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WELLS SANITARY DISTRICT
WELLS, MAINE

STANDARD SPECIFICATIONS RELATED TO CONSTRUCTION OF SANITARY SEWERS, PUMP STATIONS AND APPURTENANCES

JANUARY 2009

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JANUARY 2009

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SECTION 00010

GENERAL

PART 1 - GENERAL

The Wells Sanitary District has developed these minimum standards for wastewater projects within the District's system. It is understood that every project is different, with individual challenges. As a result, the minimum requirements provided herein are general standards and may be modified in-whole, or on a project-by-project basis, by the Superintendent of the Wells Sanitary District.

This document has been developed assuming the Contractor will have a contract with a private Developer (also referred to within the specifications as the Owner). The standards, corrections, necessary modifications (as determined by the District), etc., required by this document should be considered part of the project and should in no way reflect a financial commitment by the District and should come at no cost to the District. If this document is to be used for a District funded project, then additional language will be required to outline the District's and Contractor's financial responsibilities.

PART 2 - GENERAL REQUIREMENTS

All work performed in the District must comply with Federal, State, Town, and District regulations and permit requirements. The Contractor must also comply with Federal, State, Town, and District insurance requirements.

PART 3 - GENERAL DESIGN GUIDANCE

All work to be constructed in the District shall be designed and stamped by a Professional Engineer, licensed by the State of Maine. In addition, all designs must be submitted to the Wells Sanitary District for review and approval. Costs borne by the District during the review (outside consultation, etc.) will be paid by the District for public projects, or by the Developer for private projects.

In addition to the generally accepted standard design practices; the District will require the following:

- Pumps stations, other than individual residence pump stations, will be provided with radio communications to the District's Waste Water Treatment Facility. This work will include all required path studies, equipment and appurtenances, modifications to the District's existing electrical instrumentation and SCADA systems, and all startup and commissioning requirements. This work will be performed by a District selected Supplier, which will charge the District for the work. The District will then charge the Developer for the work, at cost. The District will provide the Developer with a written

cost estimate for this work prior to the start of construction. The Contractor will be responsible for coordinating their work with the District selected Supplier.

- Pumps stations, other than individual residence pump stations, will be duplex pump stations.
- The following table is provided as general guidance for pump station type selection. Ultimate pump station type selection must approved by the District's Superintendent.

Flow Range	Pump Stations	Specification Number
75gpm - 500gpm	Above Ground Self Priming Centrifugal Pump Station	11307
>500gpm	Custom Designed/Built Pump Station	N/A

PART 4 - DISTRICT INSPECTION REQUIREMENTS

Any wastewater system built within the District's system, whether public or private, will be sending flow to the District's Wastewater Treatment Facility. As a result, the District will provide an inspector to make sure wastewater projects are built to these standards. The costs for inspection services will be borne by the District for public projects, or by the Developer for private projects. On private projects, this inspector will be representing the District's interests alone, which may or may not coincide with the Developers.

The Contractors should expect to participate in a pre-construction meeting, and periodic meetings throughout the work as determined by the District.

PART 5 - DISTRICT WARRANTY REQUIREMENTS

If the project will remain private after its completion:

A. Provide the District with a copy of a signed letter from the Contractor to the Developer that provides a general Guarantee/ Warranty for the entire project for one year from the date of project completion.
B. Provide the District a copy of all specified extended warranties with a term longer than one year. Extended warranties shall meet the requirements specified in the relevant Section.
C. The Developer/Contractor is responsible for warranty problems during the first one year warrantee period.
D. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warranted accordingly.
E. Any part of a mechanical equipment system that shows undue or excessive wear, or that fails due to normal operational conditions during the general one year warranty shall be considered as evidence of defective material or defective workmanship, and it shall be replaced by the Contractor with equipment or parts to meet the specified requirements.

PART 6 - DISTRICT RESPONSIBILITY OF EQUIPMENT

The District is not obligated to accept ownership of the installed equipment specified herein on the date of startup or on any date following startup. If the District deems the equipment to have been satisfactory installed and meets the operation and requirements, the District will assume responsibility of said equipment, upon its completion and expiration of the Warranty period.

A. The Developer/Contractor shall provide the District with a Guarantee/ Warranty for the entire project for one year from the date of project completion (as determined by the District).
B. The Contractor will be required to handle warranty problems during the general one year warranty. Extended warranties shall meet the requirements specified in the relevant Section.
C. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warranted accordingly.
D. Provide the Self Priming Centrifugal Pump Station Warrantee to the District. It shall be in the name of the Wells Sanitary District for acceptance of Ownership of equipment.
E. Provide the Standby Power System Warrantee to the District. It shall be in the name of the Wells Sanitary District for acceptance of Ownership of equipment.
F. Any part of a mechanical equipment system that shows undue or excessive wear, or that fails due to normal operational conditions during the general one year warranty shall be considered as evidence of defective material or defective workmanship, and it shall be replaced with equipment or parts to meet the specified requirements at no cost to the District.

SECTION 01010

DESCRIPTION OF THE WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Submit complete plans and specifications of all proposed sewer extensions and pumping stations to the Wells Sanitary District for review and approval prior to the commencement of any work. Plans and specifications shall be prepared by a professional engineer licensed by the State of Maine.
2. References to District shall mean the District or its designated agent.

1.2 QUALITY ASSURANCE

A. General:

1. Developer shall be responsible for obtaining all other regulatory body approvals, such as zoning and planning boards, state review authorities and all other pertinent agencies.
2. Developer shall pay for any reasonable fees for work performed by professionals retained by the Wells Sanitary District for the sole purpose of reviewing the technical merits of the proposed project.
3. Developer shall guarantee all work to be free of defects for a period of one year after Substantial Completion, as determined by the District.

PART 2 - PRODUCTS

2.1 Only those materials specifically approved by the Wells Sanitary District shall be incorporated into the work.

2.2 All materials shall meet the requirements of all applicable codes and regulations.

PART 3 - EXECUTION

3.1 All work shall be performed in accordance with the requirements of OSHA and all other regulatory agencies.

3.2 All work shall be performed in accordance with these specifications and in a professional manner

3.3 Contractor shall not prevent continuous operation of existing sewerage works. For any work requiring disruption of existing sewerage works, the Contractor shall provide temporary facilities to convey influent or bypassed sewerage flows in a manner acceptable to the District and without interruption of services to District customers. Temporary

disruptions of services are permitted only at the discretion of and with the prior approval of the District.

3.4 Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the District and its agents, which shall provide for the construction and putting into service of the new works in the most orderly manner possible.

END OF SECTION

SECTION 01050

COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is required to work in close proximity to District's existing facilities and private easements. The Contractor will be responsible for coordinating construction activities with the District and property owners to ensure that services, facilities, and safe working conditions are maintained.

B. Other Construction Contractors may be interfacing with this Contract and working within the work area and in the vicinity of this Contract. The Contractor shall coordinate construction activities with other Contractors working in the vicinity.

C. Any damage to existing structures, equipment and property, accepted equipment or structures, and property or work in progress by others; as a result of the Contractor's or his subcontractor's operations shall be made good by the Contractor at his own expense.

1.2 COORDINATION WITH OTHERS:

A. Town of Wells:
Contractor shall coordinate access, egress, detours and traffic control, if required, with the Town of Wells. The Contractor shall notify all applicable Town Departments at least 24 hours in advance of any proposed street closings or detours.

B. Maine Department of Transportation (MDOT)
The Contractor shall be responsible for obtaining all opening and utility location permits. The Contractor shall be responsible for coordinating access, egress, detours, and traffic control on all State Highways with the MDOT Division office.

C. Central Maine Power Company (CMP)
The Contractor shall be responsible for coordinating all work in and around CMP facilities with CMP and bear all costs of CMP inspection requirements, temporary facilities relocation and all other requirements.

D. Wells Sanitary District:
The Contractor shall be responsible for coordinating all work around Wells Sanitary District facilities with the Wells Sanitary District and shall bear all costs of Wells Sanitary District inspection requirements, temporary facilities and all other requirements.

E. Fairpoint Communication:
The Contractor shall be responsible for coordinating all work around Fairpoint Communication facilities with Fairpoint Communication and shall bear all costs of Fairpoint Communication inspection requirements, temporary facilities and all other requirements.

END OF SECTION

SECTION 01070

ABBREVIATIONS & SYMBOLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Where any of the following abbreviations are used in these Specifications, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
AGA	American Gas Association
AIC	Ampere Interrupting Capacity
AGMA	American Gear Manufacturers Association
AIEE(IEEE)	American Institute of Electrical Engineers (Institute of Electrical and Electronics Engineers, Inc.)
AISC	American Institute of Steel Construction
amp	Ampere
125-16	
Amer. Std.	American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 125 (ASA Bl6 ll960)
ANSI	American National Standards Institute
API	American Petroleum Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating& Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American or Brown and Sharpe Wire Gage
AWWA	American Water Works Association
BOD	Biochemical Oxygen Demand
c.f.	Cubic Foot
c.f.m.	Cubic Foot Per Minute
c.f.s.	Cubic Foot Per Second
CI	Cast Iron
CIPRA	Cast Iron Pipe Research Association
CSI	Construction Specifications Institute
c.y.	Cubic Yards
DC	Direct Current
DEP	Department of Environmental Protection
DI	Ductile Iron
DOT	Department of Transportation
EDR	Equivalent Directional Radiation

EPA	U.S. Environmental Protection Agency
fps	Feet Per Second
ft.	Feet
gal.	Gallons
gpd	Gallons Per Day
gpm	Gallons Per Minute
HP	Horsepower
IBR	Institute of Boiler and Radiator Manufacturers
in.	Inches
inter.	Interlock
ISA	Instrument Society of America
kva	Kilovolt-ampere
kw	Kilowatt
lb.	Pound
max.	Maximum
MCB	Master Car Builders
MGD	Million Gallons Per Day
Min.	Minimum
NBS	National Bureau of Standards
NEC	National Electrical Code, Latest Edition
NEMA	National Electrical Manufacturers Association
NEWWA	New England Water Works Association
NPT	National Pipe Thread
OS&Y	Outside Screw and Yoke
PCA	Portland Cement Association
ppm	Parts Per Million
%	Percent
psi	Pounds Per Square Inch
psig	Pounds Per Square Inch Gage
PVC	Polyvinyl Chloride
rpm	Revolutions Per Minute
RUS	Rural Utility Service
s.f.	Square Foot
STL. W.G.	U.S. Steel Wire, Washburn and Moen, American Steel and Wire Cos., or Roebling Gage
s.y.	Square yard
TDH	Total Dynamic Head
USAS	Standards of the United States of America Standards Institute (formerly American Standards Association)
USS GAGE	United States Standard Gage
VC	Vitrified Clay
WSP	Working Steam Pressure
Fed. Spec.	Federal Specifications issued by the Federal Supply Service of the General Service Administration, Washington, D.C.

END OF SECTION

SECTION 01340

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Submittals to the District as required by the Specification Sections.

B. Related Work specified elsewhere:
   1. 01720 - Project Record Documents.

1.2 SHOP DRAWINGS

A. Shop Drawings are required for each and every element of the work. Each shop drawing shall be assigned a sequential number for the purposes of identification (i.e. 01, 02, etc), and shall retain its assigned number, with appropriate subscript (i.e. 01A, 01B, etc), on required resubmissions.

B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, his subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof. Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.

C. The Contractor shall submit to the District a minimum of three (3) copies of Shop Drawings and approved data. The District will retain two (2) copies (for District's and Field Representative's files) and return one (1) copy to the Contractor for distribution to subcontractors, suppliers and manufacturers. If the Contractor requires more than one copy then the number of copies submitted shall be adjusted accordingly.

D. The Contractor shall provide a copy of the completed Submittal Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every copy of each shop drawing.

E. Shop Drawings shall be submitted as a complete package by specification section, unless otherwise reviewed and approved by the District. It is the intent that all information, materials and samples associated with each specification section be included as a single submittal for the District's review.

F. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.

G. No material or equipment shall be purchased or fabricated until the required shop and working drawings have been approved by the District.

H. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal. If specific mention of deviations is not made, the Contractor will be responsible for replacing/modifying the work to make it comply with these specifications regardless if the District approved the shop drawing.

I. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.

J. The District's costs to review the shop drawings (including costs of any consulting) will be charged to the Developer.

1.3 SAMPLES

A. The Contractor shall submit samples when requested by the District to establish conformance with the specifications, and as necessary to define color selections available.

1.4 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall furnish the District two (2) copies of a complete instruction manual for installation, operation and maintenance of each item specified at least 3 months prior to the completion of the work.

B. Manuals shall include operating and maintenance information on all systems and pieces of equipment. The manual shall contain sufficient data to install, operate, maintain and repair all components of the equipment, design data specific to the project. All information required by the Operations and Maintenance Manual Certification Form described herein and any additional information deemed necessary by the District for proper installation, operation and maintenance.

C. The Contractor shall provide a copy of the complete Operations and Maintenance Manual Certification Form (copy provided for the Contractor's use at the end of this Specification Section) which shall be attached to every copy of each Operations and Maintenance Manual submitted.

1.5 MANUFACTURER'S CERTIFICATES

A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.

B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction.

1.6 SUBMISSION REQUIREMENTS

A. Accompany submittals with transmittal letter, containing:
   1. Date.

2. Project title and number.
3. Contractor's name and address.
4. The number of each Shop Drawing, Project Data and Sample submitted.
5. Notification of deviations from Contract Documents.
6. Other pertinent data.

B. A completed Submittal Certification Form shall be attached to each copy of each shop drawing and must include:
   1. Identification of deviations from Contract Documents.
   2. Contractor's stamp, initialed or signed, certifying review of the submittal, verification of field measurements and compliance with Contract Documents.
   3. Where specified or when requested by the District, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
   4. Where specified, manufacturer's guarantee.

1.7 RESUBMISSION REQUIREMENTS

A. Revise initial drawings as required and resubmit as specified for initial submittal.
B. Indicate on drawings any changes which have been made other than those required by District.

1.8 DISTRICT'S REVIEW

A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.

SUBMITTAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ DISTRICT'S PROJ. NO: _____

TRANSMITTAL NUMBER: _____ SHOP DRAWING NUMBER:_____

SPECIFICATION SECTION OR DRAWING NO: _____

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

☐ NO DEVIATIONS

or

☐ A COMPLETE LIST OF DEVIATIONS AS FOLLOWS[a]:

_____
_____
_____
_____
_____

By:_____ By:_____

Contractor[b] Manufacturer[c]

Date: _____ Date: _____

[a] Any deviations not brought to the attention of the District for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.

[b] Required on all submittals

[c] When required by specifications

General Contractor's Stamp

OPERATIONS AND MAINTENANCE MANUAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ DISTRICT'S PROJ. NO: _____

TRANSMITTAL NUMBER: _____ SHOP DRAWING NUMBER:_____

SPECIFICATION SECTION OR DRAWING NO: _____

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced operations and maintenance manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, is suitable for mounting in a 3-ring binder, and contains the following items:

- ☐ Table of Contents
- ☐ Maintenance Schedule and Summary
- ☐ Lubrication Schedule
- ☐ Troubleshooting Information
- ☐ Warranty Information
- ☐ Startup, Operation, Shutdown Procedures
- ☐ Safety Procedures
- ☐ Shop Drawings corrected to As-Built conditions
- ☐ Project-Related Design Data
- ☐ Wiring Diagrams
- ☐ Equipment Layout Drawings & Schematics
- ☐ Equipment Performance Curves
- ☐ Parts and Service Contact Information
- ☐ Manufacturer Contact Information
- ☐ Emergency Operations Plan
- ☐ List of part numbers for all components
- ☐ List of spare parts supplied and cost

By:_____ By:_____

Contractor[a] Manufacturer[b]

Date: _____ Date: _____

[a] Contact information shall include name, address and telephone number.
[b] Required on all Operation and Maintenance Manuals.
[c] When required by Specifications.

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General Contractor's Stamp

END OF SECTION

SECTION 01380

PRE-CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Contractor shall utilize still photographs and/or video tapes to obtain a visual record of the project area, a copy of same shall be given to the District.
2. Notify the District at least three (3) working days prior to photographing or videotaping the project area so the District may, at his option, observe.

1.2 QUALITY

A. Quality shall be such that the condition of existing pavement, curbing, driveway entrances, sidewalks, etc. can be readily determined.

1.3 SUBMITTAL OF PRINTS

A. Submit electronic files on CD ROM and/or video tapes to the District prior to any construction work.

B. The quality of the photos and video tapes are subject to approval by the District prior to the start of construction work in the areas shown by the photos.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. General Quality Control.
B. Workmanship.
C. Manufacturer's Instructions.
D. Manufacturer's Certificates.
E. Manufacturer's Field Services.
F. Testing Laboratory Services.

1.2 RELATED REQUIREMENTS

A. Section 01340 - Submittals
B. Section 02200 - Earthwork

1.3 QUALITY CONTROL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
B. Perform work by persons qualified to produce workmanship of specified quality.
C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with these specifications, request clarification from District before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

A. When required by individual Specifications Section, submit manufacturer's certificate that products meet or exceed specified requirements.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.

