSAL OF WASTE MATERIALS

- A. Remove trash, debris, and waste materials, from the site and legally dispose of it.
- B. Do not dispose in designated flood plain or wetlands area.

END OF SECTION

SECTION 4 - NON-PRESSURE SEWER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install pipe materials and fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.
- B. The extent of the work is generally shown on the drawings and shall be extended to accommodate changes that become necessary as a result of encountering unforeseen or changed conditions in the field.

1.03 SUBMITTALS

- A. Furnish the name and product literature of the manufacturer to the District prior to commencing work. For any given pipe material, use pipe of the same material throughout the project.
- B. The District may request the submittal of manufacturer's certification that the product meets requirements of the Specification.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Except where the type or class or use of pipe is explicitly indicated on plan or specified herein, the Contractor may provide any of the kinds of pipe specified. However, in the interest of future maintainability, only one type of pipe will be approved for use in a project except as expressly indicated otherwise on the approved Drawings.

2.02 POLYVINYL CHLORIDE (PVC) SEWER PIPE

A. Standards:

1. Pipe: 8-in. to 15-in. diameter, ASTM D3034, SDR-35; 18-in. to 27-in. diameter, ASTM F-794, F-679, and over 30-in. diameter, ASTM F-794.
2. Gasket: ASTM F477 and D3212.
3. Installation: ASTM D2321, Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, latest revision.

B. Pipe:

1. Nominal diameter as shown on the approved Drawings and class as specified herein.
 2. Minimum Pipe Stiffness (F/ Y): 46 psig, ASTM method of test D2412, "External Loading Properties of Plastic Pipe by Parallel-Plate Loadings".
 3. Standard Laying Lengths: 20 ft. and 12.5 ft.
- C. Joints:
1. Bell and spigot.
 2. Rubber gasket factory installed.
- D. Fittings and Accessories:
1. Of same strength as the pipe.
 2. Manufactured and furnished by pipe supplier or equivalent.
- E. Marking on each pipe length:
1. Class of pipe.
 2. Date of manufacture.
 3. Name of manufacturer.
- F. Conditions for Use:
1. Install per standards.
 2. Bedding: ¾-inch crushed stone in the zone from below the pipe to at least 6 inches from the top of the pipe.
 3. Use extreme care and over-excavate when necessary when sheeting is used or when the original material excavated is peat or unconsolidated or soft clay.
 4. Install 12" compacted non-native sand envelope above pipe.

2.03 DUCTILE IRON PIPE

- A. Standards:
1. Cement-mortar lining for water: ANSI A21.4 (AWWA (104).
 2. Rubber gasket joints: ANSI A21.11 (AWWA C111).
 3. Ductile iron pipe thickness: ANSI A21.50 (AWWA C150).
 4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A21.51 (AWWA C151).
 5. Cast and ductile iron fittings: ANSI A21.10 (AWWA C110).
- B. Pipe:
1. Unless otherwise shown on the approved Drawings, use Class 50 for Type 4 laying condition.
 2. Standard cement lined and seal coated unless noted otherwise on the approved Drawings.
 3. Furnish factory applied bituminous exterior coatings for all underground piping.
- C. Joints (as shown on Drawings or as specified):
1. Push-on Joint:

- a. The plain ends of push-on pipes shall be factory machined to a true circle and chamfered to facilitate fitting the gasket.
- b. Provide gaskets manufactured from a composition material suitable for exposure to the liquid to be contained within the pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pipe Laying:

1. Begin at a manhole and proceed upstream.
2. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
3. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material, which does not provide firm and uniform bearing along the outside length of the pipe.
4. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed hand-shaped to fully support the pipe.
5. Excavate suitable holes for the joints so that only the barrel of the pipe receives bearing pressure from the supporting material after placement.
6. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
7. Lay pipes true to the invert lines and grades shown on Drawings or as directed by the District. A variation of 1/8 inch or more from true invert grade and 1/4 inch or more on sewers laid on grades above one percent will be deemed sufficient reason to reject the work. The Contractor shall correct work so rejected at his/her own expense in a manner acceptable to the District.
8. The Contractor shall demonstrate his proposed methods of maintaining the grade and alignment of pipe during construction with the District prior to start of construction. Methods that will be acceptable for consideration are, but not limited to, the following:
 - a. Use of a transit
 - b. Laser beam, utilizing the equipment manufacturers recommended procedure for sewer construction.

9. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
10. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
11. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
12. Take all necessary precautions to prevent flotation of the pipe in the trench.
13. When pipe laying is not in progress, close the open ends of the pipe with temporary watertight plugs. If water is in the trench when work is resumed, do not remove the plug until all danger of water entering the pipe is eliminated.
14. Do not use the pipelines as conductors for trench drainage during construction.
15. Cut or furnish short lengths of pipe at manholes or appurtenances so that pipe entering and leaving manholes measures not more than 5 ft. from the inside face of the manhole.

B. Jointing:

1. Connect pipe in accordance with the latest manufacturer's instructions and recommendations.
2. Clear each pipe length, coupling and fitting of all debris and dirt before installing.
3. Provide and use coupling pullers for jointing the pipe.
4. Provide gasket feeler gauges for use by the pipe layer for checking the position of the rubber gaskets in the completed joints.
5. Shove home each length of pipe against the pipe previously laid and hold securely in position. Do not pull or cramp joints.
6. Make all pipe joints as watertight as possible with no visible leakage and no sand, silt, clay, or oil of any description entering the pipeline at the joints.
7. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.
8. Use only non-petroleum based pipe lubricant for all joints and fittings.

C. Pipe Cutting:

1. Cut in accordance with manufacturer's recommendations.

2. Cut the pipe with a handsaw, metal-inserted abrasive wheel, or pipe cutter with blades (not rollers).
3. Examine all cut ends for possible cracks caused by cutting.

3.02 PIPE INSULATION

- A. Install 2-inch thick x 4-foot wide Styrofoam SM insulation as manufactured by Dow Chemical Co., or approved equal, between pipe and storm water culverts, over shallow pipe or as directed by the District.
- B. Between culvert and pipe crossings if the separation distance is less than 5.0 feet, extend insulation 6 feet each side of the culvert along the pipe.
- C. Install over the pipe when there is less than 5 feet of cover between the top of pipe and original ground grade. If there is between 4 and 5 feet of cover install 4" of Styrofoam board insulation.
- D. Install 6 inches above the pipe unless otherwise directed by the District.
- E. For dual pipe trenches the insulation shall be 8-ft. wide.
- F. Provide 6-inch sand blanket above and below insulation unless otherwise directed by the District.

3.03 SCHEDULES

- A. Schedules for the classes and types of pipes are detailed in the following table:

TABLE 4-1

Pipe Material	Depth to Invert	Standard	Classification
PVC	0 – 20 feet	ASTM F-794	SDR-35
Ductile Iron Pipe	0 – 20 feet		50

END OF SECTION

SECTION 5 - PRESSURE SEWER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install the pipe materials and fittings of the type(s) and size(s), and in the location(s) shown on the Drawings as specified herein.
- B. The extent of the work is generally shown on the drawings and shall be extended to accommodate changes, which may become necessary due to unforeseen or changed conditions in the field.

1.02 SUBMITTALS

- A. Furnish the name and product literature of the manufacturer to the District prior to commencing work. For any given pipe material, use pipe of the same material throughout the project.
- B. The District may request the submittal of manufacturer's certification that the product meets requirements of the Specification.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Except where the type or class or use of pipe is explicitly indicated on the Drawings or specified herein, any of the kinds of pipe specified may be used. The pipe material for the building sewer need not be the same material as the public sewer, except for that portion of the building sewer installed beneath the paved road and shoulder.

2.02 POLY VINYL CHLORIDE (PVC) PRESSURE PIPE

- A. Standards:
 - 1. Pipe: ANSI/AWWA C900, DR 14, Class 200, for 4-inch diameter and larger. Joints ASTM F477.
- B. Use push-on joints with electrometric gasket.
- C. Outside diameter equivalent to ductile iron pipe.
- D. Use mechanical joint fittings for changes in direction and provide restraint as detailed for ductile iron pipe.
- E. Install thrust blocks on angle fittings
- F. Install cleanout manholes at regular intervals, no more than 400 feet apart.

2.03 DUCTILE IRON PIPE:

A. Standards:

1. Cement-mortar lining for water: ANSI A21.4 (AWWA C104).
2. Rubber gasket joints: ANSI A21.11 (AWWA C111).
3. Ductile iron pipe thickness: ANSI A21.50 (AWWA C150).
4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A21.51 (AWWA C151).
5. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
6. Cast and ductile iron fittings: ANSI A21.10 (AWWA C110).
7. Pipe flanges and fittings: ANSI B16.1 and ANSI A21.10 (AWWA C110).

B. Pipe:

1. Unless otherwise shown on the Drawings, the minimum thickness of ductile iron pipe shall be Class 52 for push-on and mechanical joints, and Class 53 for pipe with flanges.
2. Standard cement lined and seal coated.
3. Furnish factory applied exterior bituminous coatings for all underground piping in manholes and other underground vaults.
4. Provide polyethylene encasement for corrosion protection where required by the District. Use continuous pipe wrap. Install according to AWWA C105, ASTM A674 and ANSI A215.

C. Joints:

1. Flanged:
 - a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
 - b. Flanges shall be long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
2. Gaskets:
 - a. Equal to Flange-Type made by U.S. Pipe.
 - b. Thickness: 1/8 in.
 - c. Meet ANSI 21.11 standards for mechanical joint gaskets.
 - d. Fasteners:
 - i. Make joints with bolt, stubs with a nut on each end, or one tapped flanged with a stud and nut.
 - ii. The number and size of bolts shall meet the requirements of the same American National Standard as the flanges.
 - iii. Nuts, bolts, and studs shall be Grade B meeting the requirements of ASTM A307.

- iv. After jointing, coat entire joint with bituminous material compatible with pipe coating.
 - e. When applicable, provide and install flange clamps as shown on the Drawings.
 - 2. Push-on Mechanical Joint:
 - a. The plain ends of push-on pipes shall be factory machined to a true circle and chamfered to facilitate fitting the gasket.
 - b. Provide gaskets manufactured from a composition material suitable for exposure to the liquid to be contained within the pipe.
 - c. Bolts and nuts for mechanical joints shall be made of A588 steel.
 - 3. Grooved split ring couplings, sleeve couplings, flexible joints and couplings for connecting to existing construction only, shall be supplied as shown on the approved Drawings.
 - 4. Joint Bracing
 - a. Provide joint bracing to prevent the piping from pulling apart under pressure.
 - b. Types of Bracing:
 - i. Pipe and fittings furnished with lugs or hooks cast integrally for use with socket pipe clamps, tie rods, or bridles. Bridles and tie rods shall be a minimum of 3/4-inch diameter except where they replace flange bolts of a smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The clamps, tie rods, and bridles shall be coated with a bituminous paint after assembly or, if necessary, prior to assembly.
 - c. Mechanical joint ductile iron pipe retainer glands:
 - i. Setscrews made of ductile iron or A588 steel.
 - ii. Minimum working pressure 200 psi, up to 20 inches and 150 psi over 20 inches

D. Usage:

- 1. Use push-on mechanical joint pipe for underground installations.
- 2. Use flanged pipe when making up to flanged fittings or valves and when indicated on the Drawings.

2.04 HIGH-DENSITY POLYETHYLENE PIPE: (specification for HDPE pipe is from www.isco-pipe.com)

A. The pipe shall be manufactured from a PE 3608 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet specifications of ASTM D 3350 with a minimum cell classification of 345464C. Pipe shall have a manufacturing standard of ASTM F 714 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generating in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

B. Fittings

1. Butt Fusion Fittings: Molded butt fusion fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. Fabricated fittings shall be manufactured using a McElroy Datalogger to record fusion pressure and temperature. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The fitting shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.
2. Electrofusion Fittings: Electrofusion fittings shall be PE3608 HDPE, minimum cell classification of 345464C as determined by ASTM D 3350 and be the same base resin as the pipe. Electrofusion fittings shall have a manufacturing standard of ASTM F 1055.
3. Flanged and Mechanical Joint Adapters: Flanged and Mechanical Joint Adapters shall be PE 3608 HDPE, cell classification of 345464C as determined by ASTM D 3350 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have manufacturing standard of ASTM D 3261. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.
4. Mechanical Restraint: Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer

shall provide wide, supportive contact around the full circumference of the pipe and equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.

Serrated restrainer shall be ductile iron ASTM A 536 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel or stainless steel.

The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI, whichever is lesser. Restrainers shall be JCM Industries, Sur-Grip or pre-approved equal.

Nominal Size	Restraint Width	Serrations/inch
4", 6"	1 1/2 "	8
8", 10", 12"	1 3/4 "	8

Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturer's published average inside diameter or the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations.
2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation. Install adaptors, as required, when connecting pipes constructed from different materials.

B. Pipe Laying:

1. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material, which does not provide firm and uniform bearing along the outside length of the pipe.
3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
4. Excavate suitable holes for the joints so that only the barrel of the pipe receives bearing pressure from the supporting material after placement.
5. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
6. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
7. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
8. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
9. Take all necessary precautions to prevent floatation of the pipe in the trench.
10. Install a magnetic detect tape, or equal, 12" over pipe for use in locating pipe.

C. Temporary Plugs:

1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
3. Do not use the pipelines as conductors for trench drainage during construction.

D. Jointing:

1. Connect pipe according to manufacturer's instructions and recommendations, (i.e. push plain end of pipe until line marked on it just enters bell).