B. Representative shall submit written report to District listing observations and recommendations.

1.8 TESTING LABORATORY SERVICES

A. The Developer/Contractor will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services wherever an Independent Testing Laboratory is required by the District.

B. Services will be performed in accordance with requirements of governing authorities and with specified standards.

C. Reports will present observations and test results and indicate compliance or non-compliance with specified standards and with Contract Documents. Independent Testing Laboratory will submit one copy of each report directly to each of the following: District and Contractor. Reports will be mailed within 5 days of obtaining test results. If test results indicate deficiencies, Independent Testing Laboratory shall telephone or FAX results to District, Resident Project Representative and Contractor within 24 hours.

D. Contractor shall cooperate with Independent Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.

E. Contractor shall coordinate all testing work and shall notify District and Independent Testing Laboratory at least 24 hours prior to performing work requiring testing services.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Developer will provide and pay for all temporary applicable utilities required to properly perform the Work including the placement and removal of the utilities.
2. Completely remove all temporary equipment and materials upon completion of the Work and repair all damage caused by the installation of temporary utilities.
3. 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.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

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.
3. Comply with the latest National Electrical Code.
4. Comply with all local, State and Federal codes, laws, and regulations.

B. All temporary utilities are subject to the approval of the District.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Electrical:

1. Provide all required facilities, including but not limited to, transformers, conductors, poles, conduits, raceways, fuses, switches, fixtures, and lamps.
2. Use new or used materials adequate in capacity for the purposes intended.
3. Materials must not create unsafe conditions or violate the requirements of applicable codes.
4. Conductors:
   a. Wire, cable or busses of appropriate type, sized in accordance with the latest National Electrical Code for the applied loads.
   b. Use only UL approved wire.
5. Conduit:
   a. Rigid steel, galvanized: ANSI C80.1.
   b. Electrical metallic tubing: ANSI C80.3.
   c. Other material approved by NEC.

6. Equipment: Provide appropriate enclosures for the environment in which used in compliance with NEMA Standards.

B. Heating:
   1. When heat is required for the protection of the work, provide and install a non-hazardous type of heating apparatus, and provide adequate and proper fuel.
   2. Heating equipment and materials in proper condition.

C. Water:
   1. Provide drinking water equipment and material that will prevent contamination and health hazards.

D. Sanitary Accommodations:
   1. Shall comply with all local, State and Federal codes, laws and regulations.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Electrical:
   1. Provide electrical energy to:
      a. All necessary points on the construction site so that power can be obtained at any desired point with extension cords no longer than 100 feet.
      b. Construction site offices.
      c. Lighting as required for safe working conditions at any location on the construction site.
      d. Night security light.
      e. When applicable, Owner's present facilities during the change-over of electrical equipment.
   2. Maintain electrical energy throughout the entire construction period.
   3. Capacity:
      a. Provide and maintain adequate electrical service for construction use by all trades during the construction period at the locations necessary.
   4. Installation:
      a. Install all work with a neat and orderly appearance.
      b. Have all installations performed by a qualified electrician.
      c. Modify service as job progress requires.
      d. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, traffic areas and other work.

B. Heating:
   1. Maintain a heated environment for the work at the temperature and for the length of time specified or as directed by the District.
   2. Precaution:
      a. Operate temporary heating apparatus in such a manner that finished work will not be damaged.
      b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the District.

C. Water:
   1. Provide and maintain water for drinking and construction purposes as required for the proper execution of the Work.

D. Sanitary Accommodations:
   1. Provide and maintain sanitary accommodations for the use of the employees of the Contractor, subcontractors, and District personnel.
   2. Sanitary accommodations shall meet the requirements of all local, State and Federal health codes, laws and regulations.

END OF SECTION

SECTION 01546

USE OF EXPLOSIVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide all materials and perform all work necessary to ensure safe use and storage of explosives.
   2. Contractor shall be responsible for any and all damage resulting from use of explosives.
   3. Perform a pre-blast survey of all structures in the proximity of the blasting area to determine pre-blast conditions.
   4. Perform monitoring, documentation and record keeping during blasting.

1.2 QUALITY ASSURANCE

A. Requirements of regulatory agencies: Conduct all blasting in accordance with all applicable local and state laws, ordinances and code requirements.

B. Qualifications: The Subcontractor utilized for the blasting operations shall be licensed specialty drilling and blasting contractor with 5-years experience. The Contractor shall submit qualifications and references of the proposed Subcontractor for review and no exceptions shall be taken by the District. All blasting operations completed on this project shall be performed by a single firm.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Explosive charges and detonation devices shall be of a type suitable for the intended use.

B. Store all explosives in a secure manner, in compliance with all State and local laws and ordinances, and legibly mark all such storage places. Storage shall be limited to such quantity as may be needed for the work underway.

PART 3 - EXECUTION

3.1 PERFORMANCE - GENERAL

A. Designate as a BLASTING AREA all sites where electric blasting caps are located and where explosive charges are being placed.

B. Mark all blasting areas with signs as required by law.

C. Place signs, as required by law, at each end of the blasting area and leave in place while the above conditions prevail. Immediately remove signs after blasting operations or the storage of caps is over.

D. Perform a pre-blast survey of structures in the proximity of the blasting area to determine pre-blast conditions. The Contractor shall employ the services of an independent firm to conduct the a pre-blast survey of the condition of adjacent structures. The pre-blast survey shall include a video and photographic record of the interior and exterior of all structures within a 500-foot radius of the work area. The Contractor shall provide the District with 72-hours written notice prior to the initiation of the pre-blast survey. The pre-blast survey records shall be made available to the District upon request.

E. Notify each property owner and public utility company having structures within a 500-foot radius of the site of the work sufficiently in advance to enable the owners and companies to take such steps as they may deem necessary to protect their property. Notice shall be published in a local paper no more than 30 days nor less than 10 days prior to the initiation of the blasting. Notice shall be given to property owners within the 500-foot radius at least 10 days prior to blasting that pre-blast surveys are available. Such notice shall not relieve the Contractor of any of his responsibility for damage resulting from his blasting operation.

F. Warn all persons within the danger zone of blasting operations and do not perform blasting work until the area is cleared. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians.

G. Provide watchmen during the loading period and until charges have been exploded.

H. Provide adequate protective covering over all charges prior to explosion.

I. Prepare and submit a blasting plan prior to the commencement of the blasting operations. The blasting plan shall include proposed sketches of the location of each blast, drill patterns, delay periods, and decking. The plan should also indicate the type and amount of explosives to be used, including weight of explosives per delay, stemming, critical dimensions and the location and general description of structures to be protected.

J. Control blasting by limiting the charge weight per delay to that which produces limited levels of ground vibrations as herein specified. The Contractor shall hire a qualified testing agency to measure particle velocities and frequencies using seismograph. Peak particle velocity and frequency shall be the measures of the level of vibration. Vibration monitoring shall be performed at all structures within 100-feet of the blast.

K. Drilling and blasting operations are limited to the hours from 7am to 5pm and shall be limited to Monday through Saturday.

3.2 PERFORMANCE - CONTROLLED BLASTING AREAS

A. Blasting in "Controlled Blasting" areas shall meet all of the criteria identified above in addition to the additional criteria identified below. Controlled blasting shall be performed in areas where residences or businesses are within 100-feet of the blast area or as shown on the Drawings or specified herein.

B. Controlled blasting shall consist of more closely spaced holes with lesser amount of explosives to reduce rock overbreak and vibration.

3.3 DOCUMENTATION AND RECORD KEEPING

A. Prepare and maintain copies of all blasting logs which shall include, but not be limited to, the following information:
   1. Date, time and location of blast.
   2. Diagram of blast pattern showing the number of holes with delay number and charge by weight per hole.
   3. Blast evaluations.
   4. Weather and cloud conditions.

B. Prepare and maintain vibration measurement records which shall include, but not be limited to, the following information:
   1. Identification of instrument.
   2. Name of instrument operator.
   3. Structure at which the geophone is located.
   4. Distance and direction of geophone from blast site.
   5. Date and time of reading.
   6. Type of ground at recording station.
   7. Peak particle velocity and frequency for all components as well as resultant.
   8. Copies of seismograph readings.

C. Blast logs and vibration measurement records shall be made available to Owner and/ or Engineer upon request.

END OF SECTION

SECTION 01562

DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTIONS

A. Work Included:

1. Furnish and apply water or calcium chloride on the road surfaces within the construction site, when required to control dust and when directed by the District.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water for Sprinkling:

1. Clean, free of salt, oil, and other injurious matter.

B. Calcium Chloride:

1. Meet the requirements of AASHTO M144.

PART 3 - EXECUTION

3.1 APPLICATION

A. Water:

1. Apply water by methods approved by the District.
2. Use approved equipment including a tank with gauge equipped pump and spray bar.

B. Calcium Chloride:

1. Apply at a rate sufficient to maintain a damp surface but low enough to assure non-contamination of water courses.
2. Apply water prior to calcium chloride addition.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide all materials and perform all work necessary to completely regulate traffic in the area of Work.
   2. Perform all work in such a manner as to provide safe passage at all times for the public and with a minimum of obstruction to traffic.
   3. Do not close roads or streets to passage of the public without the permission of the proper authorities.

B. The local police department and/or the Maine Department of Transportation will decide if safe passage is being maintained and shall have the authority to require the Contractor to take any additional steps necessary to maintain safe passage. If MDOT furnishes an inspector on the job as a result of poor traffic control by the Contractor, the Contractor shall be responsible for all costs assessed by MDOT (State Highways).

1.2 SCHEDULING WORK

A. Schedule all work so that two adjacent parallel streets are not closed to passage by the public at any one time, if at all possible.

B. Revise the plan of work if it will create a traffic hazard or an unreasonably long detour.

C. Do not start work in any new location without the permission of the District.

D. Notify all police and fire departments of all scheduled detours and when streets are reopened.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND BARRICADES

A. Provide adequate warning signs, barricades, signal lights, watchmen and take other necessary precautions for the safety of the public.

B. Provide and illuminate suitable warning signs to show where construction, barricades or detours exist.

C. Provide barricades of substantial construction and painted with a finish that increases visibility at night.

D. Keep signal lights illuminated at all barricades and obstructions from sunset to sunrise.

E. Maintain all necessary signs, barricades, lights, watchmen and other safety precautions during authorized suspension of the Work, weekends, holidays or other times when the Work is not in progress.

F. Traffic control signs for construction work shall be located and of the size and type as outlined in Manual on Uniform Traffic Control Devices for Streets and Highways as published by U. S. Department of Transportation.

2.2 UNIFORMED POLICE OFFICER

A. A uniformed police officer is a police officer (local, county or state) on regular or special duty dressed in uniform with the necessary high visibility vest and apparel needed for traffic control.

B. Arrange the police detail with the Town of Wells Chief of Police.

2.3 FLAG PERSON

A. A flag person is an individual assigned specifically to the task of directing traffic and is outfitted in the necessary high visibility vest and apparel needed for traffic control.

PART 3 - EXECUTION

3.1 DETOURS

A. Provide, identify and maintain suitable detours when the project, or any part thereof, is closed to public travel.

B. When the closed part of the project is reopened, restore the detour area and any other disturbed areas to the original condition.

3.2 INCONVENIENCE TO RESIDENTS OF VICINITY

A. Whenever a traveled way is closed, perform the Work in such a manner that local travel and residents in the vicinity of the Work will be inconvenienced as little as possible.

B. Allow access to residents and abutting land owners along the project to driveways and other normal outlets from their property.

3.3 TRAFFIC CONTROL OFFICERS

A. Where required by the local, county or state police departments and/or when specified, traffic control officer shall be Uniformed Police Officers.

B. Where the local, county or state police departments do not wish to or are unable to furnish traffic control officers and/or when specified, the traffic control officers shall be flag person.

END OF SECTION

SECTION 01710

PROJECT CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
2. At completion of work, remove waste materials, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces. Leave project clean and ready for use.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conduct cleaning and disposal operations in accordance with all applicable local and state laws, ordinances, and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Cleaning During Construction:

1. Execute cleaning operations to ensure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
2. Entirely remove and dispose of material or debris during the progress of the work that has washed into or has been placed in watercourses, ditches, gutters, drains, catch basins, or elsewhere as a result of the Contractor's operations.
3. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
4. At reasonable intervals during the progress of work, clean the site and dispose of waste materials, debris, and rubbish.
5. Clean interiors of buildings, when applicable, prior to finish painting, and continue to clean on an as-needed basis until buildings are ready for occupancy.
6. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw material from heights.

7. When applicable, schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.

B. Control of Hazards:
   1. Store volatile wastes in covered metal containers, and remove from premises daily.
   2. Prevent accumulation of wastes which may create hazardous conditions.
   3. Provide adequate ventilation during use of volatile or noxious substances.

C. Disposal:
   1. Do not burn or bury rubbish and waste materials on project site.
   2. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
   3. Do not dispose of wastes into streams or waterways.

D. Final Cleaning:
   1. Employ experienced workmen, or professional cleaners, for final cleaning.
   2. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from all sight-exposed interior and exterior finished surfaces.
   3. Repair, patch and touch up marred surfaces to specified finishes.
   4. Broom clean paved surfaces.
   5. Rake clean non-paved surfaces of the project site.
   6. Restore to their original condition those portions of the site not designated for alterations by the Drawings and Specifications.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART l - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Keep accurate record documents for all additions, substitutions of material, variations in work, and any other additions or revisions to the Contract.

B. Related Work Specified Elsewhere:
   1. Section 01340, Submittals.

C. At the completion of the project deliver record documents to the District for review.

1.2 MAINTENANCE OF DOCUMENTS

A. Maintain at job site, one copy of:
   l. Contract Drawings
   2. Specifications
   3. Addenda
   4. Reviewed Shop Drawings
   5. Change Orders
   6. Any other modifications to the Contract
   7. Field Test Reports
   8. Dated photo records of:
      a. Difficult construction installations
      b. River crossings
      c. Utility crossings
      d. Infrastructure installed within 3 feet of existing buildings

B. Maintain documents in clean, dry, legible condition.

C. Do not use record documents for construction purposes.

D. Make documents available at all times for inspection by the District, and by the end of the project, transmit these documents to the District.

1.3 RECORDING

A. Label each document "PROJECT RECORD" in large high printed letters.

B. Keep record documents current and do not permanently conceal any work until required information has been recorded.

C. General Field Recording Issues:
   1. All ties should be taken from existing, permanent features such as utility poles, corners of houses and hydrants. Porches, sheds or other house additions should be avoided for they could be torn down. A minimum of two ties should be taken.
   2. Stations should be recorded to the nearest foot.

3. Inverts should be recorded to the nearest hundredth of a foot.
4. Elevations should be recorded to the nearest hundredth of a foot.
5. Building dimensions should be recorded to the nearest 1/4".

D. Project Record Drawings - Legibly mark Contract Drawings to record existing utilities and actual construction of all work, including but not limited to the following (where applicable):

1. Existing Utilities

   Water mains and services, water main gate valves, sewer mains and services, storm drains, culverts, steam lines, gas lines, tanks and other existing utilities encountered during construction must be accurately located and shown on the Drawings. In congested areas supplemental drawings or enlargements may be required.

   a. Show any existing utilities encountered in plan and profile and properly labeled showing size, material and type of utility. Ties should be shown on plan. Utility should be drawn to scale in section (horizontally and vertically) and an elevation should be called out to the nearest hundredth of a foot.
   b. When existing utility lines are broken and repaired, ties should be taken to these locations.
   c. If existing water lines are replaced or relocated, document the area involved and pipe materials, size, etc. in a note, and with ties.

2. Manholes, Catch Basins, Valve Pits and other structures.
   a. Renumber structure stationing to reflect changes.
   b. Show ties to center of structure covers or hatches.
   c. In general, show inverts at center of structures. However, for manholes with drop structures, or steep channels (greater than 0.2' change on slope), show inverts at face of manhole.
   d. Show inverts for other structures at the face of the structure.
   e. Draw any new structures that are added on plan and profile.
   f. Show any field or office redesigns.
   g. Redraw plan if the structure's location is moved more than 5 feet in any direction. [Note: It is important to show existing utilities, as outlined in Paragraph 1 above, especially if they were one reason for relocating the sewer, manholes and other structures.]
   h. Redraw profile if inverts changed by more than 6 inches.

3. Gravity Sewer Line
   a. Change sewer line slopes indicated on Drawings if inverts are changed.
   b. Draw any new gravity lines that are added on plan and profile.
   c. Show any field or office redesigns.
   d. Redraw the sewer line profile if manhole inverts are redrawn.
   e. Redraw the sewer line on plan corresponding to relocated manholes.

4. Water Mains and Force Mains
   a. Show ties to the location of all valves, bends (horizontal and vertical), tees and other fittings. The use of thrust blocks should be recorded.

b. Revise elevations indicated on the Drawings to reflect actual construction.

5. House Services
   a. Draw all house services (even to empty lots) on plan, and show ties.
   b. Show ties or distances to wyes from manhole.
   c. Show chimneys heights in the profile.
   d. "Sanitary Sewer Service Location" forms shall be used to record sewer service information. A copy of these forms should be provided to the District, along with the Record Drawing Set.
6. Septic Tanks
   a. Show ties to center of tank covers.
   b. Label size of septic tanks that are other than standard 1000 gallon capacity.
   c. "Sanitary Sewer Service Location" forms shall be used to record septic tank information. A copy of these forms should be provided to the District, along with the Record Drawing Set.
7. Ledge
   a. Ledge profiles should be shown. Note whether the plotted ledge profile reflects undisturbed or expanded conditions.
8. Yard Piping and Buried Electrical Conduit
   a. Site piping should be drawn to reflect the installed locations, with ties and elevation of all bends (horizontal and vertical).
   b. Show routing for electrical conduits and pull boxes, especially in close proximity to buildings and when the conduits change direction or cross process piping.
9. Roads
   a. Show centerline road profile and level spot elevations.
   b. Show pavement widths.
   c. On road cross sections, show the pavement cross slope.
   d. Show any deviations from the design plans.
10. Buildings
   a. In general, small changes to structures should not be redrawn. If any dimensional changes were made in the field, the numerical change should be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.
   b. Show finished concrete elevations (top of slab, top of wall, top of footing, etc.). Redraw any foundation, frost wall, etc. that was modified, deepened, or altered during construction.
   c. Adjust finished concrete horizontal dimensions that are shown on the Drawings.
   d. Adjust structural steel elevations and horizontal dimensions that are shown on the Drawings.
   e. Show location of anchors, construction and control joints, and waterstops, when they are different from those shown on Drawings.

f. Any additions or major changes should be shown in both plan and elevation (i.e. relocated doors, opposite door swings, change in wall location, relocation of floor drains).
g. Show approximate location and routing of electrical conduits in walls, slabs and ceilings. Most conduits are run in groups, therefore, use range of measurements to define location for entire section of conduits.
h. Special circuits for computers, alarms and instrumentation should be shown.
i. Show any changes in location and elevation of ductwork and devices, fuel piping and equipment, and heat piping and equipment.
j. Location of gravity sewer system below slabs in buildings should be shown, if changes are made in the configuration.
k. If wall mounted electrical switches, control boxes, thermostats, etc. have been relocated significantly, (other side of door, or to a wall other than indicated diagrammatically on electrical plans) make the revision accordingly.

E. Specifications and Addenda - Legibly mark up each section to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by Change Order, Field Order, or other method.

1.4 SUBMITTALS

A. At the completion of the project, deliver record documents to the District.
B. Accompany submittal with transmittal letter, in duplicate, containing:
1. Date, project title and number.
2. Contractor's name and address.
3. Title and number of each record document with certification that each document is completed and accurate.
4. Signature of Contractor, or his authorized representative.
C. Failure to supply all information on the Project Record Drawings as specified in Part 1.3 may result in the District charging the Developer for all costs associated with the District having to develop proper record drawings.

END OF SECTION

SECTION 02050A

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall furnish all labor, materials, tools, equipment and apparatus necessary and shall do all work required to complete the demolition, removal, and alterations of existing facilities as indicated on the Drawings, as herein specified, and/or as directed by the District.
2. Demolition and alteration work will occur with minimum interference to District operations.
3. All equipment, piping, and other materials that are not to be relocated or to be returned to the District shall become the property of the Contractor and shall be disposed of by him, away from the site of the work and at his own expense.
4. All demolition or removal of existing structures, utilities, equipment, and appurtenances shall be accomplished without damaging the integrity of existing structures, equipment, and appurtenances to remain, to be salvaged for relocation or stored for future use.
5. Such items that are damaged shall be either repaired or replaced at the Contractor's expense to a condition at least equal to that which existed prior to the start of his work.

1.2 JOB CONDITIONS

A. Condition of Structures:

1. The District assumes no responsibility for the actual condition of structures to be demolished.
2. Conditions existing at the time of inspection for bidding purposes will be maintained by the District as far as practicable.

1.3 UTILITIES

A. Utility Locations:

1. Utility locations shown on the plans are approximate only, based on information supplied by the utility companies.

B. Coordination with Utilities:

1. The Contractor shall make all necessary arrangements and perform any necessary work to the satisfaction of affected utility companies and governmental divisions involved with the discontinuance or interruption of affected public utilities and services.

1.4 SUBMITTALS

A. Schedule - Demolition:
   1. Submit two (2) copies of proposed methods and operations of demolition to the District for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required.
   2. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the District's operations.

1.5 PROTECTIONS

A. Ensure the safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Erect temporary, covered passageways as required by authorities having jurisdiction.
B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

1.6 DAMAGES

A. The Contractor shall promptly repair damages caused by demolition operations to adjacent facilities at no cost to the District.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Remove and dispose of non-salvageable material in accordance with all applicable local and state laws, ordinances and code requirements.
B. Dispose of material daily as it accumulates.
C. Carefully remove, store and protect from damage all materials to be salvaged.
D. Buildings and Adjacent Property:
   1. Protect all buildings and property adjacent to equipment to be removed from damage by erecting suitable barriers or by other suitable means.
   2. Leave such buildings in a permanently safe and satisfactory condition.
E. Maintaining Traffic:
   1. Ensure minimum interference with roads, streets, driveways, sidewalks and adjacent facilities.
   2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
F. Architectural, structural, mechanical, process and electrical demolition, removal and alteration are indicated in the corresponding sections.
G. Mechanical/Process Demolition:

1. Mechanical/Process demolition in general shall consist of the dismantling and removal of existing piping, tanks, pumps, motors, equipment and other appurtenances as specified, and indicated on the Drawings.
2. It shall also include, where necessary, the cutting of existing piping for the purpose of making connections thereto.
3. Piping not indicated to be removed but which may interfere with construction shall be removed to the nearest solid support, capped and left in place. Where piping that is to be removed passes through the wall of existing structures, it shall be cut off and properly capped on each side of the wall.
4. When piping is to be altered or removed underground, the remaining piping shall be properly capped or plugged.
5. Abandoned underground piping shall be left in place unless it interferes with new structures or unless otherwise noted on the Drawings.

H. Salvage:
1. Salvaged items shall be stored on site for the District in an acceptable location and manner.

I. Tank Cleaning:
1. The District shall be responsible for removal and disposal of the liquid contents of the existing tanks, which will be renovated as part of this project. The District will clean the walls and floors of existing tanks once after notified of the intent to begin demolition work.
2. If the demolition work does not commence within the Contractor's approved project schedule, the tank(s) may be placed back in operation by the District. It will then be the Contractor's responsibility to drain and clean the tanks. When the existing tank(s) are empty, clean the tank walls and floor using a high pressure steam cleaning device.

J. Maintain Treatment:
1. During demolition, maintain treatment as required by the District.

K. Demolition Sequence:
1. The demolition sequence is to conform with the reviewed and approved project schedule.

L. Pest Control:
1. Provide pest control when needed or when directed by the District.
2. Exterminate and prevent migration of rodents to adjoining buildings in accordance with the requirements of the state or local health department.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Clearing includes, but is not limited to, removal of trees, brush, stumps, wooded growth, grass, shrubs, poles, posts, signs, fences, culverts and other vegetation and minor structures; the protection of designated wooded growth; the storage and protection of minor structures and materials which are to be replaced; and the disposal of nonsalvageable structures and materials, and necessary preliminary grading.
2. Prior to construction, the Contractor and District shall meet with impacted third party property owners to identify which trees/shrubs are to be saved.

B. Limits of Work:

1. Perform clearing and grubbing work within the areas required for construction, or as shown on the Drawings, to a depth of l2 inches below the existing grade.
2. Perform additional clearing and grubbing work within areas and to depths which, in the opinion of the District, interfere with excavation and/or construction, or are otherwise objectionable.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Dispose of combustible material by burning only when permitted by and in accordance with all applicable local and state laws, ordinances and code requirements.

B. Remove and dispose of nonsalvageable structures and material in accordance with all applicable local and state laws, ordinances and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials required to complete the work.

B. All timber and wood shall become the property of the Contractor unless other agreements are made between the District and the Contractor.

C. Repair any damage to structures to the complete satisfaction of the District.

PART 3 - EXECUTION

3.1 PREPARATION

A. Carefully preserve and protect from injury all trees and/or shrubs not to be removed.

B. Right-of-way:
   1. Where excavation is required on public or private rights-of-way containing trees, shrubs, other growth, or any structure or construction, obtain the District's direction concerning the extent to which such obstacles can be cleared or stripped prior to performing the Work.
   2. In all rights-of-way, remove only those particular growths or structures which are, in the opinion of the District, essential for construction operations.
   3. All other removals or damage shall be replaced or restored at the Contractor's expense.

3.2 PERFORMANCE

A. Clearing:
   1. Remove and dispose of all trees, brush, slash, stubs, bushes, shrubs, plants, debris and obstructions within the area to be cleared, except any areas that may be designated as "Selective Clearing", and except as otherwise shown on the Drawings or as directed by the District.
   2. Remove all stumps unless otherwise directed by the District.
   3. Dispose of material to be removed daily as it accumulates.
   4. Take special care to completely dispose of all elm trees and branches immediately after cutting either by burial in approved locations or, when permitted, by burning in areas well removed from standing elm growth.

B. Protection of Wooded Growth:
   1. Fell trees toward the center of the area being cleared to protect trees and shrubs to be left standing.
   2. Cut up, remove and dispose of trees unavoidably falling outside the area to be cleared.
   3. Employ skilled workmen or tree surgeons to trim and repair all trees that are damaged but are to be left standing and paint all cut surfaces with an approved bituminous paint.

C. Selective Clearing:
   1. When shown on the Drawings and when directed by the District, perform selective clearing work to preserve natural tree cover.
   2. Perform selective clearing work only under the direction and supervision of the District.
   3. Remove all dead and uprooted trees, brush, roots and other material which, in the opinion of the District, are objectionable.
   4. Cut flush with the ground and remove only those trees indicated by the District.

5. Employ skilled workmen or tree surgeons to carefully trim all branches requiring cutting on trees to be left standing and to paint all cut surfaces with an approved bituminous paint.
6. Paint tree roots which are cut and are to be left exposed to the weather with an approved bituminous paint.

D. Grubbing:
1. Perform grubbing work beneath new roads, driveways, walks, seeded areas and other areas and as directed by the District.
2. Grub out all sod, vegetation and other objectionable material to a minimum depth of l2 inches below the existing grade.
3. Completely remove all stumps, including major root systems.

E. Disposal:
1. Remove from the site and dispose of material not being burned.
2. Provide an approved disposal area unless otherwise specified.

F. Burning:
1. Dispose of combustible materials by burning, only if approved by local and state officials.
2. Employ competent workmen to perform burning work in such a manner and at such locations that adjacent properties, trees and growth to remain, overhead cables, wires and utilities will not be jeopardized.
3. Do not leave fires unguarded.
4. Do not burn poison oak, poison ivy or other plants of similar nature.
5. Do not use tires or other combustible waste material to augment burning.
6. Burn combustible materials daily as the work progresses.
7. The Contractor shall be responsible for all damage caused by burning and shall be responsible for obtaining all necessary permits for burning.

3.3 REPLACEMENT OF MATERIALS

A. Paving, Curbing and Miscellaneous Material:
1. Remove all paving, subpaving, curbing, gutters, brick, paving block, granite curbing, flagging and minor structures that are over the area to be filled or excavated.
2. Remove and replace bituminous asphaltic and portland cement concrete in accordance with the appropriate sections of these Specifications.
3. Properly store and preserve all material to be replaced in a location approved by the District.

B. Shrubs and Bushes:
1. Remove, store, and replace ornamental shrubs and bushes to be preserved in accordance with accepted horticultural practices.

C. Topsoil:
1. When applicable, carefully remove, store, and protect topsoil in accordance with the appropriate section of this division.

D. Responsibility:
   1. Replace, at no additional cost to the District, materials lost or damaged because of careless removal or neglectful or wasteful storage, disposal or use of these materials.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
   1. Excavation
   2. Backfilling and Filling
   3. Compaction
   4. Embankment Construction
   5. Grading
   6. Providing soil material as necessary
   7. Disposal of excess suitable material and unsuitable materials

B. Related Work Specified Elsewhere: (When Applicable)
   1. The use of explosives is specified in Division 1.
   2. Traffic Regulation is specified in Division 1.
   3. Clearing and Grubbing, Dewatering, Filter Fabric, Temporary Erosion Control, Stripping and Stockpiling of Topsoil, Sheeting, Landscaping, and Paving are specified in the appropriate sections of this Division.
   4. Quality Control is specified in Division 1.
   5. Pipe, fittings and valves are specified in Division 15 or 2.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. All work shall be performed and completed in accordance with all local, state and federal regulations.
   2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits.

B. Line and Grade:
   1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.

C. Testing Methods:
   1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93 (or latest revision).
   2. Compaction Control:
      a) Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated or specified, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using

10-lb. Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor), or latest revision, unless otherwise indicated.

b) The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D 1556-90, (or latest revision) or Nuclear method Designation D2922.

c) Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).

1.3 SUBMITTALS

A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Developer/Contractor.

B. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.

C. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.4 TESTS

The Independent Testing Laboratory shall conform to the following procedures and standards:

A. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the District and Contractor at the District's expense unless otherwise indicated (see Section 01400 - Quality Control).

B. Field density tests on embankment materials shall be as follows:
   1. Tests shall be taken on every 200 cubic yards of embankment material.

C. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.

D. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.

E. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the District.

F. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the District.

G. Additional density testing will be required by the District if the District is not satisfied with the apparent results of the Contractor's compaction operation.
   1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary to obtain the required

compaction. The cost of retesting will be borne by the Contractor and no allowance will be considered for delays in the performance of the work.

1.5 JOB CONDITIONS

A. Existing Utilities and Structures:

1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

A. Aggregate Base: Shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Type B Aggregate for base shall not contain particles of rock that will not pass the 4 inch square mesh sieve. The gradation of the part that passes a 3-inch sieve shall meet the following grading requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves Type B Aggregate
1/2 inch	35-75
1/4 inch	25-60
No. 40	0-25
No. 200	0-5

B. Aggregate Leveling Course and Untreated Surface Course: Shall be screened or crushed gravel consisting of hard durable particles which are free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the material shall meet the grading requirements of the following table:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1 inch	95-100
3/4 inch	90-100
No. 4	40-65
No. 10	10-45
No. 200	0-7

C. Blanket Drain Material: Shall be gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Blanket

drain material shall not contain particles of rock which will not pass the 2-inch square mesh. The gradation of the part that passes a 2-inch sieve shall meet the following grading requirements:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
2 inch	100
1/4 inch	25-70
No. 40	0-30
No. 200	0-5

The blanket drain material shall have a permeability of $5x10^{-3}$ cm/sec. or faster. Permeability supersedes gradation requirements.

D. Common Borrow: Shall consist of approved material required for the construction of the work where designated. Common borrow shall be free from frozen material, perishable rubbish, peat, organic, and other unsuitable material.

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
6-inch	100
No. 200	0-5

Common borrow may be used for embankments unless otherwise indicated and provided that the material is at a moisture content suitable for compaction to the specified density. No rocks shall exceed 3/4 of the depth of the specified lift thickness.

E. Crushed Stone: Shall be a uniform material consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, containing angular pieces, as are those which come from a mechanical crusher. Gradation requirements shall be as follows:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10

F. Screened Stone: Shall be a well graded stone consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

G. Select Fill: Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
4 inch	100
3 inch	90-100
½ inch	25-90
No. 40	0-30
No. 200	0-5

H. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

2.2 CONCRETE

A. If concrete is required for excess excavation, provide 3000 psi concrete complying with requirements of Section 03300.

2.3 FILTER FABRIC

A. If filter fabric is required, refer to Section 02260.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed and notify the District in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 EXCAVATION

A. General:
   1. Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
   2. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all cofferdamming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
   3. All excavation shall be classified as either earth or ledge.
      a) Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders measuring less than one cubic yard.
      b) Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion of the District can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than two cubic yards in total volume shall be considered to be rock unless, in the opinion of the District it must be removed from its existing position by one of the methods mentioned above.

B. Additional Excavation: When excavation has reached required subgrade elevations, notify the District who may choose to observe the conditions.
   1. If material unsuitable for the structure or paved area or pipeline (in the opinion of the District) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crushed stone, or concrete as directed by the District.

C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization. Remedial work required is as follows:
   1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or screened stone compacted to 95%. Provide 12" minimum select fill or screened stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to District.
   2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
   3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by District.

D. Structural Excavation:
   1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.
   2. Excavations for structures shall be carried to the lines and subgrades shown on the Drawings.
   3. Excavate areas large enough to provide suitable room for building the structures.
   4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the District.
   5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation or otherwise injure the work, adjacent structures, or persons and property in accordance with all state and OSHA safety standards.
   6. Erect suitable fences around structure excavation and other dangerous locations created by the work.
   7. Exposed subgrade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas and shape to receive the foundation components of the structure.
      a. 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, and for inspection.

b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.

E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.
1. Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.
4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
5. Unless otherwise specifically directed or permitted by the District, begin excavation at the low end of sewer and storm lines and proceed upgrade.
6. Perform excavation for force mains in a logical sequence.
7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the District.
8. 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, as outlined in the appropriate section of this Specification.