2. Clear each pipe length, coupling and fitting of all debris and dirt before installing.
3. Use coupling pullers for jointing the pipes.
4. Use gasket feeler gauges for checking the position of the rubber gaskets in the completed joints.
5. Shove home each length of pipe against the pipe previously laid and hold securely in position. Do not pull or cramp joints.
6. Make all pipe joints as watertight as possible with no visible leakage and no sand, silt, clay, or soil of any description entering the pipeline at the joints.
7. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.

E. Butt Fusion (for HDPE pipe only)

1. Sections of polyethylene pipe should be joined in to continuous lengths of the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacture's recommendations. The butt fusion equipment used in the joining procedures should be as recommended by the manufacturer, including, but not limited to, temperature requirements of 400-450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 psi. The butt fusion joining will produce a joint-weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a McElroy Data Logger or equal. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.

F. Sidewall Fusion (for HDPE pipe only)

1. Sidewall fusions for the connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ -inch larger than the size of the outlet branch being fused.

G. Mechanical:

1. Bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining will be accomplished using

either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc. Either mechanical joint joining method will have a ductile iron mechanical joint gland.

H. Pipe Cutting:

1. Cut according manufacturer's recommendations.
2. Examine all cut ends for possible cracks caused by cutting.

END OF SECTION

SECTION 6 - BUILDING SEWER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install building sewer with appropriate fittings from the public sewer to the building drain. If the building drain is not installed or if the building sewer is for a future connection, install appropriate service connection on public sewer and install building sewer to property line.
- B. Where sewer services currently exist, provide and install tee fittings and reconnect the existing service line to the new sewer. Install services only as necessary to reconnect the existing connections.

PART 2 - PRODUCTS

- A. Tee and Wye Fittings:
 - 1. Have the same diameter and material as the main line pipe, with a 4 in. branch.
 - 2. Saddle type tees or wyes may be used on existing pipe only where approved by the District and then carefully installed as recommended by the pipe manufacturer.
 - 3. Fittings: Same material and strength class as that of the adjoining sewer.
- B. Building Sewer:
 - 1. 6" diameter to property line; then 4" or 6" to building.
 - 2. Install proper plugs or caps with each type of pipe used, capable of retaining air and watertight during testing.
 - 3. Material:
 - a. PVC: SDR-35.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fittings and laterals in the general location(s) shown on the Drawings.
- B. Install tee or wye fittings with a straight run of the same diameter as that of the adjoining sewer and a 4-inch or 6-inch branch. Branch shall be angled upwards at a minimum 45-degree angle.
- C. Install fittings only as construction proceeds, unless otherwise directed.
- D. Extend sewer service from the main sewer to the building drain or property line if building drain is not available.
- E. Install sewer service with minimum slope of ¼-inch per foot.
- F. The ends of the sewer service shall be capped or plugged.

G. Markers:

1. Mark the end of each building sewer with a 2-inch x 4-inch timber extending from the end of the pipe vertically to at least 18 inches above the ground surface, or as directed. Paint top of board green to identify it as sewer.
2. Securely anchor and maintain in a vertical position until backfilling has been completed.
3. The exposed portion of each marker shall have the depth of the sewer service, from the ground surface to invert, indicated on it.
4. The end of each building sewer shall be left exposed until accurate tie measurements of its location have been taken.

H. Vertical Chimneys:

1. Use wherever the sewer depth is 12 feet or greater.
2. Vertical Rise: As required to bring the end of sewer service to a depth of 6 feet.

3.02 BUILDING SEWER LOCATION RECORDS

- A. Record the location of all services encountered and/or newly installed and the location of utilities within the excavation limits.
- B. Record in a bound notebook and provide the District with a legible photocopy.
- C. Record by accurate "swing ties" or other method acceptable to the District.
- D. Provide information within 45 days of completing installation and testing of the system.

END OF SECTION

SECTION 7 - FIELD TESTING OF NON-PRESSURE PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all equipment and perform leak tests in gravity sewer pipe by means of a low-pressure air test as specified herein.
- B. Exfiltration and infiltration tests shall be permitted in areas only when approved by the District.
- C. All testing shall be performed in the presence of the District's representative.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 AIR TESTING:

- 1. Comply with ASTM D3034 for testing methods.
- 2. Pneumatic Plugs: Sealing length equal to or greater than the diameter of the pipe to be tested.
- 3. Pneumatic Plugs: Size and type to resist internal test pressures without requiring external bracing or blocking.
- 4. All air used shall pass through a single control panel.
- 5. Use three (3) individual hoses for the following connections:
 - a. From control panel to pneumatic plugs for inflation.
 - b. From control panel to sealed line for introducing low-pressure air.
 - c. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

B. Procedures:

- 1. Pneumatic Plug Seal Pre-Testing:
 - a. Before being used in the actual test installation, lay one length of pipe on the ground and seal at both ends with the pneumatic plugs to be checked.
 - b. Introduce air into the plugs to 25 psig.
 - c. Sealed pipe shall be pressurized to 5 psig.
 - d. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- 2. Testing Installed Pipe:
 - a. Place plugs in the line and inflate to 25 psig

- b. Introduce low-pressure air into sealed line until the internal air pressure reaches 4 psig greater than the average backpressure of groundwater over the pipe.
- c. Wait at least 2 minutes for the air pressure to stabilize.
- d. After the stabilization period (3.5 psig. minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply. The portion of line being tested shall be termed "acceptable" if the time required for the pressure to decrease from 3.5 to 2.5 psig is greater than the time shown for the given diameters in the following table:

Pipe Diameter (inches)	Time (minutes)
4	2
6	3
8	4
10	5
12	5.5
15	7.5
18	8.5
21	10
24	11.5
36	18
48	22

- 3. If the pipe, as laid, fails to meet these requirements, perform the necessary work to meet these requirements.

3.02 INFILTRATION AND EXFILTRATION TESTS

- A. If the installation fails to meet the above requirements for the air test, an exfiltration or infiltration test may be performed as directed, and if approved, by the District.
- B. Leakage shall not exceed 100 gallons per inch diameter per day per mile of pipe, when tested by either internal pressure or external pressure means. Should the pipe, as laid, fail to meet these requirements, perform the necessary work to meet these requirements. Where groundwater is high, the District may elect to accept infiltration measurements in lieu of exfiltration tests.

C. Infiltration Test:

1. Requires groundwater levels to be a minimum of one foot above the crown of the pipe of the high end of the section being tested.
2. Infiltration Test Procedures:
 - a. District to determine allowable length of sewer main and connecting lines to be tested.
 - b. No more than 1,000 feet of sewer main is to be laid before testing.
 - c. With all connecting pipes plugged (other than those included in test section), install a V-notch weir in downstream end of pipe.
 - d. Construct the V-notch weir accurately and ensure a watertight seal between weir and pipe.
 - e. Allow time for water to build up behind weir until steady, uniform flow passes through V-notch.
 - f. Record readings as directed by the District.