F. Protection of Persons, Property and Utilities:
1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Exercise extreme caution and utilize sheeting, bracing, and whatever other precautionary measures that may be required.
3. Rules and regulations governing the respective utilities shall be observed in execution of all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or

specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the District, the locations of such abandoned utilities. Extreme care shall be taken when performing work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable.

4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the District, to the complete satisfaction of the District, the utility, the property owner, and the District.

G. Use of Explosives:
   1. Refer to Section 01546.

H. Stability of Excavations:
   1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
   2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

I. Shoring and Bracing:
   1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
   2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction.
   3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.

J. Material Storage:
   1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods to control erosion.
   2. Locate and retain soil materials away from edge of excavations.

K. Dewatering:
   1. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged. Refer to Specification Section 02401.

L. Cold Weather Protection:
   1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
   2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.

M. Separation of Surface Material:
   1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.

2. Prior to excavation, existing pavement shall be cut where in the opinion of the District it is necessary to prevent damage to the remaining road surface.
3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.

N. Dust Control:
1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.

3.3 BACKFILL AND FILL

A. General:
1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.
2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.
4. Backfill excavations as promptly as work permits, but not until completion of the following:
   a. Acceptance by District of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   b. Inspection, approval, and recording locations of underground utilities.
   c. Removal of concrete formwork.
   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
   e. Removal of trash and debris.
   f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
   g. Density testing having results meeting requirements specified herein.
5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the District the backfill and fill shall be placed in layers not to exceed 8 inches in thickness.
6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on

the Drawings. The fill and backfill materials shall be placed in layers not exceeding 8 inches in thickness.

7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
8. Suitable excavated material shall meet the following requirements:
   a. Free from large clods, silt lumps or balls of clay.
   b. Free from stones and rock fragments with larger than 12 inch max. dimension.
   c. Free from organics, peat, etc.
   d. Free from frozen material.
9. If sufficient suitable excavated material is not available from the excavations, and where indicated on the Drawings, the backfill material shall be select fill or common borrow, unless otherwise indicated, as required and as directed by the District.
10. Do not backfill with, or on, frozen materials.
11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
12. Do not mechanically or hand compact material that is, in the opinion of the District, too wet.
13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in Compaction section.
15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.
16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.
17. Place material in a manner that will prevent stones and lumps from becoming nested.
18. Completely fill all voids between stones with fine material.
19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.
20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
22. Leave sheeting in place when damage is likely to result from its withdrawal.
23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.

B. Pipe Bedding, Initial Backfill and Trench Backfill

1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.

2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight (8) inches.
4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
5. Provide underground sewer marking tape for the full length of sewer trenches as shown on the Drawings. Marking tape shall be SETON #210 SEW or equivalent.
6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with 6-inches of compacted sand.
7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
8. The following schedule gives the bedding requirements for various types of pipe. Distances refer to vertical thickness below the pipe.

BEDDING REQUIREMENTS

DI, PVC, PE, or Concrete Pipe	6 inches min. screened stone.

9. The following schedule gives the initial backfill requirements for various types of pipes.

INITIAL BACKFILL REQUIREMENTS

DI or Concrete, Pipe	Screened stone or select fill 6 inches min. over top of pipe.
PVC or PE Pipe	6 inches min. screened stone over the top of the pipe.

10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.
11. Where pipes or structures pass through or under the impervious core of the lagoon embankments, bedding and backfill material shall consist of the impervious embankment material. Extra care should be given to properly and thoroughly compact the bedding material around the pipe.

C. Improper Backfill:
1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the District.

2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.

D. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than 1 vertical to 4 horizontal.
2. 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.

3.4 COMPACTION:

A. General:
1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:
1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.
a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).
b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).
c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM D1557).
d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D1557).
e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.
f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).

C. Moisture Control:
1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, in quantities controlled to prevent free water 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 discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.

D. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.
   1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
   2. Tamping or Rolling: If the material is to be compacted by tamping or rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:
   1. Grading shall consist of that work necessary to bring all areas to the final grades.
   2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
   3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:
   1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
   2. Grade surfaces to be free from irregular surface changes, and as follows:
      a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than 1" 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 1/2" 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 3/8" above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs:
1. Grade surface to be smooth and even, free of voids, and compacted as specified, to the required elevation.
2. Provide final grades within a tolerance of 1/2" when tested with a 10' straight edge.

D. Compaction:
1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

E. Protection of Graded Areas:
1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BASE COURSE AND LEVELING COURSE

A. General:
1. Base course consists of placing the specified materials in layers to support a leveling course or paved surface, as indicated in the Drawings.

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

C. Placing:
1. Place base course on prepared subbase conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.
2. Place leveling course on prepared base course, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compaction.

D. Shaping and Compacting:
1. All layers of aggregate base course and leveling course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
2. The Contractor shall bear full responsibility for and make all necessary repairs to the base leveling courses and the subgrade until the full depth of the base leveling courses is placed and compacted.
3. If the top of any layer of the aggregate base or leveling course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material.

END OF SECTION

SECTION 02225

FLOWABLE FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install flowable fill material.

1.2 QUALITY ASSURANCE

A. Perform work in accordance with ACI 229, Controlled Low-Strength Materials, or as specified here-in.

1.3 SUBMITTALS

A. Submit Mix designs for each mixture to be provided at least 15 days prior to production.

1.4 TESTING

A. Flowability: Reference ASTM D 6103

1. A 3 inch diameter by 6 inch long open ended cylinder is placed vertically on a level surface and filled to the top with flowable fill. The cylinder is then lifted vertically to allow the material to flow out onto the level surface. The test is considered passing when the material spread is at least 7 inches in diameter and there is no noticeable segregation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Materials shall meet the following requirements:

1. Portland Cement, Type I or II - ASTM C150.
2. Fly Ash (LOI limits do not apply) - ASTM C618.
3. Fine Aggregate/Mineral Filler – ASTM C 33, ASTM or non-ASTM sands or mineral fillers with 100% passing the 1/2" sieve may be considered which produce an acceptable flow and desired performance characteristic. Soils with fine clays will not be considered. All other than ASTM C 33 materials must receive prior approval from the District.
4. Water – Potable or ASTM C 94.

B. Excavatable Flowable Fill:

1. Compressive strength at 28 days between 100-200 psi.
2. Mix:
   a. Portland Cement: 50-100 lb/yd^3
   b. Fly Ash: up to 350 lb/yd^3, lime content not to exceed 10% by weight.
   c. Fine Aggregate/Mineral Filler: 2000-3000 lb/yd^3
   d. Water: 325-600 lb/yd^3, for Class F fly ash and cement-only mixtures up to 1000 lb/yd^3 may be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flowable fill shall be produced and delivered using standard concrete construction equipment and practices.
B. Placing flowable fill shall be by chute, pumping, or other method approved by the District.
C. The flowable fill shall be discharged directly from the mixer truck into the space to be filled.
D. No flowable fill shall be placed on frozen ground.
E. At the time of placement the flowable fill shall have a temperature of at least 40 degrees F.
F. When flowable fill is placed in freezing temperatures, the material should be covered with blankets and protected from freezing until hardening.
G. The Contractor shall provide all necessary means to confine the material within a designated space.
H. Formed walls or other bulkheads shall be constructed to withstand hydrostatic pressure exerted by flowable fill where necessary and as determined by the District.
I. The Contractor is responsible to ensure underground utilities, including but not limited to pipes, tanks, structures, cables, etc. are secured to prevent floating.
J. No compaction or vibration of the material is required.
K. Where flowable fill is being used as pipe bedding it shall be placed in lifts to ensure lateral support of the pipe develops along the side of the pipe before continuing with the backfilling.
L. When paving over flowable fill in cold weather, any frozen material on the surface shall be scraped off and removed prior to paving.
M. The flowable fill shall be left undisturbed until the material obtains sufficient strength. Sufficient strength for paving is achieved when the flowable fill can support the weight of foot traffic without apparent deformation. Sufficient strength for supporting vehicular traffic is 2.5 tons per square foot as measured by a pocket penetrometer.
N. Trenches shall be covered and barricaded until hardening occurs.

END OF SECTION

SECTION 02260

FILTER FABRIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish all materials and install filter fabric of the types, dimensions and in the location(s) shown on the Drawings and specified herein.

B. Related Work Specified Elsewhere:
   1. Temporary Erosion Control is specified in the appropriate sections of this Division.

1.2 QUALITY ASSURANCE

A. A competent laboratory must be maintained by the manufacturer of the fabric at the point of manufacture to insure quality control.

B. During all periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140^{o}F, mud, dirt, dust and debris.

1.3 SUBMITTALS

A. Manufacturer shall furnish certified test reports with each shipment of material attesting that the fabric meets the requirements of this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Filter fabric for use in stabilization, drainage, underdrains, erosion control, landscaping and beneath structures shall be formed in widths of not less than six (6) feet and shall meet the requirements of Table 1. Both woven and non-woven geotextiles are acceptable; however no "slit-tape" woven fabrics will be permitted for drainage, underdrain, and erosion control applications.

Table 1

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM D4595-86	120 pounds
Grab Elongation	ASTM D4632-86	50 percent

Mullen Burst Strength	ASTM D3786-87	210 psi
Puncture Strength	ASTM D3787	60 pounds
Trapezoid Tear Strength	ASTM D4533-85	50 pounds
Water Flow Rate	ASTM D4491-85	120 gal/min/sf
Equivalent Opening Size (EOS)	ASTM D4751	80
Coefficient of Permeability	ASTM D4491-85	0.2 cm/sec

The geotextile shall have property values expressed in "typical" values that meet or exceed the values stated above as determined by the most recent test methods specified above.

B. Filter fabric for use in reinforcement and under riprap shall meet the requirements of Table 2. Woven and non-woven geotextiles are acceptable.

Table 2

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM 4595-86	195 pounds
Grab Elongation	ASTM D4632-86	20 percent
Mullen Burst Strength	ASTM D3786-87	340 psi
Puncture Strength	ASTM D3787	85 pounds
Trapezoid Tear Strength	ASTM D4533-85	85 pounds
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve number(s) between #20 and #100

The geotextile shall meet or exceed the "typical" values stated above as determined by the most recent test methods specified above.

C. Filter Fabric for use in siltation fencing shall be the following:
   1. Environfence 100X (Mirafi)
   2. Supac 4NP (Phillip 66)
   3. Exxon 180 Siltfence
   4. Amoco 1380 Silt Stop
   5. Harris Siltfence
   6. Or equivalent

PART 3 - EXECUTION

3.1 Install filter fabric as shown on the drawings or as directed in appropriate specifications in this division or in accordance with manufacturer's instructions or as directed by the District.

END OF SECTION

SECTION 02270

TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices, as specified herein, as shown on the Drawings and as directed by the District.
   2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices, or as required to control erosion that occurs during normal construction operations.
   3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.

B. Related Work Specified Elsewhere:
   1. Site work is specified in appropriate sections of this Division.

C. Design Criteria:
   1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
   2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices, as may be necessary, until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

A. The Contractor shall furnish the District, in writing, his Erosion Control Plan, including proposed locations for storage of topsoil and excavated material, before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of his responsibility for completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Baled Hay:
   1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

B. Sand Bags:
   1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:
   1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.

2. Type and use shall be as specified by the "Maine Erosion and Sedimentation Control Handbook for Construction - Best Management Practices" prepared by the Maine DEP and the Soil and Water Conservation Commission herein after referred to as the BMP.

D. Mats and Nettings:
   1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.
   2. Type and use shall be as specified in the BMP.

E. Permanent Seed:
   1. Conservation mix appropriate to the predominant soil conditions as specified in the BMP and subject to approval by the District.

F. Temporary Seeding:
   1. Use species appropriate for soil conditions and season as specified in the BMP and subject to approval by the District.

G. Water:
   1. The Contractor shall provide water and equipment to control dust, as directed by the District.

H. Filter Fabrics:
   1. Filter fabric shall be of one of the commercially available brands such as Mirafi, Typar or equivalent. Fabric types for particular applications shall be approved by the District prior to installation.

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
   2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:
   1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:

Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
Summer (5/15 - 8/15)	Sudangrass	40 lbs/acre
Late Summer/Early Fall (8/15 - 9/15)	Oats	80 lbs/acre
	Annual Ryegrass	40 lbs/acre
Fall (9/15 - 10/1)	Winter Rye	112 lbs/acre
Winter (10/1 - 4/1)	Mulch w/Dormant Seed	80 lbs/acre*
Spring (4/1 - 7/1)	Oats	80 lbs/acre
	Annual Ryegrass	40 lbs/acre

* seed rate only

D. Siltation fences shall consist of porous filter fabric with a wire mesh backing and shall be supported by posts as per manufacturer's recommendations. Fabric shall be approved by the District.

E. Mulch All Areas Receiving Seeding:
Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturer's specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

F. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations. Contractor shall provide matting along the flowline of all ditches and swales having a longitudinal slope in excess of 0.01 ft/ft, and on all slopes in excess of 3(H) to 1(V).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Erosion Checks:
1. Temporary erosion checks shall be constructed in ditches.
2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas, as necessary, to inhibit soil erosion.
3. Siltation fence shall be located and installed as shown on plans or as required to comply with all Federal, State and Local Regulations.
4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

B. Erosion control matting for slopes and ditches shall be installed where indicated on the Drawings and as required to stabilize the soil until permanent vegetative stabilization is established.

C. Maintenance:
Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the District for effectiveness of location, installation and condition with corrective action taken by the Contractor, as appropriate.

D. Removing and Disposing of Materials:
1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of upon approval by District.
2. When removed, such devices may be reused in other locations, provided they are in good condition and suitable to perform the erosion control for which they are intended.

3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.
4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

SECTION 02401

DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, operate and maintain, as incidental to the project, dewatering equipment for the control, collection and disposal of ground and surface water where necessary to complete the work.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. Keep work areas dewatered until the structures, pipes, and appurtenances to be built there have been completed to such an extent that they will not be damaged by water.
2. Thoroughly brace or otherwise protect against flotation all pipelines and structures which are not stable.
3. Maintain standby backup equipment and power supply throughout the duration of the dewatering operation.
4. Prevent soil particles from entering the discharge points.
5. Ground water level shall be maintained at least one foot below the bottom of the excavation.

B. Disposal of Water:

1. Dispose of water pumped or drained from the construction site in a suitable manner to avoid siltation of adjacent drainage structures and piping, wetlands or water bodies, injury to public health, damage to public and private property, and damage to the work completed or in progress.
2. Provide suitable temporary channels for water that may flow along or across the construction site.
3. Provide treatment as necessary to prevent discharge of contaminated ground water caused by Contractor's operations, or any contaminated ground water that may pass through the excavation support system selected by the Contractor.
4. Contractor must obtain all necessary regulatory approvals for the disposal of dewatering flows.

C. Damage:

1. Avoid damage to adjacent buildings, roads, structures, utilities and other facilities.
2. Any damage resulting from the dewatering operations, or the failure of the Contractor to maintain the work in a suitably dry condition shall be repaired by the Contractor at no additional cost.

D. Temporary Underdrains:
1. When necessary, temporary underdrains may be placed in excavations.
2. Underdrain pipe shall be perforated corrugated metal, polyethylene or P.V.C. pipe.
3. Entirely surround the underdrain and fill the space between the underdrain and the pipe or structure with free draining material.

E. Excavation Sump Pumping:
1. When necessary and where appropriate to the geotechnical conditions encountered, excavations may be over excavated 6 to 12 inches and filled with screened stone to allow sump pumping of groundwater.
2. The system shall be installed with suitable screens and filters so that pumping of fines does not occur.

F. Well and Wellpoint System:
1. If necessary, dewater the excavations and trenches with an efficient well or wellpoint system to drain the soil and prevent saturated soil from flowing into the excavated wells and area.
2. Wellpoint and well system shall be of the type designed for dewatering work and shall be installed with suitable screens and filters so that pumping of fines does not occur.
3. Pumping units shall be capable of maintaining sufficient suction to handle large volumes of air and water at the same time.

END OF SECTION

SECTION 02444

CHAIN LINK FENCE AND GATES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all materials and install chain link fence of the types, sizes and in the location(s) shown on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. USS Cyclone.
2. National Fence Mfg. Co., Inc.
3. Anchor Fence, Inc.
4. Or equivalent.

1.3 SUBMITTALS

A. Submit satisfactory guarantees by the fence manufacturer covering any faults and defects in all parts of the fence arising from defective workmanship or materials for a period of one year from the date of installation.

PART 2 - PRODUCTS Wright-Pierce

2.1 FENCE MATERIALS

A. Posts:

1. All posts: Galvanized steel, 35 percent minimum carbon content, 75,000 pounds per square inch minimum tensile strength.
2. Line Posts: 2-3/8 inch O.D. pipe weighing 3.65 pounds per linear foot or 2 inch x 2-l/4 inch H section weighing 4.l0 pounds per linear foot.
3. End, Corner, and Pull Posts: 2-7/8 inch O.D. pipe weighing 5.79 pounds per linear foot.
4. Gate Posts: For single swing gates, or one leaf of double gates:
   a. Up to 6 feet wide: 2-7/8 inch O.D. pipe weighing 5.79 pounds per linear foot.
   b. 6 feet to l3 feet wide: 4 inch O.D. pipe weighing 9.ll pounds per linear foot.
5. Post Tops: Tubular post tops designed to prevent moisture from entering posts and to support top rail.
6. All posts shall be of sufficient length to provide a 36 inch minimum setting in concrete footings, at a depth specified on the plans.