D. Exfiltration Test

1. Procedures:
 - a. District to determine allowable length of sewer to be tested.
 - b. Properly cap or plug and block service laterals, stubs and fittings into sewer lines being tested.
 - c. Plug downstream ends of test section providing a water supply connection standpipe in manhole upstream.
 - d. Fill test section and upstream standpipe and allow time for water adsorption in manholes.
 - e. Measure drop in upstream standpipe over 4 - 15 minute periods and compute leakage.

NOTE: The upstream manhole may be used as the standpipe. Test sections must be kept short enough to maintain a reasonably low head to prevent excess pressures on ends of laterals.

3.03 ADDITIONAL TESTING FOR FLEXIBLE CONDUIT

- A. Test vertical deflection of the conduit by a rigid "Go-No-Go" device.
- B. Prior to testing the pipe make sure the line is clean and free of debris that might cause the device to jamb.
- C. Pull the gauge by hand as mechanical equipment may result in jamming the device.
- D. Test all pipe by this method.

- E. Maximum Allowable Deflection: 3 percent of the pipe diameter if tested 0 to 2 months after installation and 5 percent of the pipe diameter if tested more than 2 months after installation.
- F. If requested by the District, provide a videotape of the installed sewer main with commentary and pipe footage recorded on the tape.

END OF SECTION

SECTION 8 - FIELD CLEANING/TESTING OF PRESSURE SEWER PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all equipment and material to clean and perform leakage tests in pressure sewer pipes by "pigging" and hydrostatic pressure test methods as specified herein.
- B. Submit the proposed testing procedure to the District at least 30 days before testing for approval.
- C. Conduct all cleaning and testing in the presence of a District representative.

PART 2 – PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.01 CLEANING

- A. Before pressure testing the pipe, clean the pipe by "pigging" with foam-type pipeline pig.
- B. Pigs used shall be basic foam type with densities between 2 and 5 pounds per cubic foot.
- C. Two passes through the line shall be made; the first pass shall use a 2-lb pig, the second pass shall use a 4-lb pig.
- D. During each pass the pressure gauges shall be monitored to see that working pressures are not exceeded and to record pressures during the second pass of the pig.

3.02 PRESSURE TESTING

- A. Conduct test according to Section 4 of AWWA C-600 Standard for Installation of Water Main, except for stated pressure requirements.
- B. Leakage shall not exceed 15 gallons in 24 hours per mile of pipe per inch diameter when tested by water pressure at 1.5 times the design working pressure of the pipe, but not less than 50 psi.
- C. Should the pipe fail to meet the leakage requirements, re-excavate and repair.
- D. Conduct all cleaning and testing in the presence of the District's representative.

END OF SECTION

SECTION 9 - SEWER AND DRAINAGE STRUCTURES

Part 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install manholes, piping and all incidental work, strictly according to the specifications and applicable Drawings and standard details.

1.02 QUALITY ASSURANCE

- A. Manholes and other structures, including all component parts, shall have adequate space, strength and leak-proof qualities considered necessary for the intended service. Space requirements and configurations shall be shown on the Drawings.
- B. Manholes may be assembled from precast sections with steel reinforcement, with approved jointing, or concrete cast monolithically in place. In any approved manhole, the complete structure shall be of such material and quality as to withstand loads of 8 tons (H-20 loading) without failure and prevent leakage in excess of one gallon per day vertical foot of manhole, continuously for the life of the structure. Life expectancy of the structure is greater than 25 years.

1.03 SUBMITTALS

- A. Provide plans with the location, depth, and size of proposed sanitary sewers and structures to the District for review before construction. The District requires at least 2 weeks for review.
- B. Provide the location, depth and size of all existing sanitary sewers and structures within the project area to the District before construction.
- C. Provide manufacturer's Information: Joint sealants, gaskets and waterproofing.
- D. Provide shop drawings of all precast units.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Precast Concrete Manholes:
 - 1. Provide reinforced concrete riser sections, with an eccentric top with a 30-inch opening, and a monolithic base section conforming to dimensions on the plans.
 - 2. Manufactured in accordance with ASTM Designation C-478 (latest revision) unless otherwise noted herein.

3. The minimum compressive strength of concrete: 4,000 psi.
4. The circumferential steel reinforcement for riser pipe, cone sections and base walls: 0.12 in²/linear ft.
5. Reinforcing shall extend into the shiplap joint of each manhole section.
6. Casting methods must assure each unit to be very dense in structure and impervious to water.
7. Paint manhole exterior with two heavy coats of bituminous paint.
8. For manholes to be used as valve vaults, blow-off or vent manholes or wetwells, paint the interior in the same fashion.
9. Shiplap Joint:
 - a. Sections shall be set so as to be vertical and in true alignment.
 - b. The District shall approve horizontal joints between sections of precast concrete barrels. The joint shall include a bitumastic-like sealant (Kent-Seal, Ram-Nek or equal). These shall be installed two per joint on both the upper and lower shiplap. Elastomeric O-rings shall not be acceptable.
10. Pipe to Manhole Joints: Only as approved by the District and, for water-tightness, will depend upon a rubber boot either cast-in-place or press-wedged in place and a stainless steel strap. For forcemain terminus, use link seal and mortar around it.
11. All precast sections and bases shall have the date of manufacture and the name of the manufacturer impressed or indelibly marked on the inside wall.
12. Manhole Steps:
 - a. Forged aluminum safety type, alloy temper T6 or ½ -inch steel reinforced polypropylene plastic manufactured to ASTM D246 Type II, Grade 16906 and ASTM c478 standards.
 - b. Cast in walls of the precast section so as to form a continuous ladder with a distance of 12" between steps.
 - c. Apply a heavy coat of bituminous paint all aluminum in contact with concrete.
13. Provide 2 holes for the purpose of handling and laying the structure. These holes shall be temporary and shall be plugged with non-shrink grout (ASTM C287) after installation.
14. Precast Base Sections: Cast holes for pipes in the base section so that there is a clear distance of 4-½

inches minimum between the inside bottom of the base section and the pipe invert. Use of fiberglass channels for manhole inverts is encouraged for rehabilitation work and allowed after consideration of future expansion, for new installations.

15. Drop Services: The District does not allow internal drop services in manholes. If a service is connected to a manhole, provide an external drop or tie the service in at the invert of the manhole.

B. Manhole Frames and Covers:

1. **Provide a 28-inch diameter clear opening.**
2. **Provide 30-inch covers with the letter "S" or the word "SEWER" cast into the top surface, letter to be 3 inches high.**
3. Frames and covers supplied by Etheridge, Neenah or Lebanon.
4. Provide machine-bearing surface.
5. Castings shall be good quality, strong, tough, even-grained cast iron, smooth free from scale, lumps, blisters, sand holes, and defects of every nature which would render them unfit for the service for which they are intended.
6. Castings shall also be Class 30, conforming to the ASTM Standard Specification for Gray Iron Castings, Designation A48.
7. Contact Surfaces of Covers and Frame Seats shall be machined at the foundry, before shipment to prevent rocking of covers in any orientation.
8. Thoroughly clean and subject to a careful hammer inspection.
9. Before being shipped from the foundry, sandblast castings and give two coats of coal-tar-pitch varnish, applied in a satisfactory manner to make a smooth, tough coating. Repair damaged coatings prior to installation.