B. Top Rails:

1. l-5/8 inch O.D. galvanized steel pipe weighing 2.27 pounds per linear foot.

2. Provided with galvanized, outside sleeve, self-centering 7 inch long couplings approximately every 20 feet.
3. Top rails shall pass through the post tops and form a continuous brace from end to end of each stretch of fence.
4. Securely fasten top rails to the terminal and corner posts with heavy galvanized steel brace bands and rail end connections.

C. Horizontal Braces:
1. Provide horizontal braces (brace rails) at all pull, corner, and terminal posts midway between top rails and ground and extend to the first adjacent line posts.
2. Securely fasten braces to the line posts by brace ends and brace bands and to pull, corner and terminal posts by rail ends and brace bands.
3. Braces shall be l-5/8 inch O.D. galvanized steel pipe weighing 2.27 pounds per linear foot with plain ends.
4. Brace each corner and pull post on two sides.
5. Brace each terminal post on one side.

D. Diagonal Braces:
1. Provide diagonal braces (truss rods) from the brace ends on the line posts back to the bottom of pull, corner or terminal posts and fastened by brace bands.
2. Diagonal braces shall be 3/8 inch diameter galvanized steel rods.
3. Diagonal braces shall be provided with heavy galvanized iron turnbuckles to adjust the tension.

E. Fence Fabric:
1. Wire: 9 gauge, 0.l48 inch diameter galvanized steel wire, of medium high carbon quality, minimum tensile strength of 80,000 pounds per square inch, interwoven into 2 inch diamond mesh.
2. Fabric: 72 inches wide, selvage shall be knuckled at bottom and twisted and barbed at top.
3. PVC-coated fabric shall meet ASTM F668, Class 2a, 2-inch mesh, 0.120-inch diameter wire. Color: GREEN.

F. Fabric Connections - Securely fasten fabric to:
1. All terminal posts by l/4 inch x l/4 inch galvanized tension bars with ll gauge galvanized pressed steel bands spaced approximately l4 inches apart.
2. All line posts with 6 gauge galvanized wire clips spaced approximately l4 inches apart.
3. All top rails with 9 gauge galvanized tie wires spaced approximately 24 inches apart.
4. The bottom edge of the fabric shall be fastened to a bottom tension wire with wireties spaced approximately 24 inches apart.

2.2 GATE MATERIALS

A. Gate Frames:
1. Fabricate from 2 inch O.D. steel pipe weighing 2.72 pounds per linear foot.

2. All welded construction with malleable iron or pressed steel corner fittings. All welds shall be ground smooth to the surface plane of the base metals. Welding shall be performed prior to galvanizing.
3. Frames shall be rigid enough to be free of twist or sag.
4. Gate leaves shall have truss rods or intermediate braces.

B. Truss Rods:
1. Install 3/8 inch diameter truss rod on each gate.

C. Gate Fabric:
1. Material and Fabrication: Identical to fence fabric.
2. Installation: Securely fasten to gate with tension bars and hook bolts spaced approximately l5 inches apart.

D. Hinges:
1. Bottom Hinges: Ball and socket type designed to carry the weight of the gate.
2. Upper Hinges: Wraparound adjustable type.

E. Locking Devices:
1. Positive type latching device with provision for padlocking.

F. Gate Keeper:
1. Install on centerline of double gates.
2. Gate keeper shall be adjusted with gate keeper rod to prevent opening of gate levers when padlocked.
3. Fabricate from a 1-3/4 inch wide by 1-3/4 inch deep galvanized channelway approximately 7 inches long.
4. Anchor into a l2 inch by 12 inch by 3 feet deep concrete foundation with a 1-1/2 inch O.D. galvanized steel pipe, l8 inches long, welded to the channelway.
5. Slope top edges of channelway from center toward each end.
6. Form concrete foundation to meet tops of channelway sides to prevent its removal.
7. Obtain approval from the District prior to installation of the gate keeper.

G. Outer Gate Catches:
1. Material: Galvanized malleable iron or steel.
2. Designed to anchor securely into l2 inch diameter by 3 feet deep concrete footing.
3. Obtain approval from the District prior to installation of outer gate catches.

2.3 WARNING SIGNS

A. When applicable, provide warning signs.

B. The number of signs, the location, size and wording shall be as shown on the Drawings or as directed by the District.

C. Material:
1. l6 gauge metal with a baked enamel finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Galvanizing:
   1. Hot dip galvanize all fence and gate materials.
   2. Minimum zinc coating shall be 2.0 ounces per square foot of surface.
   3. Galvanize all gate frames after fabrication.

3.2 INSTALLATION

A. Post Spacing:
   1. Equidistant in the fence line.
   2. Maximum spacing l0 feet on centers.

B. Post Setting:
   1. Set all posts plumb with tops aligned.
   2. Set all posts not less than 36 inches deep in concrete footings. Bottom of footings shall be at least 5' below finish grade. Slope top of footing to shed water.

C. Bracing: Brace gate, corner, end and pull posts to the next nearest post with a horizontal brace (compression member) and a diagonal truss rod and truss tightener (tension member).

D. Rails:
   1. Install rails before installing chain link fabric.
   2. Pass top rail through intermediate post caps.
   3. Provide expansion couplings spaced as recommended by manufacturer.

E. Gates:
   1. All gates shall open a full 180°.
   2. All gates shall open outward unless noted otherwise.

F. Alignment and Grade:
   1. Install fencing to the alignment shown on the Drawings or as directed by the District.
   2. Changes in alignment of 30° or more shall be considered as corners.
   3. Install fencing to follow the general contour of the finished grades, unless otherwise shown on the Drawings or as directed by the District.
   4. Install bottom edge of fence fabric approximately 2 inches above finished grade.

G. Placement of Fabric:
   1. Stretch fabric to a uniform finish as tight as possible without pulling the material out of shape.
   2. Place fabric on the faces of the posts away from the site.
   3. Place the top edge of the fabric parallel with the top rail.
   4. Provide all stretcher bars, bands, ties, and all other fastening devices, accessories, and appurtenances for the complete installation of fencing and gates.
   5. Install fence fabric to provide approximately 2-inch deflection at center of span of fabric when a force of approximately 30 pounds is applied

perpendicular to fabric. Fabric shall return to its original position when the force is removed.

END OF SECTION

SECTION 02485

LOAMING & SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the District.

B. Related Work Specified Elsewhere (When Applicable): Earthwork, excavation, backfill, compaction, site grading and temporary erosion control are specified in the appropriate Sections of this Division.

1.2 SUBMITTALS AND TESTING

A. Seed:

1. Furnish the District with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
2. This certification shall appear in, or with, all copies of invoices for the seed.
3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
4. Each lot of seed shall be subject to sampling and testing, at the discretion of the District, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:

1. Inform the District, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
3. Have soil samples tested by an independent soils testing laboratory, approved by the District, at the Contractor's expense.
4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
5. Approval, by the District, to use topsoil for the work will be dependent upon the results of the soils tests.

C. Lime & Fertilizer:

1. Furnish the District with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the District.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the District may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE & HANDLING

A. Seed:
   1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the District.
   2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
   1. Furnish all fertilizer in unopened original containers.
   2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the District, to the proposed planting or to proper grading.

B. Seeding:
   1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
   2. Weather Conditions:
      a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
      b. Stop the seeding work when, in the opinion of the District, weather conditions are not favorable.
      c. Resume the work only when, in the opinion of the District, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:
   1. Provide the grass seed mixture approved by the District, having the following composition:
      a. Park Mixture:
         50 percent Creeping Red Fesque
         30 percent Kentucky Bluegrass
         20 percent Annual Ryegrass
      b. Roadside Mixture:
         50 percent Creeping Red Fescue
         15 percent Kentucky Bluegrass
          5 percent White Clover
          2 percent Red Top
          3 percent Birdsfoot Trefoil
         25 percent Annual Ryegrass
   2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:
   1. Fertile, friable, natural topsoil typical of the locality, without admixture of subsoil, refuse or other foreign materials and obtained from a well-drained site. Mixture of sand, silt, and clay particles in equal proportions.
   2. Free of stumps, roots, heavy of stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, weeds, sticks, brush or other deleterious matter.
   3. Not less than 4 percent nor more than 20 percent organic matter.
   4. Topsoil depth shall be 4-inches, unless otherwise indicated.

C. Lime:
   1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. l00 sieve.
   2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. l00 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:
   1. Provide a commercial fertilizer approved by the District.
   2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
      l0% Available phosphoric acid
      l0% Available potash
      l0% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:
   1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
   2. Demonstrate to the District that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
   1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
   2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.
   3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
   4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
   1. Grade the areas to be seeded as shown on the Drawings or as directed by the District.
   2. Leave all surfaces in even and properly compacted condition.
   3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
   1. Uniformly distribute and evenly spread topsoil on the designated areas.
   2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
   3. Correct any irregularities in the surface resulting from top soiling or other operations to prevent the formation of depressions where water may stand.
   4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, harrowing, or other approved method until the condition of the soil is acceptable to the District. The surface shall be cleared of all debris and or stones one inch or more in diameter.

C. Placing Fertilizer:
   1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
   2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the District.
   3. The incorporation of fertilizer may be a part of the tillage operation specified above.
   4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
   1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
   2. Distribute lime at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the District.

E. Seeding:
   1. Fine rake and level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
   2. Hydroseeding:
      a. Hydroseeding may be performed where approved and with equipment approved by the District.
      b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
      c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
      d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
   3. Drill Seeding:
      a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
      b. Sow the seed uniformly over the designated areas to a depth of l/2 inch and at a rate of 5 pounds per l,000 square feet.
   4. Broadcast Seeding:
      a. Broadcast seeding may be performed by equipment approved by the District.
      b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per l,000 square feet.
      c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
      d. Cover the seed to an average depth of l/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
      e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
   1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
   2. Compact the entire area immediately after the seeding operations have been completed.
   3. Compact by means of a cultipacker, roller, or other equipment approved by the District weighing 60 to 90 pounds per linear foot of roller.

4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

3.3 PROTECTION & MAINTENANCE

A. Protection:
   1. Protect the seeded area against traffic or other use.
   2. Erect barricades and place warning signs as needed.

B. Maintenance:
   1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with District.
   2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
   3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to Substantial Completion of the General Contract.
   4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until Acceptance by the District of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by District prior to use.

3.4 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

SECTION 02513A

BITUMINOUS CONCRETE PAVING (Maine)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish all plant, labor, equipment and materials required to install bituminous concrete pavement courses, including sidewalks, driveways, temporary and permanent trench paving and restoration of pavement markings as shown on the Drawings and as specified herein.
   2. Remove bituminous asphaltic and/or Portland cement pavement, and replace bituminous asphaltic pavement, base, binder courses and surface courses, including temporary pavement, within the area(s) shown on the Drawings and as directed.
   3. Keep pavement removal to a minimum width suitable for the required construction.
   4. Apply pavement markings to the permanent paving as specified.

B. Work Not Included: Removal and replacement of paving for the convenience of the Contractor will not be considered for payment.

C. Related Work Specified Elsewhere (When Applicable):
   1. Excavation, backfill, aggregate base and subbase Division 2.

1.2 QUALITY ASSURANCE

A. Materials: Use only materials furnished by a bulk bituminous concrete producer regularly engaged in the production of hot mixed, hot laid bituminous concrete.

B. Equipment: Utilize appropriate equipment well suited for the mixtures being placed.

C. Mix Requirements, Method of Placement and Compaction: All mixes shall conform to the State of Maine Department of Transportation's SUPERPAVE mix standards.

1.3 SUBMITTALS

A. A Job Mix Formula approved by the State of Maine Department of Transportation's Central Laboratory in Bangor shall be submitted for each mixture to be supplied at least 15 calendar days prior to production.

B. Delivery slips shall be furnished with each load of mix delivered to the project. Information shall include:
   1. Vehicle identification.
   2. Date.
   3. Project.
   4. Identification of material.
   5. Gross, tare and net weights.
   6. Signed by the bituminous concrete producer.
   7. Stamped by a licensed public weighmaster.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot Bituminous Paving Mix:
   1. Binder Course - Maine D.O.T. Type 19.0 mm Superpave Mix
   2. Surface Course - Maine D.O.T. Type 12.5 mm Superpave Mix
   3. Sidewalks and Drives - Maine D.O.T. Type 9.5 mm Superpave Mix
   4. Deep Lifts in Full Construction - Maine D.O.T. Type 25.0 Superpave Mix.

B. Composition of Mixtures - Control Points

SIEVE SIZE	GRADING			
	TYPE 25 mm	TYPE 19 mm	TYPE 12.5 mm	TYPE 9.5 mm
	PERCENT BY WEIGHT PASSING - COMBINED AGGREGATE			
37.5 mm	100			
25 mm	90-100	100		
19 mm	-90	90-100	100	
12.5 mm	-	-90	90-100	100
9.5 mm	-	-	-90	90-100
4.75 mm	-	-	-	-90
2.36 mm	15-41	23-49	28-58	32-67
1.18 mm	-	-	-	-
0.60 mm	-	-	-	-
0.30 mm	-	-	-	-
0.075 mm	1-7	2-8	2-10	2-10

C. Tack Coat:
   1. Emulsified type, Grade RS-1, CRS-1, HFMS-1, CSS-1, 1h

D. Pavement markings shall conform to AASHTO Designation M248-74 for ready-mixed white and yellow traffic paints, Type I.

PART 3 - EXECUTION

3.1 GENERAL

A. Grade Control:
   1. The Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

B. Trench areas shall receive initial paving as the work progresses where trenches are in paved streets. Not more than 300 linear feet of backfill trench shall be left unpaved.

C. Reset all existing manholes to finished grade as required at no additional cost to the Owner.

3.2 PAVEMENT REMOVAL

A. General:

1. Exercise extreme care in the removal of pavement so that pavement will not be unnecessarily disturbed or destroyed.
2. Mechanically cut pavement to be removed to a straight line, unless otherwise directed by the Wells Sanitary District.
3. All pavement removed shall become the property of the Contractor and disposed of.

B. Maine DOT Areas:
1. When removing pavement under the jurisdiction of the Maine DOT, strictly adhere to all DOT regulations controlling pavement openings.

3.3 SURFACE PREPARATION

A. Tack coats shall conform to Section 410 of the Maine D.O.T. Standard Specifications.

B. Tack Coat:
1. Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.4 WEATHER AND SEASONAL LIMITATIONS

A. The Contractor may place Hot Mix Asphalt Pavement for use other than a traveled way wearing course in either Zone between the dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 2°C or higher and the area to be paved is not frozen. The Contractor may place Hot Mix Asphalt Pavement as traveled way wearing course between the dates of April 15th and the Saturday following October 15th, provided the air temperature determined as above is 10°C or higher. For the purpose of this Subsection, the traveled way includes truck lanes, ramps, approach roads and auxiliary lanes.

B. Hot Mix Asphalt Pavement used for curb, driveways, sidewalks, islands, or other incidentals is not subject to seasonal limitations, except that conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, the Contractor shall not place Hot Mix Asphalt Pavement on a wet or frozen surface, and the air temperature shall be 2°C or higher.

3.6 PLACING THE MIX

A. General:
1. Place asphalt concrete mixture on prepared surface. Minimum allowable temperature for placing is 225°F. Maximum shall be 325°F. Place in areas inaccessible to paving machine and small areas by hand. Place each course to required grade, cross-slope and compacted thickness.

B. Protection:
1. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened to the extent that the pavement will not be damaged.

3.5 PAVEMENT MARKINGS

A. Material, approved by the Engineer, is to be furnished and applied after the installation of permanent paving.
B. Apply pavement markings in accordance with existing markings. Match paint color, marking dimensions, layout and other details with existing markings in the vicinity of the project.

END OF SECTION

SECTION 02514

BITUMINOUS CONCRETE TEMPORARY PAVEMENT (COLD MIX)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish all plant, labor, equipment and materials required to install cold mix bituminous concrete temporary pavement, as shown on the Drawings or directed and as specified herein.
   2. Cold mix shall be used only when hot mix bituminous concrete pavement is not available and then only as a temporary pavement.

B. Related Work Specified Elsewhere (When Applicable):
   1. Bituminous concrete paving and aggregate base courses are specified in this Division.

1.2 QUALITY ASSURANCE

A. Materials: use only materials furnished by a bulk bituminous concrete producer regularly engaged in the production of bituminous concrete pavement.

1.3 SUBMITTALS

A. A certificate of compliance shall be furnished to the District stating that the materials supplied comply with the specification requirements.

1.4 JOB CONDITIONS

A. Grade Control: The Contractor shall establish and maintain the required lines and grades, including crown and cross-slope during construction operations.

B. Weather Limitations: No material shall be mixed between September 15 and May 1, unless the aggregate is heated and dried, as directed during the mixing process. The heated mixture may be used directly from the plant without stockpiling, but if stockpiled, shall be protected from moisture. When placing mix after September 15th, the mix required shall be premixed and stockpiled prior to September 15. Necessary changes in the bituminous material to permit prolonged stockpiling shall be provided so that the mixture may be readily handled and placed during fall weather. Mixture placed after September 15th may be placed upon frozen base when the base has been properly constructed. Mixture may be placed after September 15 only if the air temperature is above 30^{o}F, or as directed by the District.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate shall consist of clean, tough, durable fragments free from an excess of flat,

elongated, soft or disintegrated particles and shall be processed from a stone or gravel source. The total aggregate shall be well graded and shall conform to the following gradation requirements as specified.

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves Crushed Stone or Crushed Gravel
1 inch	100
3/4 inch	90 - 100
No. 4	45 - 65
No. 8	32 - 52
No. 50	10 - 22
No. 200	1.0 - 3.0

B. Bituminous material shall be MS-4 grade emulsified asphalt in accordance with the "State of Maine, Department of Transportation Standard Specifications for Highways and Bridges", latest edition.

Bituminous material shall be mixed at the rate of approximately 21 gallons per cubic yard of aggregate. This may vary at the direction of the Engineer based on aggregate gradation.

PART 3 - EXECUTION

3.1 PLACING THE MIX

A. General:

1. Where directed by the Engineer, temporary pavement consisting of two (2) inches of cold bituminous (cold mix) surface shall be placed.
2. The temporary pavement shall be repaired as necessary to maintain a surface for traffic. Any settlement or holes appearing in the pavement shall be repaired immediately.
3. The Contractor shall remove the temporary pavement and regrade the aggregate base for the installation of initial and final paving.

END OF SECTION

SECTION 02601

MANHOLES, COVERS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Construct manholes, covers, frames, brick masonry, inverts and apply waterproofing in conformance with the dimensions, elevations, and locations shown on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. Precast Manhole Base, Barrel and Top Sections:
   1. Conform to ASTM C478-97 except as modified herein, and on the Drawings.
   2. Average strength of 4,000 psi at 28 days.
   3. Testing:
      a. Determine concrete strength by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the bases, barrels and tops.
      b. Have tests conducted at the manufacturer's plant or at a testing laboratory approved by the District.
      c. Have not less than 2 tests made for each 100 vertical feet of precast manhole sections.

B. Manhole Steps
   1. Acceptable Manufacturers:
      a. Aluminum Company of America.
      b. Reliance Steel Products, Inc.
      c. M. A. Industries, Inc.
      d. Or equivalent.

C. Frames and Covers:
   1. Acceptable Manufacturers:
      a. Etheridge Foundry Co.
      b. Neenah Foundry Co.
      c. E. L. LeBaron Foundry Company.
      d. Or equivalent.

D. Masonry:
   1. Brick: Shall comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick.
   2. Cement: ASTM C-150.
   3. Hydrated Lime: ASTM C-207
   4. Sand: ASTM C33

E. Waterproofing:
   1. Acceptable Manufacturers:
      a. Minwax Fibrous Brush Coat, Minwax Co., N.Y., N.Y.
      b. Tremco 121 Foundation Coating, Tremco Mfg. Co., Newark, N.J.
      c. Or approved equal.

1.3 SUBMITTALS

A. Submit shop drawings and manufacturer's literature.

PART 2 - PRODUCTS

2.1 PRECAST MANHOLE SECTIONS

A. Dimensions, shall be as shown on the Drawings:
   1. Base & Riser Sections:
      a. Diameter: As shown on the Drawings.
      b. Length: As required.
      c. Wall Thickness: Not less than 5 inches.
      d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to insure accurate joint surfaces.
   2. Tops:
      a. Diameter: Eccentric cone type, 24 inches I.D. at top, 48 inches I.D. at bottom unless otherwise shown on the Drawings.
      b. Length: 4 feet.
      c. Wall thickness: Not less than 5 inches at the base, tapering to not less than 8 inches at the top.
      d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to insure accurate joint surfaces.
      e. Exterior face of cone sections shall not flare out beyond the vertical.
   3. Flat Slab Tops:
      a. Location: Where shallow installations do not permit the use of a cone-type top and where indicated on the Drawings.
      b. Slab thickness: Not less than 6 inches.
      c. Constructed to support an HS-20 wheel loading.

B. Openings:
   1. Provide openings in the risers to receive pipes entering the manhole.
   2. Make openings at the manufacturing plant.
   3. Size: To provide a uniform annular space between the outside wall of pipe and riser.
   4. Location: To permit setting of the entering pipes at the correct elevations.
   5. Openings shall have a flexible watertight union between pipe and the manhole base.
      a. Cast into the manhole base and sized to the type of pipe being used.
      b. Type of flexible joint being used shall be approved by the District. Install materials according to the Manufacturer's instructions.
         1. Lock Joint Flexible Manhole Sleeve made by Interpace Corporation.
         2. Kor N Seal made by National Pollution Control System, Inc.
         3. Press Wedge II made by Press-Seal Gasket Corporation.
         4. A-Lok Manhole Pipe Seal made by A-Loc Corporation.
         5. Or equivalent.

C. Joints:
   1. Joint gaskets to be flexible self seating butyl rubber joint sealant installed according to manufacturer's recommendations. For cold weather applications, use adhesive with joint sealant as recommended by manufacturer.
      Acceptable Materials:
      a. Kent-Seal No. 2
      b. Ram-Nek
      c. Or equivalent.
   2. Joints between precast sections shall conform to related standards and manufacturer's instructions.
   3. All manholes greater than 6 ft. diameter and all manholes used as wet wells, valve pits and other dry-pit type structures shall be installed with exterior joint collars. The joint collar shall be installed according to the manufacturer's instructions. Acceptable materials:
      a. MacWrap exterior joint sealer as manufactured by Mar-Mac Manufacturing Company.
      b. Or equivalent.

D. Waterproofing:
   1. The exterior surface of all manholes shall be given two coats of bituminous waterproofing material at a application rate of 75 to 100 square feet per gallon, per coat.
   2. The coating shall be applied after the manholes have cured adequately and can be applied by brush or spray in accordance with the manufacturer's written instruction.
   3. Sufficient time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

E. Frost Protective Wrapping:
   1. The frost protective wrap shall be constructed of an ultraviolet resistant polyethylene material and shall be a minimum thickness of 6 mils.

2.2 FRAMES AND COVERS

A. Standard Units:
   1. Made of cast iron conforming to ASTM A48-76, Class 30 minimum.
   2. Have machined bearing surfaces to prevent rocking.
   3. Castings shall be smooth with no sharp edges.
   4. Constructed to support an HS-20 wheel loading.
   5. Dimensions and Style shall conform to the Drawings, Standard castings differing in non-essential details are subject to approval by the District:
      a. Covers - solid with sewer in 3-inch letters diamond pattern.
      b. Frame - 24-inch diameter clear opening, with flange bracing ribs.
   6. Minimum weight of frame and cover shall be 430 lbs.

B. Water Tight Units:
   1. Same features as above for Standard Units, with 22-inch diameter minimum clear opening.

2. Sealing features:
   a. Inner lid held by a bronze tightening bolt in a locking bar.
   b. Neoprene gasket
   c. Water tight pick hole.
3. Minimum weight of frame and cover shall be 510 lbs.

2.3 MANHOLE STEPS

A. Aluminum or polyethylene coated steel safety type designed with a minimum concentrated live load of 300 pounds.
B. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.
C. Aluminum surfaces to be embedded shall be given a protective coating of an approved heavy-bodied bituminous material. The steps shall become thoroughly dry before being placed into the concrete.
D. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps.

2.4 MASONRY

A. Brick:
   1. Sound, hard, uniformly burned, regular and uniform in shape and size, compact texture, and satisfactory to the District.
   2. Immediately remove rejected brick from the work.
B. Mortar:
   1. Composition (by volume):
      a. 1 part portland cement.
      b. 1/2 part hydrated lime.
      c. 4-1/2 parts sand.
   2. The proportion of cement to lime may vary from 1:1/4 for hard brick to 1:3/4 for softer brick, but in no case shall the volume of sand exceed 3 times the sum of the volume of cement and lime.
C. Cement shall be Type II portland cement.
D. Hydrated lime shall be Type S.
E. Sand:
   1. Shall consist of inert natural sand.
   2. Grading:

Sieve	Percent Passing
3/8-inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 50	10-30
No. 100	2-10
Fineness Modulus	2.3 - 3.1

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Precast Manhole Sections:
   1. Perform jointing in accordance with manufacturer's recommendations and as approved by the District.
   2. Install riser sections and tops level and plumb.
   3. Make all joints watertight.
   4. When necessary, cut openings carefully to prevent damage to barrel sections and tops. Replace damaged manhole sections and tops at no additional cost to the Owner.
   5. When manhole steps are included in the Work, install barrel sections and tops so that steps are in alignment.

B. Drop Manholes:
   1. The difference in elevation between the invert of the inlet pipe to the invert of the outlet pipe shall not exceed 24 inches without use of a drop structure.
   2. Where difference in elevation exceeds 24 inches, construct a drop manhole as shown on the Drawings or as directed by the District.

C. Adjust to Grade:
   1. Adjust tops of manholes to grade with brick masonry.
   2. Concrete rings are not acceptable for adjusting to grade.

D. Pipe Connections to Manholes: Connect pipes to manholes with joint design and materials approved by the District.

E. Invert Channels:
   1. Smooth and semicircular in shape conforming to the inside of the adjacent sewer section.
   2. Make changes in direction of flow with smooth curves having a radius as large as permitted by the size of the manhole.
   3. Stop the pipes at the inside face of the manhole where changes of direction occur.
   4. Form invert channels with brick.
   5. Shape invert to make smooth transition in vertical grade.
   6. Slope the floor of the manhole to the flow channel, as shown on the Drawings.

F. Masonry:
   1. Laying Brick:
      a. Use only clean bricks in brickwork for manholes.
      b. Moisten the brick by suitable means until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
      c. Lay each brick in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and thoroughly bond as directed.
      d. Construct all joints in a neat workmanlike manner. Construct the brick surfaces inside the manholes so they are smooth with no mortar

extending beyond the bricks and no voids in the joints. Maximum mortar joints shall be 1/2 inch.

e. Outside faces of brick masonry shall be plastered with mortar from ¼-inch to 3/8-inch thick.

f. Completed brickwork shall be watertight.

2. Curing:

a. Protect brick masonry from drying too rapidly by using burlaps which are kept moist, or by other approved means.

b. Protect brick masonry from the weather and frost as required.

G. Frames and Covers:

1. Set all frames in a full bed of mortar, true to grade and concentric with the manhole opening.
2. Completely fill all voids beneath the bottom flange to make a watertight fit.
3. Place a ring of mortar at least one inch thick around the outside of the bottom flange, extending to the outer edge of the manhole all around its circumference.
4. Clean the frame seats before setting the covers in place.

H. Plugging and Patching:

1. Fill all exterior cavities with non-shrink grout and with bituminous waterproofing once the concrete and mortar has set.
2. Touch up damaged water proofing.

I. Cleaning:

1. Thoroughly clean manholes, steps, frames and covers of all debris and foreign matter.

J. Bedding and Backfilling:

1. Bedding of manholes shall be 6 inches of 3/4" screened stone.
2. Backfill a minimum of 18 inches all around manhole with gravel borrow.

K. Frost Protective Wrap:

1. The Contractor shall comply with the manufacturer's instructions for the particular conditions of installations in each case.
2. Clean each manhole exterior of all dirt and remove any sharp protrusions.
3. Apply two (2) 6-inch wide vertical strips of bituminous waterproofing material and/or duct tape from the top to bottom of the manhole per layer.
4. Prior to installing pipe through each manhole or valve pit, wrap each manhole to the maximum depth of frost penetration, but not less than 5 feet below grade, with four (4) layers of the polyethylene material by beginning the wrap at the adhesive strip and proceeding around the manhole, valve pit, etc., continuously by overlapping the adhesive strip by 24 inches on the final layer. Cut the polyethylene wrap in areas where piping exits the manhole. The size of the cut is to be equivalent to the pipe's outside diameter.
5. Tuck and pleat the polyethylene wrap at the top of each manhole in a continuous manner, minimizing the size of each fold. Extend the polyethylene wrap past the top of the manhole frame and temporarily tuck the remainder inside the frame, until final backfill and paving.

6. In paved areas, cut the polyethylene wrap flush with the manhole rim after the pavement is in place.
7. In unpaved areas, pull the polyethylene wrap together, and tie around frame with galvanized wire.
8. Protect the installed frost barrier from harmful weather exposures and from possible physical abuses, where possible by prompt installation of concealing work or, where that is not possible, by temporary covering or enclosure.
9. Backfill around the manhole/frost barrier with material as outlined in Section 02200 - Earthwork.

3.2 MANHOLE TESTING

A. General:
   1. Perform either a vacuum test or a combination of the exfiltration and infiltation tests on all manholes.
   2. All testing must be performed in the presence of the District.
   3. Suitably plug all pipes entering each manhole and brace plugs to prevent blow out.

B. Exfiltration Tests After Backfilling:
   1. Fill each manhole with water to the top of the manhole frame.
   2. A period of up to 2 hours may be permitted, if the Contractor so wishes, to allow for absorption.
   3. At the end of the absorption period, refill each manhole with water to the top of the manhole frame and begin the 4-hour test period.
   4. At the end of the 4-hour test period, refill each manhole to the top of the manhole frame and measure the volume of water added. The leakage for each manhole shall not exceed 1/16 gallon per foot of diameter per vertical foot (above ground water) per 4-hour period.

C. Infiltration Tests:
   1. When the groundwater is above the bottom of the manhole, infiltration testing may be performed on that portion of the manhole below water level.
   2. After a 15-minute period, if no water is visibly moving down the interior surfaces of a manhole, the portion of the manhole below groundwater may be considered to be satisfactorily watertight.
   3. The remaining portion above the groundwater level must be tested for exfiltration as specified above.

D. Vacuum Test:
   1. The manhole shall be tested by a vacuum test after assembly of the manhole, connection piping and backfilling.
   2. Plug all lifting holes completely with non-shrink grout.
   3. Properly tighten all boot clamps and brace all plugs to prevent them from being sucked into the manhole.
   4. Install the testing equipment according to the manufacturer's instructions.
   5. A vacuum of 10 inches of Hg shall be drawn on the manhole and the loss of 1 inch of Hg vacuum timed. The manhole shall be considered to have passed

the test if the time for the loss of 1 inch of Hg vacuum is two (2) minutes or longer.

6. If the manhole fails the initial test, the Contractor shall locate the leak(s) and make repairs. The manhole shall be retested until a satisfactory test result is obtained.
7. If a satisfactory vacuum test cannot be obtained, the manhole shall be water exfiltration tested and repaired as necessary.

E. Manhole Repairs:
   1. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the District.
   2. The use of lead-wool or expanding mortar will not be permitted.

F. After the manholes have been backfilled and prior to final acceptance, any signs of leaks or weeping visible inside the manholes shall be repaired and the manhole made watertight.

END OF SECTION

SECTION 02612

REINFORCED CONCRETE PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish and install reinforced concrete pipe and fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere:
   1. Manholes, Catch Basins, Excavation and Backfill are specified in the appropriate sections in this division.
   2. Pipe & Pipe Fittings - General is specified in Division 15.

1.2 QUALITY ASSURANCE

A. Reinforced-concrete pipe and fittings shall be manufactured by a reputable manufacturer with a minimum of five years experience in the design and fabrication thereof.

B. Standards:
   1. Pipe: AASHTO M170-79I unless otherwise specified herein.
   2. Gasket: AASHTO M198-75.
   3. Steel reinforcement: AASHTO M55-75.
   4. Portland cement: AASHTO M85-79I.
   5. Coal Tar Epoxy Coating: AASHTO: M224-68 (1974)

1.3 SUBMITTALS

A. Submit shop Drawings in accordance with the Standard General Conditions of the Construction Contract showing pipe dimensions, reinforcement, joint and other details prior to fabrication.

B. Submit certified copies of mill test reports for all tests as outlined for concrete pipe under AASHTO M170-79I.

C. Submit certified copies of compliance of all tests and procedures as outlined in AASHTO M224-68(1974) and this specification.

1.4 DELIVERY, STORAGE AND HANDLING

A. Do not ship pipe units until they have aged for at least five days at an average minimum temperature of 60°F.

B. Do not ship pipe and manhole units with protective coating until the coating is completely dry and maximum chemical resistance has been obtained.

C. Prevent earth, water, and other material from entering the pipe at all times.

D. Furnish devices to permit satisfactory support of the pipe unit when it is lifted and handle each unit in a manner and by such means as recommended by the manufacturer.

1.5 FIELD QUALITY CONTROL

A. Acceptance will be on the basis of tests of materials, absorption tests, plant load bearing tests, pressure tests, and inspection of the complete product.

B. Inspection may be made at the place of manufacture or on the construction site after delivery, or both, and the pipe shall be subject to rejection at any time due to failure to meet all of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture.

C. Any break in the interior and/or exterior protective coating detected at the construction site shall be brought to the attention of and evaluated by the Engineer before any patching or touch up is attempted.