C. Cast in Place Base Sections: (Not recommended – use only with explicit permission of the District)

1. Use only for all manholes constructed on existing sewer lines.
2. Construct with Portland cement concrete, cast in place as shown the approved Drawings, or as directed by the District.
3. Channels: Construct of brick masonry or fiberglass inverts.

4. Inlet and Outlet Pipes: Carefully cast in place to the correct direction and elevation.
5. Should an invert elevation not to be correct to the District, the entire base shall be removed and replaced.
6. Waterproof joint around the pipe entering the base
7. Coordinate the work so that the manhole base is poured immediately after the pipe to the manhole has been laid.
8. Do not lay pipe on the uphill side of the manhole until the base has been poured.

D. Brick:

1. Provide sound, hard, and uniformly turned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the District.
2. Comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick.
3. Immediately remove rejected brick from the site.

E. Mortar:

1. Composed of Portland cement, hydrated lime, and sand, in the proportions of 1 part cement to ½ part lime to 4-½ parts sand, (by volume).
2. The proportion of cement to lime vary from 1:¼ for hard brick to 1:1/3 for softer brick, but in no case shall the volume of sand exceed three times the sum of the volume of lime.
3. Cement: Type II Portland cement conforming to ASTM C-150, Standard Specifications for Portland Cement.
4. Hydrated Lime: Type S conforming to the ASTM Standard Specification for Hydrated Lime for Masonry Purposes, Designation C207.
5. Sand: Inert natural sand conforming to the ASTM Standard Specifications for Concrete (Fine) Aggregates, Destination C33 as follows:

Sieve	% Passing
# 3/8	100
4	95-100
8	80-100
16	50-85
50	10-30

100	2-10
-----	------

FINENESS MODULUS 2.3-3.1

F. Cleanout Manhole Ball Valve:

1. Carbon steel body.
2. Stainless steel ball and stem.
3. Suitable for service with hydrogen sulfide.
4. Full bore wall.
5. Lever operated.

G. Force Main Terminus Manhole:

1. Force main shall enter manhole a maximum of 2.0 ft. above invert of outgoing sewer with long radius 45- or 22½-degree bend.
2. Provide 2 cast iron spool piece fittings (each 1.0 foot) and 3 mechanical joints outside manhole before transition to PVC forcemain.
3. Shape invert to provide smooth flow transition.

H. Rehabilitation of Sewer Manholes

1. Use composite liner made up of Quadex® cement product or equal covered with epoxy coating.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Precast Manholes:

1. Place on a 6" layer of compacted bedding material.
2. Dewater excavation while placing bedding material and setting the base or pouring concrete.
3. Use waterstops at the horizontal joint of cast-in-place manhole bases.
4. Connect inlet and outlet stubs and seal according to the manufacturer's recommended procedure.
5. Place barrel sections and cones of the appropriate combination of heights using manufacturer's recommended procedure for sealing the horizontal joints.
6. Perform a leakage test as described herein.
7. Following a satisfactory completion of the leakage test, place the frame and cover on the top or otherwise prevent accidental entry by unauthorized persons, children, and animals until final adjustments to grade are made.

B. Cleanout Manholes for Forcemains

1. Place a cleanout manhole every 400 feet (maximum) in forcemain.

C. Drop Connections:

1. Construct external drop connection if mainline sewers or service materials have invert elevations 2.0 feet or higher above the invert of the manhole discharge pipe, as shown on the approved Drawings.
2. When precast bases are used, provide a base under precast manhole base selection and drop pipe, drop fitting assembly and concrete encasement all as shown on approved Drawings.

D. Channels:

1. Build with care.
2. Raise the sides perpendicular by brick masonry construction from the spring line to the height of the crown of the pipe.
3. Where changes in directions are made at manholes, shape the invert with as great a radius as possible, and to the complete satisfaction of the District.
4. Lay and join brick to provide smooth and even flow through the manholes.
5. Use fiberglass inverts wherever possible.

E. Laying Brick:

1. Use clean bricks.
2. Moisten by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
3. Lay in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and thorough bond.

3.02 VACUUM LEAKAGE TESTS (Preferred Method)

A. General

1. Conduct the test in a District representative present for each manhole.

B. Preparation for Test:

1. After the manhole has been assembled in place, fill lifting holes and point with an approved non-shrinking grout.
2. Perform test prior to placing the shelf and invert and before filling and pointing the horizontal joints, and before backfilling.
3. If the groundwater table has been allowed to rise above the bottom of the manhole, lower for the duration of the test.

4. Plug pipes and other openings into the manhole and the plugs braced to prevent blow out.
- C. Test Procedure:
1. Test immediately after manhole assembly.
 2. Use manhole vacuum test equipment equal to NPC systems, Inc., Milford, New Hampshire.
 3. Set tester in place.
 4. Inflate compression band to seal to structure.
 5. Draw a vacuum of 10-inch Hg.
 6. Close the valve.
 7. Acceptable test:
 - a. Less than 1 inch Hg drop in 3 minutes for a manhole less than 10 feet in depth.
 - b. Less than 1 inch Hg drop in 5 minutes for a manhole 10 feet to 20 feet in depth.
 8. If leakage occurs fill those points with non-shrink grout, allow to set and retest.
 9. Rejected Manholes: Disassemble, construct or replace as directed by the District.

3.03 LEAKAGE TESTS

- A. Preparation for Test:
1. Coordinate schedule to ensure that a District representative is present at the beginning of the test.
 2. After the manhole has been assembled in place, fill lifting holes and point with an approved non-shrinking grout.
 3. Perform test before placing the shelf and invert and before filling and pointing the horizontal joints.
 4. If the groundwater table has been allowed to rise above the bottom of the manhole, lower for the duration of the test.
 5. Plug pipes and other openings into the manhole and brace the plugs to prevent blow out.
- B. Test Procedure:
1. Fill manhole with water to the top of the cone section.
 2. If the excavation has not been backfilled and observation indicates no visible leakage, the manhole may be considered to be unsatisfactorily watertight.
 3. If the test as described above is unsatisfactory as determined by the District or if the manhole excavation has been backfilled, continue the test.
 4. A period of time may be permitted to allow for absorption.
 5. At the end of this period, refill the manhole to the top of the cone, if necessary, and measure water level for at least 8 hours.

6. At the end of the test period, refill to the top of the cone, measuring the volume of water added.
7. Extrapolate to a 24-hour rate and determine leakage on the basis of depth.
8. The rate shall not to exceed 1 gallon per vertical foot for a 24-hour period.
9. If the test fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repair by approved methods as directed by the District to bring the leakage within the allowable rate.
10. Leakage due to a defective section or joint or exceeding the 3-gallon per vertical foot per day, shall be cause for the rejection of the manhole.
11. Rejected Manholes: Uncover the manhole as necessary and disassemble, reconstruct or replace as directed by the District.
12. Retest and, if satisfactory, fill and point all inferior joints and those exterior joints within 6 feet of the surface.
13. Conduct either before or after backfilling around manhole.
14. However, if backfilling is done prior to testing, for any reason, it shall be at the contractor's own risk. If backfilled before a failed test, the contractor is responsible for determining the reason for any failure of the test.
15. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorption, or other reasons. Assume that all loss of water during the test is a result of leaks through the joints or through the concrete.
16. Take any steps necessary to assure the District that the water table is below the bottom of the manhole throughout the test.

C. Infiltration Test:

1. If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole as determined by the District, use to evaluate the water-tightness of the manhole.
2. However, if the District is not satisfied, lower the water table and carry out a vacuum or exfiltration test.

END OF SECTION

SECTION 10 - COMBINATION SEWAGE AIR & VACUUM VALVE

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Furnish and install combination sewage air and vacuum valves on the sewer force main including tapping and fittings of the type (s) and size (s), and in the location (s) shown on the approved Drawings and as specified herein. Valves shall be sized according to manufacturer's standard recommendation, unless otherwise noted herein.

1.02 ACCEPTABLE MANUFACTURERS

- A. Valve & Primer Corporation, Clow Corporation, Crispin Valve, or equal.

1.03 SUBMITTALS

- A. Shop drawings and Manufacturer's catalog information.

PART 2 - PRODUCTS

2.01 COMBINATION SEWAGE AIR AND VACUUM VALVE

A. Standards:

1. Air/Valve:

- a. Body, cover and bottle: Cast iron with stainless steel trim
- b. Float and float guide: Stainless steel, ASTM A240.
- c. Seat: Buna-N
- d. Exterior paint: Primer, TT-P-86, Type IV; finish paint, compatible with primer, applied in two coats, total mils DTM.
- e. Inlet and outlet: Minimum 2 in. for screwed connections.
- f. All hardware including connection nipples and full port ball valve: Stainless steel
- g. All stainless steel shall be American made #316

B. Construction Features:

- 1. Two Valve Chambers: One air and vacuum valve, and one air release valve which allows unrestricted venting and re-entry of air when force main. Provide removable splash hoods on both chambers.

2. Air and Vacuum Valve:

- a. Incorporates upper and lower stainless floats connected by common stainless steel guide.
- b. Air gap retards waste solids from fouling the upper shut-off float.
- c. Upper float fitted with baffle to protect shut off float from direct flow.
- d. Internals removable from top without main valve removal.
- e. Fittings:
 - i. 2-in. shut-off plug valve at main.
 - ii. 1-in. blow-off valve.
 - iii. ½-inch back flushing valve, with quick disconnect coupling.
 - iv. 6-ft hose with quick disconnect coupling.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install according to manufacturer's instructions. Provide galvanized steel pipe stands for pipe support beneath valve.
- B. Drill and tap D.I. pipe for 2-inch stainless steel nipple. For D.I. pipe less than 6 in. diameter and all PVC pipe, provide tee fitting in line with C.I. blind flange, mount tee with branch vertical drill and tap flange for 2-inch stainless steel nipple.
- C. Assemble valve cylinders and fittings.
- D. Securely strap valve cylinders to manhole walls using stainless steel straps, concrete anchors, and anchor bolts.

END OF SECTION

SECTION 11 - SUBMERSIBLE PUMP STATION

PART 1 - GENERAL

1.01 ACCEPTABLE MANUFACTURES (PACKAGE STATION)

- A. Superior Concrete Co., Inc., American Concrete, George Roberts, or equal
- B. E-One Corporation, or equal for Low-Pressure Sewer Pumping systems.

1.02 SUBMITTALS

- A. Catalog Data: Manufacturer's literature and illustrations.
- B. Manufacture's Specifications and Engineering Data.
 - 1. Materials
 - 2. Parts
 - 3. Devices
 - 4. Accessories
 - 5. Performance Data
- C. Shop Drawings:
 - 1. Fabrication
 - 2. Assembly
 - 3. Installation
 - 4. Wiring Diagram
- D. Operation and Maintenance Manuals:
 - 1. Equipment function
 - 2. Normal operating characteristics
 - 3. Limiting conditions
 - 4. Installation Instructions:
 - a. Assembly
 - b. Installation
 - c. Alignment
 - d. Adjustment
 - e. Checking
 - 5. Operating Instructions
 - a. Start up
 - b. Routing and normal operation
 - c. Regulation and control
 - d. Shut down
 - e. Emergency
 - 6. Lubrication and Maintenance Instructions.
 - 7. Guide to Troubleshooting.
 - 8. Parts List and Predicated Life of Parts Subject to Wear.
 - 9. Drawing:
 - a. Outline
 - b. Cross section
 - c. Wiring diagrams

- d. Assembly
- 10. Test Data and Performance Curves
- E. Equipment Supplier's Written Report That Equipment:
 - 1. Has been properly installed and lubricated.
 - 2. Has been properly aligned.
 - 3. Is free from undue stress imposed by piping or mounting bolts.
 - 4. Has been operated under full load condition and the satisfactory operation has been obtained.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE PUMP STATION:

A. General: Submersible sewage pump station shall be constructed and installed as shown on the approved Drawings. Systems shall include two submersible pumps with slide-away couplings with 316 SS steel guide pipes. Guide pipes shall be Schedule 80. The slide-away coupling to be fitted with mating faces secured to standard ASA flange on pump and stationary elbow fitting that when mated together provide a metal-to-metal contact. Stationary coupling which incorporates an incline plane fitting to provide the closing action for the knife edge coupling to be self-cleaning and non-clogging. No rubber asphalt paint, pivot action, or gaskets are required. Pump slide bracket to be stainless steel construction. Shut-off and check valves for each pump shall be installed in a separate, underground valve vault. Furnished aluminum access covers (Bilco or approved equal with H-10 loading) for both the pump station and valve vault top, guide fitting for guide pipes, stainless steel lifting chain, all to be installed in the valve vault. Valve vault shall have shall have 4-inch drain mud valve to drain vault to wetwell.

B. Pump Design:

Description	Parameter
Pumps	2 per station, constant speed
Minimum Velocity	3.5 feet/sec.
Minimum Flow	80 gallons per minute
Motors	60 Hz, 1.15 service factor
Acceptable Manufacturers	HOMA or equal
Variable Frequency Drives	Danfoss or equal (if 3-phase power is unavailable)

C. Pump Construction: The pump and motor housing shall be cast iron with all parts coated with baked-on epoxy paint.

Finish coat shall be air-dry enamel. All exposed hardware, fasteners, nuts and bolts shall be stamped 316 SS. All mating surfaces, where watertight sealing is required, shall be machined and fitted with rubber o-rings of square cross - section. No other sealing device shall be used. The impeller shall be cast iron and dynamically balanced. The mating of the impeller and shaft shall be a slip fit with one keyway. The pump shall have an oil chamber for seal lubrication. Two permanently lubricated bearings (upper and lower) shall stabilize the pump shaft. **Upper and lower seal units contain tungsten-carbide rings.** Seal failure sensors shall be provided.