D. The Engineer will inspect all field coatings of pipe and manhole joints before backfilling will be approved.

E. Immediately remove from the project site all rejected pipe.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe:
   1. Interior surfaces free from roughness, projections, indentations, offsets, or irregularities of any kind.
   2. Class and nominal diameter as shown on the Drawings.
   3. Minimum laying length: 8 feet, unless otherwise approved by the Engineer.
   4. Reinforcement: Welded steel wire fabric conforming to AASHTO M55-75. Elliptical reinforcement will not be permitted.
   5. Cured as specified under AASHTO M170-79I.

B. Joints:
   1. Sealed by rubber gaskets set into grooves in the spigot rings.
   2. Constructed to remain watertight during service and to allow movement due to expansion, contraction, and normal settlement.

C. Gaskets:
   1. Continuous rings of a composition and texture that will assure a watertight and permanent seal.
   2. Suitable in size to fill the groove on the spigot when pipe lengths are assembled.
   3. Smooth surfaces free from pitting, blisters, porosity, and other imperfections.

D. Concrete:
   1. Consist of cement, sand and crushed stone or crushed or uncrushed gravel accurately proportioned for density and strength.
   2. Minimum cement content 6 bags (564 pounds) per cubic yard.
   3. Aggregate: Hard, durable particles, clean and free from loam and organic materials.
   4. Water: Clean and free from deleterious amounts of acids, alkalis, and organic materials.
   5. Minimum strength: 3000 psi at 7 days, and 4500 psi at 28 days.

E. Fittings:

1. Of the same strength as the pipe.
2. Joints compatible with pipe.

F. Concrete Preparation for Coating:
1. All curing oils, form oils, laitance, soluble salts, and loose concrete must be removed.
2. Concrete that will be submerged or exposed to water must be etched with a 15 to 20 percent muriatic acid solution or brush blasted to achieve a profile similar to a medium grade sandpaper.
3. Complete any additional requirements included in the manufacturer's instructions.
4. Surface must be free from moisture during coating application and drying period.

G. Coating Mixing:
1. Follow manufacturer's instructions.

H. Coating Application:
1. Protective coating for reinforced concrete pipe and precast manhole sections shall be applied at place of manufacture.
2. Protective coating for manholes shall be field applied for cast-in-place sections and inverts.
3. Minimum coating thickness will be 20 mils applied in two or more coats.
4. Minimum dry film required per coat - 8 to 10 mils. Minimum wet film required per coat - 10 to 14 mils.
5. Allow the first coat to completely dry before application of second coat.
6. Do not apply coating after "pot life" has expired.
7. Special equipment to be utilized to obtain high quality results includes a wet or dry film thickness gauge, moisture meter, and any additional equipment as suggested by the manufacturer.
8. Observe manufacturer's temperature range for application.
9. Follow manufacturer's instructions so long as they do not supersede this specification.

2.2 MARKING

A. Clearly mark the following information on each unit of pipe.
1. Class of pipe
2. Date of manufacture
3. Name of manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect all pipe prior to installation. Replace pipe discovered to be defective either before or after installation.

B. Install all pipe and fittings to the lines and grades shown on the Drawings and/or as directed by the District.

C. Before submerging unit, the protective coating must reach maximum chemical resistance.

D. Jointing:
   1. Thoroughly clean and check each joint before installing.
   2. Thoroughly lubricate the bell and gasket with the lubricant supplied by the manufacturer.
   3. Joint all lengths of pipe in accordance with the manufacturer's installation instructions.
   4. Provide gasket feeler gages for use by the pipe layer and the Engineer for checking the position of the rubber gaskets in the completed joints.
   5. All joints will be coated on the inside and outside before installation and joining of pipes.

D. During installation, close open ends of pipe with temporary, watertight plugs to prevent earth, water, and other material from entering the pipe.

E. Touch-up:
   1. Any on site touch-up necessitated by cracks, breaks, or chips in the protective coating shall be accomplished in accordance with specified coating application procedures.
   2. The touch-up will be performed by the coating supplier and only then after notifying the Engineer and receiving approval.

END OF SECTION

SECTION 02615

DUCTILE IRON PIPE & FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install ductile iron pipe and fittings of the type(s) and size(s) as specified herein.

1.2 QUALITY ASSURANCE

A. Standards (As Applicable):
   1. Cement-mortar lining for water: ANSI A2l.4 (AWWA C104).
   2. Rubber gasket joints: ANSI A2l.ll (AWWA C111).
   3. Ductile iron pipe thickness: ANSI A2l.50 (AWWA C150).
   4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A2l.5l (AWWA C151).
   5. Pipe flanges and fittings: ANSI Bl6.l and ANSI A21.10 (AWWA C110).
   6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
   7. Cast and ductile iron fittings: ANSI A2l.l0 (AWWA C110).
   8. Ductile Iron Compact Fittings: ANSI 21.53 (AWWA C153).

B. Acceptable Manufacturers:
   1. Tyler
   2. Griffin
   3. Union
   4. US Pipe
   5. Or equivalent.

1.3 DELIVERY, STORAGE & HANDLING

A. Exercise extra care when handling ductile iron pipe because it is comparatively brittle.

B. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.

C. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General:
   1. All exterior (buried) ductile iron pipe shall have push-on or mechanical joints unless otherwise specified or shown on the Drawings. Pipe within valve pits and other structures is considered interior pipe and shall be flanged.
   2. Unless otherwise shown on the Drawings or in the pipe schedule, the minimum thickness of ductile iron pipe shall be:
      a. For pipe 4 inches in diameter and smaller: Class 5l.
      b. For pipe 6 inches in diameter and larger: Class 52.

c. Pipe with flanges: Class 53.

3. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
4. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings, and except for air piping lines which shall be completely unlined.
5. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings.
6. Factory applied bituminous coatings (in accordance with AWWA C151) shall be furnished on the exterior of all underground piping unless specified otherwise.
7. The outside of pipe within structures and exposed shall not be coated with bituminous coating, but shall be thoroughly cleaned and given one shop coat of Intertol Rustinhibitive Primer 621 by Koppers Co.; Multiprime by PPG Industries; Chromox 13R50 Primer made by Mobil Chemical Co.; or equivalent.

B. Joints (as shown on Drawings or as specified):

1. Push-on and 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 fluid to be contained within the pipe. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40 °F to 250°F.
   c. Bolts and nuts for buried mechanical joints shall meet the AWWA C-111 requirements and be made of A588 steel.
2. 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.
   c. Gaskets:
      (l) Ring type of rubber with cloth insertion.
      (2) Thickness of gaskets l2 inches in diameter and smaller: l/l6 inch.
      (3) Thickness of gaskets larger than l2 inches in diameter: 3/32 inch.
      (4) On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 200°F.
   d. Fasteners:
      (l) Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.
      (2) The number and size of bolts shall meet the requirements of the applicable ANSI standard.
      (3) Nuts, bolts, and studs shall be Grade B meeting the requirements of ASTM A307.
      (4) After jointing, coat entire joint with bituminous material compatible with pipe coating unless other coating required by Section 09900.

e. When applicable, provide and install flange clamps as shown on the Drawings.

3. Joint Bracing:
   a. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings.
   b. Types of bracing:
      (l) Pipe and fittings furnished with approved 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 bituminous paint in buried installations and shall be coated with the same coatings as the piping system in interior installations after assembly or, if necessary, prior to assembly.
      (2) Mechanical joint follower gland pipe restrainers.
         (a) Ductile iron gland and restraining ring.
         (b) Gasket shall be standard MJ gasket -ANSI/AWWA-C111/A21.11.
         (c) Working pressure 350 psi, up to 8 inches; 250 psi, 10 inches to 16 inches.
         (d) Test pressure two times working pressure.
         (e) Grip Rings™, Romac Industries, or other equivalent as approved by District.
      (3) Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:
   1. Pressure rating of 350 psi for D.I. compact fittings and 250 psi for all others unless indicated otherwise on the Drawings or as specified.
   2. Joints the same as the pipe with which they are used or as shown on the Drawings.
   3. Cement lining and seal coat as specified for pipe.
   4. Factory applied bituminous coatings shall be furnished for all underground fittings.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the District to inspect pipe, fittings, gaskets, and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
   1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerances for pipe clearances.
D. Immediately remove all rejected materials from the project site.

3.2 INSTALLATION

A. General:
   1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.
   2. Concrete thrust blocks or other acceptable thrust resistant system is required at all fittings on pressure pipe. Where thrust blocks are used, these shall be placed against undisturbed soil or screened gravel compacted to 95 percent and shall be placed so that the joints are accessible for repairs.

B. Assembling Joints:
   l. Push-on Joints:
      a. Insert the gasket into the groove of the bell.
      b. Uniformly apply a thin film of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
      c. Insert the chamfered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.
   2. Bolted Joints:
      a. Remove rust preventive coatings from machined surfaces prior to assembly.
      b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.
      c. After jointing coat all bolts with bituminous material compatible with the pipe coating required herein and/or in Section 09900.
   3. Flanged Joints:
      a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
      b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
   4. Mechanical Joints:
      a. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
      b. Lubricate the gasket, bell, and spigot by washing with soapy water.
      c. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly seated.
      d. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
      e. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joint to the proper tension with a torque wrench.
      f. The correct range of torque (as indicated by a torque wrench) and the length of wrench (if not a torque wrench) shall not exceed:
         (l) Range or Torque: 60-90 ft.-lbs.
         (2) Length of Wrench: l0 inches.
      g. If effective joint sealing is not attained at the maximum torque specified above, disassemble, thoroughly clean, and reassemble the joint. Do not overstress the bolts to tighten a leaking joint.

5. Bell and Spigot Joints:
    a. Thoroughly clean the bell and spigots and remove excess tar and other obstructions.
    b. Insert the spigot firmly into place and hold securely until the joint has been properly completed.

B. Fabrication:
    l. Tapped Connections:
        a. Make all tapped connections as shown on the Drawings or as required by the District.
        b. Make all connections watertight and of adequate strength to prevent pullout.
        c. Drill and tap normal to the longitudinal axis of the pipe.
        d. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.
        e. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANS A2l.5l based on 2 full threads for ductile iron and 3 full threads for cast iron.
    2. Cutting:
        a. Perform all cutting as set forth in AWWA C600.
        b. Carefully chamfer all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.

C. Pipe Deflection:
    l. Push-on and Mechanical Joints:
        a. The maximum permissible deflection of alignment at joints shall be limited to that given in AWWA C600.
    2. Flexible Joints:
        a. The maximum deflection in any direction shall not exceed the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 02622

POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide and install PVC non-pressure pipe and fittings of the size(s) and type(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere: (When Applicable)
   1. Excavation and backfill, dewatering, pavement, borrow and bedding material, and cleaning and testing requirements are specified in the appropriate sections of this division.
   2. Pipe & Pipe Fittings - General is specified in Division 15.

1.2 QUALITY ASSURANCE

A. Manufacturers:
   1. Certain-Teed.
   2. J-M Manufacturing.
   3. Or equivalent.

1.3 SUBMITTALS TO THE DISTRICT

A. Submit shop drawings in accordance with Section 01340 and this specification.

B. Submit manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these Specifications.

C. Submit other documents as specified in the appropriate Sections of this Division.

1.4 DELIVERY STORAGE AND HANDLING

A. Provide all labor necessary to assist the District to inspect pipe, fittings, gaskets and other materials.

B. Carefully inspect all materials at the time of delivery and just prior to installation.

C. Carefully inspect all pipe and fittings for:
   1. Defects and damage
   2. Deviations beyond allowable tolerances for joint dimensions.
   3. Removal of debris and foreign matter.

D. Examine area and structures to receive piping for:
   1. Defects, such as weak structural components that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerance for pipe clearances.

E. All materials and methods not meeting the requirements of the Drawings and Specifications will be rejected.

F. Immediately remove all rejected materials from the project site.

2.1 MATERIALS

A. Pipe and Fittings:
   1. The polyvinyl chloride pipe and fittings, including those required for stubs, shall conform to ASTM standard specification for PVC Sewer Pipe and Fittings, Designation D 3034 (SDR 35) (4" to 15"), F679 (18" to 27").
   2. Straight pipe shall be furnished in lengths of not more than 13 feet.
   3. Saddles will not be allowed.

B. Joints:
   1. Joints for the polyvinyl chloride pipe shall be push-on joints using factory installed elastomeric ring gaskets.
   2. The gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
   3. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and ground water, and which will endure permanently under the conditions of the proposed use.
   4. The joints shall conform to ASTM Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals, Designation D3212-76.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:
   1. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight.
   2. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length.
   3. If a piece of pipe fails to meet this requirement for straightness it shall be rejected and removed from the site.
   4. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. Jointing:
   1. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
   2. Pipe and fittings shall be installed to the lines and grades indicated on the drawings or as required by the District. Care shall be taken to insure true alignments and gradients.
   3. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation.
   4. Each pipe unit shall than be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.

5. Joints shall not be "pulled" or "cramped" unless permitted by the District.

C. Service Connections:
   1. All service connections to new pipe shall utilize a wye fitting.
   2. All service connections must enter the top half of the mainline pipe.

D. Pipe Deflection:
   1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
   2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the District.
   3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the District may require without additional compensation.

E. Testing:
   1. Clean and test pipe in accordance with appropriate sections of this division.

END OF SECTION

SECTION 02628

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test all polyethylene pipe, pipe fittings and appurtenances of the type(s) and size(s) and in the location(s) as shown on the Drawings and as herein specified.

B. Related Work Specified Elsewhere:
   1. "Pipe and Pipe Fittings - General" is specified in Section 15050.
   2. "Earthwork" is specified in Section 02200.

1.2 QUALITY ASSURANCE

A. Pressure rating or pressure class of pipe as shown on the Drawings or specified herein.

B. Standards:
   1. ASTM C901-02: Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½" (13 mm) through 3" (76 mm) for Water Service.
   2. AWWA C 906-99: Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4" (100 mm) through 63" (1,575 mm) for Water Distribution and Transmission.
   3. ASTM D 2657-97: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
   4. ASTM D 2683-98: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
   5. ASTM D 2837-04: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
   6. ASTM D 3261-03: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
   7. ASTM D 3350-02a: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
   8. ASTM F 1055-98e1: Standard Specification for Electrofusion type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and tubing.
   9. NSF/ANSI-61-2003e: Standard for Drinking Water Systems Components - Health Effects, NSF International, Ann Arbor, MI.
   10. CSA B 137.1-2002: Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
   11. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Piping Systems Using Hydrostatic Pressure.

12. Manufacturers of high density polyethylene pipe, fittings, adapters, and couplings must be certified under ISO 9000, Quality Management Systems - Fundamentals and Vocabulary, International Organization for Standardization (ISO), Geneva, Switzerland.
13. 49 CFR 192 subpart F, 192.281, selected requirements for plastic joints; 192.282, requirements for qualifying joining procedures; 192.285, specifies qualifying persons to make joints; and 192.287, specifies inspection of joints.
14. Fusion Operators: Operators shall meet the minimum qualification requirements outlined in 49 CFR 192 subpart F, 192.285 and shall have documented experience with successful butt fusion of pipe larger than 24 inch diameter.
15. Joint Fusion Data: Fusion plate temperature (^{o}F), interfacial fusion pressure (psi), interfacial contact fusion time (sec.), and cooling time (min.) shall be recorded by data logger for computer download or recorded by the operator(s) in a field book for each joint fusion completed.
16. Pipe deemed damaged or unacceptable to the District shall be replaced at no cost to the District. Pipe shall be adequately protected during storage to prevent external damage to the pipe side wall or ends. Pipe will gouged side walls will be rejected by the District.
17. Exterior pipe markings shall include the nominal pipe diameter, SDR, and rated working pressure.

C. Acceptable Pipe and Fitting Supplier/Manufacturers:
1. PolyPipe, Inc. "PW Pipe"
2. KWH Pipe, "Sclairpipe"
3. Performance Pipe
4. "Isco-Pipe"
5. "Poly-Cam"
6. "Friatec"
7. Vari-Tech "Performance Pipe"
8. Independent Pipe Products, Inc.
9. Or approved equal.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1.
B. Submit manufacturer's "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.
C. Submit experience statement for operator(s) to complete the pipe fusion to demonstrate the minimum experience and qualification requirements described in paragraph 1.2.B.14.
D. Following pipe construction, submit joint fusion data in an electronic spreadsheet format as a record to document joint fusion quality control.
E. Submit manufacturers installation instructions and specifications for all fittings, couplings, adapters, saddles, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipes shall be DIPS with SDR ratings.

B. Polyethylene compounds utilized in the manufacture of products furnished under this specification shall be listed in PPI TR-4, have a grade of PE34 with a minimum cell classification of PE 334434[C, D, or E] for PE 3408 materials, as defined in ASTM D3350. Pipe shall be in conformance with AWWA C901, AWWA C906, or CSA B137.1. They shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1600 psi (PE3408) at a temperature of 73.4°F (23°C).

C. All materials which come in contact with water, including lubricants, shall be evaluated, tested and certified for conformance with NSF/ANSI Standard 61.

D. Clean re-work material of the same type grade, and cell classification generated from the manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing and fittings produced meet all the requirements of AWWA C901, AWWA C906, or CSA B137.1.

E. Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements above. Dimensional and performance characteristics shall conform to the requirements of AWWA C901, AWWA C906, or CSA B137.1.

F. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed in a concentration of not less than 2%.