- D. Access Frame and Cover: The access frame and cover for pump stations and valve manhole shall be designed for H-10 loading. The frame and cover shall have a flush locking mechanism and safety handle to hold doors in the open position. Doors shall be of skid-proof design.
- E. Check Valve: All check valves are to be Class 150 flanges faced and drilled per 125-pound template. The swing check valve shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a stainless steel shaft and fasteners for exterior lever and weight. The valve must be tight season, and must operate without hammer or shock. The seat ring must be renewable and shall be securely held in place by a threaded joint.
- F. Non-rising Stem Wedge Gate Valves: Gate valves shall be 4-inch or larger. Manufacturers shall be DeZurik Corp. or Homestead Industries.
- G. Handwheel Operators: All manual valves shall have handwheel operators (unless instructed otherwise) of proper size to provide maximum 40-lb rim pull operation. Handwheels shall be made of bronze or cast iron materials, and shall be properly secured to the valve stem to prevent displacement during use.
- H. Wrench Operator: Wrench for wrench-operated valves shall be of bronze or cast iron, and suitable size and length to facilitate easy operation. For underground or under floor valves, an e type wrench shall be provided.
- I. Drain Mud Valves: A drain mud valve with extended stem and nut shall be installed in the valve vault and shall be rising stem type with cast iron body cover and yoke. The stem nut disc ring,

and seat ring shall be bronze. The bolts and nuts shall be stainless steel. Mud drain valves shall be furnished with stainless steel extension stem and stainless steel operating nut and with stem guides, and shall be similar to Clow Model No. F3075 or approval equal.

2.02 PUMP STATION CONTROLS

A. All Control Panels must comply with NFPA 70e regarding Arc Flash safety.

B. Duplex Electrical Control: Use an Panasonic FPO programmable logic controller (PLC) duplex control and alternation. Install two circuit breakers with through-door operating handle, two magnetic starters (Telemecanique or equal) for three-phase with overload protection in each leg, and door-mounted Square D manual-off-automatic selector switches for each pump. ***In locations where only single phase power is available, provide variable frequency drives. All models to include transformers for 115 VAC control circuit.*** Mount the control panel remote from lift station as shown on the approved Drawings. The control panel shall be NEMA 4 construction without clips with locks.

Do we want/need these transformers?

C. Primary Liquid Level Sensor:

1. Provide Senix ultrasonic level control for the following functions:
 - a. Low-level alarm and pump lockout (auto reset on lockout).
 - b. Pumps off.
 - c. Start lead pump.
 - d. Start lag pump (duplex operation).
 - e. Stop lead pump
 - f. Stop lag pump
 - g. High-level alarm.
 - h. Flow Monitoring

D. Backup (Secondary) Liquid Level Sensors: Install two non-mercury liquid level sensors – one for low-level and one for high-level alarms. Provide enough electrical cable to equal the depth + diameter of the wetwell + 15 feet. Cast a 3-inch galvanized coupling into the top of the wetwell opposite the access hatch. Use a Wiegmann (BN4-1084CHSS) stainless steel junction box, or equal, mounted in the concrete wetwell top opposite of the access hatch. Provide Wago terminal blocks, or equal, as needed for all electrical connections.

Electrical wires (8-gauge) will then run to a control panel through 1¼-inch and ¾-inch galvanized conduit. Provide explosion-proof seals in conduit for wires leaving the junction box.

1. Provide a NEMA 4 enclosure for the level sensor.
 2. Include cable heavily sheathed in PVC.
 3. System shall operate on 24 VAC.H.
 4. Provide a horizontal stainless steel, 1-inch diameter, Schedule 40 adjustable level sensor support pipe. Place sensor support pipe within easy reach from the access hatch, between hatch and cast-in nipple.
- E. Provide 1-inch tap valve and shut-off pressure gauge on each pump discharge next to valve, 2-inch gauge face with 1" x ¼" stainless steel isolation diaphragm and ½-inch quick disconnect flush connection.
- F. If a generator is included and public water is available, provide 2-inch diameter PVC water service, 1¼-inch frost-proof yard hydrant with shut-off and 30 feet of 1¼-inch hose with Strahman-type nozzle. Provide covered, lockable hose rack. If there is no generator building than no public water is required.
- G. Install lightning arrestor, three-pole thyrite type.
- H. Install an 8-foot ¾-inch copper-grounding rod adjacent to the central control panel.
- I. Look to Attachment A for more information about specific pump station control cabinet parts
- J. Each pump station shall be provided with a Motorola Modular Remote Unit (MRU), which includes encoders, decoders, radio for both data transmission and voice communication, battery backup in a NEMA 4 housing for wall mounting, an Omni directional antenna complete with interconnecting cable, and a power supply to the MRU. Interconnecting wire shall be installed between the enunciator, and shall be sufficient to handle 2 encoders. The system shall transmit over the same frequency as the Kennebunk Sewer District and shall be coordinated with the local Motorola representative to ensure that the equipment is the same as and compatible with the current Motorola System.

2.03 LOW-PRESSURE SEWER PUMPING SYSTEMS

- A. As an alternative to a traditional submersible pump station as described above, KSD would consider installation of a Low-pressure Sewer Pumping System (E-One, or equal). This system would consist of individual grinder pump stations that would feed into common low-pressure forcemains. The pumping stations would be owned, operated, and maintained by sewer Property Owner. If this approach is taken, submit plans and specifications to KSD for review and approval.

PART 3- EXECUTION

3.01 FACTORY TESTING

- A. Submit certified copies of test curves from equivalent units to the District.

3.02 INSTALLATION

- A. Install all equipment according to the manufacture's recommendations. Make all adjustments required to provide complete and satisfactory operation upon completion of the Contract.
- B. Before ordering any materials or doing any work, verify all measurements concerning equipment and layout. No extra compensation will be allowed for difference between actual dimensions and those shown on the Contract Drawings.
- C. Provide Davit Arm Base atop wetwell for safely servicing the pump station. Consult with the District for location of base.

3.03 SERVICE

- A. When the equipment is capable of being operated, the equipment manufacturer shall provide competent personnel for a period not to exceed one (1) day to check the completed installation and instruct the Owner's personnel in its use.

END OF SECTION

SECTION 12 - STANDBY GENERATION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Furnish and install a standby generator to be owned and maintained by the Kennebunk Sewer District. Install according to the following minimum requirements of the District.

1.02 SUBMITTALS

- A. Shop drawings and Manufacturer's catalog information.

PART 2 - PRODUCTS

2.01 Generator Set

- A. Acceptable brands
 - a. Kohler, Onan, Caterpillar
- B. Motor
 - b. Speed of 1800 rpm
 - c. Diesel Fuel
 - d. Cooling radiator water/ anti-freeze mix (50/50)
 - e. Electrical 12v starting
 - f. Alternator must be a minimum of 60 amps
 - g. Optima red top battery
 - h. Automatic shut down battery charger (Napa #85-300A)
 - i. 120v block heater
 - j. Exhaust critical silencer
 - k. Battery charger and block heater are connected to oil pressure switch so they will shut down when motor is running
 - l. Exhaust piping will be rigid schedule 40 black iron, except for steel flex pipe connection to the generator set
- C. Generator
 - a. Main output power breaker
 - b. Brushless design
 - c. 1800 rpm speed
 - d. Rotating field
 - e. 12 lead reconnectable output configuration
 - f. Adjustable output voltage potential
 - g. Meters:
 - 1. Output voltage
 - 2. Output amperage

3. Frequency
4. Battery voltage
5. Oil pressure
6. Hour meter
7. Coolant temperature
8. Engine speed

h. Alarm Conditions and Shut Down

1. not in auto
2. low-fuel level
3. low-water level
4. high-water temperature
5. over-speed
6. low-oil pressure
7. over crank
8. e-stop

D. Additional Accessories: Provide a suitable sized breaker panel for lights, unit heaters, receptacles, annunciator, radio telemetry, etc.

E. Provide underground utility power and meter, main switch, transformer (if required) and all interconnecting wiring and conduit. Mount pump control panels in generator building.

2.02 ENCLOSURE

A. The standby generator shall be housed in a permanently installed enclosure of either fiberglass or wood construction. If the generator is installed to power pump motors of 5 horsepower or less, a pre-manufactured fiberglass enclosure may be used. Otherwise a built in-place wooden structure must be constructed to meet the following requirements:

Area of Construction	Requirements
Building	<ul style="list-style-type: none"> • Meet all pertinent building codes • Large enough so that with all components installed the walkways on both sides and behind generator are no less than 4 feet • 2-damper actuated louvers on opposite walls to open either on high temperature or diesel engine start • Size of louvers will be dictated by generator size • Adequate lighting, wall plugs and switches for service required

	<ul style="list-style-type: none"> The District shall select and approve colors.
Doors	<ul style="list-style-type: none"> Insulated painted steel double door 36"x 84" each All hardware including knobs, latches, and hinges are to be of commercial grade
Window	<ul style="list-style-type: none"> All windows are to be double hung with thermal pane
Roof	<ul style="list-style-type: none"> Pitched roof with a minimum wall height of 12' from finish floor to top of plate 30 year guarantee shingles
Walls	<ul style="list-style-type: none"> 2"x 6" lumber - 16" on center walls with 6" R-19- faced fiberglass insulation 1/2" CD exterior plywood with 15 # felt and cedar clapboard or vinyl siding 10' wall height
City Water (if needed)	<ul style="list-style-type: none"> Water meter Backflow preventor that meets KKWWD standards Hose and rack Nozzle
Ventilation	<ul style="list-style-type: none"> Components <ol style="list-style-type: none"> Supply louvers Recirculation louvers Exhaust louvers Exhaust fan Electric unit heater Generator run signal Temperature controller Operation <ol style="list-style-type: none"> Generator off <ol style="list-style-type: none"> Temperature above 75 <ol style="list-style-type: none"> Supply louvers – open Recirculation lovers – open Exhaust lovers – closed Exhaust fan – on Electric Unit heater – off Temperature below 68 <ol style="list-style-type: none"> Supply louvers – closed Recirculation lovers – open Exhaust lovers – closed Exhaust fan – off Electric Unit heater – on Generator on Temperature above 75 <ol style="list-style-type: none"> Supply louvers – open

	<ul style="list-style-type: none"> ii. Recirculation lovers – open iii. Exhaust lovers – closed iv. Exhaust fan – on v. Electric Unit heater – off <p>d. Temperature below 68</p> <ul style="list-style-type: none"> i. Supply louvers – closed ii. Recirculation lovers – open iii. Exhaust lovers – closed iv. Exhaust fan – off v. Electric Unit heater – on
Fuel Tank	<ul style="list-style-type: none"> • 275-gallon double walled vertical residential style heating oil tank • Vent alarm with level indicator • 1-1/2" fill and vent lines • Standard fill connection for heating oil truck • Standard vent cap • Fire-matic valve • General 1A-25 fuel filter
Transfer Switch	<ul style="list-style-type: none"> • Sized for generator and pump station max loads • Fully automatic switch that transfers load upon power failure and then back when power is restored • Aux. generator run contacts for generator building ventilation system • Time delay on engine starting adjustable • Time delay for engine cool down adjustable • Under / over frequency for emergency source • Manual transfer capability • Normal / emergency power indication • Exercise time clock adjustable • Exercise under load / no load switch • Adjustable phase voltage sensing for both pickup and dropout on all power legs
Interior woodwork and trim	<ul style="list-style-type: none"> • 1/2" CD plywood on interior • Painted one coat of primer plus two coats of alkyd enamel
Clapboards	<ul style="list-style-type: none"> • Finished with an opaque stain, approved by the District
Rafters	<ul style="list-style-type: none"> • 2"x 10" - 16" on-center • 2"x 4" collar ties

	<ul style="list-style-type: none"> • 12" Kraft-faced fiberglass insulation between collar ties • 1/2" plywood, 15# felt, asphalt with aluminum drip edge • 1" x 10" fascia and 1/2" exterior plywood suffixed with continuous vent
Floor	<ul style="list-style-type: none"> • Minimum of 1'3" thick reinforced concrete slab • 2-1" overlapping layers of Styrofoam insulation • A 2" sand blanket • A 2" Zurn floor drain to wet well with vent stack through the roof and incorporated clean out

2.03 ALTERNATIVE TO ONSITE GENERATOR

A. As an option to the on-site Generator, developments may contribute to a fund to be used towards purchasing portable generators. Contributions shall be calculated as follows:

Kennebunk Sewer District
Portable Generator Contribution Table

<u>Number of Units</u>	<u>Contribution</u>
<u>1 to 10</u>	<u>\$2,500</u>
<u>11-30</u>	<u>\$3,500</u>
<u>31-50</u>	<u>\$4,000</u>
<u>51+</u>	<u>\$5,000</u>

B. In addition, the design shall provide 6 hours of emergency storage; of the 6 hours a minimum of 2 hours shall be provided in the wetwell above the high level alarm.

C. Stations requiring a pump motor 15 horsepower or greater shall be required to provide an enclosed onsite power generator built to KSD specifications.

D. Exception: In lieu of onsite generators, additional wet well storage capacity may be a considered. A 24-hour storage period will be used to determine wet well depth. However, wetwell depth must not exceed an additional six feet due to this design, and the storage shall be below the influent pipe.

END OF SECTION