G. The polyethylene resin compound shall have a resistance to environmental stress cracking as determined by procedure detailed in ASTM D l693 with sample preparation by procedure C of ASTM D l928 of not less than 40 hours.

H. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

I. Polyethylene fittings shall have the same pressure rating as the pipe itself for all pressurized pipeline applications.

J. Polyethylene fittings shall be molded style for diameters up to 12 inches and fabricated style for diameters larger than 12 inches.

2.2 ADAPTERS AND COUPLINGS (As Applicable)

A. Polyethylene Mechanical Joint Adapter

1. For joining IPS or DIPS size polyethylene pipe to any ANSI\AWWA C153 ductile iron fitting and valve.
2. Molded from NSF listed PE 3408 resin.
3. Adaptor shall meet requirements of AWWA C901, 906.
4. Adaptor kit to include anchor fitting, retainer gland ring, gasket, and long tee-bolts, and rubber gasket. All hardware components shall be Type 316 stainless steel.
5. Provide stiffeners as neccessary.

B. Polyethylene Flanged Adapter

1. For joining IPS or DIPS size polyethylene pipe to ANSI B16.1, ANSI B16.5, or ANSI A21.10 (AWWA C110) flange as required.

2. Molded from NSF listed PE 3408 resin.
3. Adaptor kit to include Type 316 stainless steel backing ring, gasket, and long tee-bolts, and rubber gasket. All hardware components shall be Type 316 stainless steel.
4. Adaptor shall meet requirements of AWWA C901, 906.

C. Polyethylene Wall Anchor
1. For restraining polyethylene pipe in cast-in-place concrete headwall.
2. Molded from NSF listed PE 3408 resin.
3. Pressure rating and size shall be the same as the required pipe and fitting SDR.
4. IPS or DIPS to match required pipe size.

D. Polyethylene Electrofusion Coupling
1. For joining plain ends of polyethylene pipe where butt fusion is not practical as approved by the District.
2. Molded from NSF listed PE 3408 resin or fabricated from pipe meeting NSF requirements with an integral heating element and electrical leads to connect the heating element power supply.
3. Pressure rating and size shall be the same as the required pipe and fitting SDR.

E. Polyethylene Electrofusion Saddle
1. For installation corporation stops in HDPE pipe for water service connection or manual air release valve.
2. Molded from NSF listed PE 3408 resin with an integral heating element and electrical leads to connect the heating element power supply.
3. Pressure rating and size shall be the same as the required pipe and fitting SDR.

F. Threaded HDPE Transition Adapter, Unions, and Threaded Adapters
1. For joining polyethylene pipe to threaded fittings and valve ends (NPT.
2. HDPE end of transition adapters be SDR rated to match required pipe SDR.
3. HDPE end of transition adapters shall be molded from NSF listed PE 3408 resin.
4. All metallic materials shall be constructed of Hastelloy C-276
5. Coupling transition end shall be Male NPT.
6. IPS or DIPS to match required pipe size.

G. Blind Flanges
1. Molded from NSF listed PE 3408 resin.
2. Pressure rating and size shall be the same as the required pipe and fitting SDR.

2.4 FABRICATION

A. Thermal Butt-Fusion:
1. Join the pipe to itself, or to the polyethylene fittings or to the flange connections by means of thermal butt-fusion.
2. Have all fusion performed by personnel trained by the pipe supplier or other qualified persons, using tools approved by the pipe supplier.
3. The polyethylene fittings and flanged connections to be joined by thermal butt-fusion shall be from the same type, grade and class of polyethylene compound as the polyethylene pipe unless otherwise approved.

4. Joint strength must be equal to that of the adjacent pipe.

B. Socket Fusion (When Applicable)
   1. Join the pipe to socket type fittings by means of socket fusion
   2. Have all fusion performed by personnel trained by the pipe supplier or other qualified persons, using tools approved by the pipe supplier.
   3. The polyethylene fittings to be joined by thermal socket-fusion shall be from the same type, grade and class of polyethylene compound as the polyethylene pipe unless otherwise approved.

C. Electrofusion (When Applicable)
   1. Applies to the installation of electrofusion couplings and saddles.
   2. Have all fusion performed by personnel trained by the pipe supplier or other qualified persons, using tools approved by the pipe supplier.
   3. The coupling or saddle shall be joined using heat created by electric current from a control box.
   4. Install clamps to hold the fitting in place during the fusion process.

D. Flanged Joints
   1. Flange joining of sections of pipe is allowed to facilitate the pipe installation process as approved by the Engineer.
   2. Joints shall include full face gaskets.
   3. Flange bolts shall be tightened to the same torque valve and tightening pattern recommended by the manufacturer.
   4. Flange bolts and nuts shall be Type 316 stainless steel and have tensile strength equivalent to SEA Grade 3.
   5. Use flat Type 316 stainless steel washers between the nut and backup ring.
   6. Retighten bolts to the manufacturer recommended torque value after an hour to offset the effects of compression set.

E. Mechanical Connections: The mechanical connections of the polyethylene pipe to auxiliary equipment shall be in accordance with the pipe suppliers written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPES AND FITTINGS

A. Install pipe and fittings in accordance with the Marine Installations Chapter of PPI Handbook of Polyethylene Piping and C906 (4 in. to 63 in. diameter).

B. Install joint and transition adapters in accordance with the manufactures recommendations.

C. Refer to the drawings and Section 02200 for additional bedding and backfill requirements.

D. Joining surfaces must be clean and dry.

E. Pipe must not be dumped, dropped, pushed or rolled into the trench. Provide appropriate equipment to lift move and lower the pipe into the trench as necessary.

3.2 TESTING

A. Joint Quality

1. 12" diameter and smaller - On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12" or 30 times the wall thickness in length (minimum) and 1" or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.
2. Pipes larger than 12" diameter - Visual inspection of the joint shall be the primary indicator of joint quality. Specific visual inspection criteria shall be provided by the pipe and fitting manufacturer. The v-groove between the bends shall be uniform around the circumference of the pipe and the both sides of the bead shall have uniform thickness and height indicating proper pipe alignment during the fusion process.
3. All fused joints shall be visually inspected by qualified fusion operators and the District during construction to assure uniform alignment and beading.

B. Leak Test
   1. Refer to Section 15050 for testing.

END OF SECTION

SECTION 02650

BURIED UTILITY MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. This work shall consist of providing utility line markings installed above all buried lines installed as part of this contract as indicated on the Drawings and replacing existing markings disturbed as part of this contract.

B. Related Work Specified Elsewhere:
   1. Pipe, excavation, backfill, insulation are specified in the appropriate Sections in this Division.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and color shall be in accordance with latest AASHTO specifications for pipe and utility marking.

B. For ferrous pipe material use 0.004" minimum polyethylene film; 6" wide clearly marking type of buried utility

C. For non-ferrous pipe material (e.g. Concrete, PVC, PE, etc.) use detection tape composit of polyethylene and metallic core 6" wide clearly marking type of buried utility.

D. Seton Identification Products, New Haven, CT, Utility Safeguard LLC or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Marking tape shall be installed over utility lines centerline and buried 24" below grade.

B. Markings damaged during opening of trench shall be reinstalled with 2' overlap at broken sections.

END OF SECTION

SECTION 02753

TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish all necessary labor, materials, supervision and equipment to satisfactorily inspect gravity sewer lines and sewer service pipes as required by means of a closed circuit television system.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. The cameras shall be designed and constructed for sewer line inspection work. The mechanical design of the lens shall allow it to turn and rotate 360 degrees to provide a close up view of sewer pipe walls and sewer service pipes. The camera shall be designed to maintain proper orientation of the picture while the lens is turning and rotating.

B. The cameras shall be operative in 100% humidity conditions.

C. The lighting for the cameras shall be suitable to allow a clear picture of service pipes and the entire periphery of the mainline sewer pipe, such that joints, root intrusions, cracks, offset joints, deposits, etc. can be seen and identified by the District.

D. The lens focus and rotational capabilities and the light intensity will be remotely controlled from an above ground television "studio".

E. The cameras shall produce a continuous, full color picture with a quality acceptable to the District.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Flow Control:

1. A minimum of 75% of the periphery of the sewer line shall be visible at all times.
2. The District may require that the line be plugged so that the entire periphery can be inspected.

B. Operation:

1. Perform inspection of sewer lines after lines have been suitably cleaned.
2. When inspecting newly constructed sewer lines, introduce water into the sewer lines to be tested from the upstream manhole prior to the television inspection, but no more than 24 hours in advance of the inspection.
3. Lines will be suitably isolated from the remainder of the sewer line as required.
4. Move the cameras through the line in either direction at a uniform rate as directed by the District.
5. The District may require Contractor to pull cameras back to get a second view of a section of the pipe.

6. Use manual winches, power winches, television cable reel powered rewinds, high-pressure hose and reels on jet-cleaning trucks, or a flexible pole, to move the camera through the sewer.
7. The screen monitor and winch operators shall be in full communication at all times.
8. Remove all wires, screens, sand bags, etc. used in the television inspection process from the sewers at the completion of inspection of each sewer section.

C. Measurement:
1. Measurement for location of defects, service connections, etc., shall be accurate to two tenths (0.2) of a foot over the length of the section being inspected.

D. Records:
1. Printed records shall be provided, reflecting location of defects, service connections, etc., shall be recorded and stored to "Wincan" digital reporting software (or equivalent).:
   a. Keep records and supply to the District when the work has been completed.
   b. Show the exact location in relation to adjacent manholes, of each infiltration point discovered by the television camera.
   c. Show locations of laterals, unusual conditions, roots, break-in storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features.
2. Inventory the houses and apparent empty lots bordering each section of sewer line that is inspected and compare results to the number and location of house services found during the inspection. Log inconsistencies and report them to the District.
3. Video / Photographs:
   a. A copy of the video shall be provided to the District in DVD format.
   b. The video shall be digitally recorded, indexed by pipe section (labeled by manhole number or other means acceptable to District) and allow for printing of still photographs.
   c. Photographs shall be printed at District's request and shall be identified on the back as follows:

Date _____
Section, MH#_____ to MH#_____
Diameter of Sewer _____
Distance from MH#_____ is _____
Description of item photographed _____
_____

END OF SECTION

SECTION 02755

FINAL SEWER TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Final sewer testing work includes the performance of testing and inspecting each and every length of sewer pipe, pipe joints and each item of appurtenant construction.
2. Perform testing at a time acceptable to the District, which may be during the construction operations, after completion of a substantial and convenient section of the work, or after the completion of all pipe laying operations.
3. Provide all labor, pumps, pipe, connections, gages, measuring devices and all other necessary apparatus to conduct tests.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. All sewers, manholes, and appurtenant work, in order to be eligible for acceptance by the District, shall be subjected to tests that will determine the degree of watertightness and horizontal and vertical alignment.
2. Thoroughly clean and/or flush all sewer lines to be tested, in a manner and to the extent acceptable to the District, prior to initiating test procedures.
3. Perform all tests and inspections in the presence of the District and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes.
4. Perform testing by test patterns determined by or acceptable to the District.
5. Remedial Work:
   a. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspections.
   b. Completely retest all portions of the original construction on which remedial work has been performed.
   c. Perform all remedial work and retesting in a manner and at a time acceptable to by the District.

B. Line Acceptance Tests (Gravity sewers with no active service connections):

1. Test all gravity sewer lines with no active service connections for leakage by conducting a low pressure air test.
2. Equipment:
   a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
c. All air used shall pass through a single central panel.
d. Connect 3 individual hoses:
(l) From the control panel to the pneumatic plugs for inflation,
(2) From the control panel to the sealed sewer line for introducing the low pressure air,
(3) From the sealed sewer line to the control panel for continually monitoring the air pressure rise in the sealed line.

3. Testing Pneumatic Plugs:
a. Seal test all pneumatic plugs prior to using them in the actual test.
b. Lay one length of pipe on the ground and seal both ends with the pneumatic plugs to be tested.
c. Pressurize the sealed pipe to 5 psig.
d. The pneumatic plugs are acceptable if they remain in place without bracing.

4. Testing Sewer Pipeline:
a. After the sewer pipe has been cleaned and the pneumatic plugs checked, place the plugs in the sewer line at each manhole and inflate them.
b. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psig greater than the average groundwater pressure.
c. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psig greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.
d. After the stabilization period, disconnect the air hose from the control panel to the air supply.
e. The pipeline will be acceptable if the pressure decrease is not greater than l/2 psig in the time stated in the following table for the length of pipe being tested:

	Time (Min.) for Length of Pipe			
Pipe Diameter (inches)	0-100 ft	101-200 ft	201-300 ft	301-400 ft
4	2.0	2.0	2.0	2.0
6	3.0	3.0	3.0	3.0
8	4.0	4.0	4.0	5.0
10	5.0	5.0	6.0	8.0
12	5.5	5.5	8.5	11.5
15	7.0	8.5	13.0	17.0
18	8.5	12.0	19.0	25.0
21	10.0	17.5	26.0	35.0
24	11.5	23.0	34.0	45.5
27 and larger	14.5	29	43.0	58.0

6. Test Results:
    a. If the installation fails the low pressure air test, determine the source of leakage.
    b. Repair or replace all defective materials and/or workmanship and repeat low pressure air test.

C. Line Acceptance Tests (Gravity sewers with active services):
1. Test all new gravity sewer lines with active services by conducting a low-pressure air test on all joints using a packer after all services have been connected or capped at the property line and all trenches backfilled but before the surface course of permanent pavement is installed.
2. Equipment:
    a. Closed-circuit television system.
    b. Testing devices (packer):
        (1) Capable of isolating individual joints by creating a sealed void space around the joint being tested.
        (2) Constructed such that low pressure air can be admitted into the void area.
        (3) Shall contain a pressure gauge accurate to one tenth (0.1) psi in-line with the feed line to monitor the void pressure.
        (4) Capable of performing in sewer lines where flows do not exceed 1/4 of the pipe diameter without resorting to any method of flow control.
3. Testing Sewer Pipeline Joints:
    a. Test all joints except those with visible infiltration.
    b. Procedure:
        (1) Pull television camera through sewer line in front of the packer.
        (2) Position the packer on each joint to be tested.
        (3) Inflate the sleeves on each end of the packer.
        (4) Apply four (4.0) psi pressure above the existing hydrostatic pressure on the outside of the joint to the void area created around the inside perimeter of the joint.
        (5) Shut off the supply of air once the pressure has stabilized at the required amount.
        (6) Monitor the void pressure for thirty (30) seconds.
        (7) Repair the joint if the pressure drops more than one half (1/2) psi in the thirty (30) seconds.
    c. Water or chemical pressure testing may be used in lieu of air testing subject to review and approval by the District.
    d. Re-clean and re-inspect all lines not approved by the District.
    e. Repairing of Joints:
        1. When a joint fails the pressure test, excavate and repair the failed joint. Repairing joints with chemical grout will not be permitted.
    f. The District may request checking of the testing equipment for accuracy.
        1. Perform standard air test on a clean continuous section of pipe.
        2. Repair the equipment if the void pressure drops.
    g. Testing Operation Inspection:

1. Reset each joint, as specified herein, prior to acceptance and final payment for joint testing. Retest all joints that fail until the test requirements are met.

h. The contractor will supply a black and white photograph of every joint that fails the pressure test.

D. Alignment Tests (Gravity Sewers):
1. Perform tests for the correctness of horizontal and vertical alignment on each and every length of gravity sewer pipeline between manholes.
2. Alignment tests to be conducted after all pipe has been installed and backfilled.
3. The observation test shall be conducted after all upstream work has been completed and the pipeline cleaned of debris.
4. Notify the District at least 24 hours in advance of the proposed observation testing.
5. Introduce water into the sewer lines to be tested from the upstream manhole prior to the observation test but no more than 24 hours in advance of the test.
6. Beam a source of light, acceptable to the District, through the pipeline from both ends and the District will directly observe the light in the downstream, and/or upstream manhole of each test section.
7. The length of pipe between manholes, diameter of pipe and amount of light observed in the manhole at the end of each pipe section will determine acceptance of the alignment test by the District.
8. The amount of vertical and horizontal deflection shall not be greater than the ASTM allowance and (manufacturer's recommendations) for the pipe being tested.
9. No standing water shall be allowed. The presence of standing water shall be cause for rejection of that pipe (including manhole) section.
10. Improper alignment will be corrected by re-excavation and resetting of pipe.

E. Pipe Deflection: (Gravity Sewers)
1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the District.
3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the District may require.

F. Television Inspection Tests (Gravity Sewers)
1. Where television inspection testing is required, test procedures shall be in compliance with the requirements outlined in Specification Section 02753.
2. No standing water shall be allowed. The presence of standing water may be cause for rejection of that pipe.

3. Any standing water, detectable leaks, improper joints or any other unacceptable feature detected by the television inspection will be corrected by re-excavation and resetting pipe.

G. Inspection of Appurtenant Installations:
   1. Completely inspect, at a time determined by the District, all manholes and inlets to ascertain their compliance with the Drawings and Specifications.
   2. Provide access to each manhole and inlet and check the following characteristics:
      a. Shape and finish of invert channels,
      b. Watertightness and finish of masonry structures,
      c. Location, type, and attachment of stops,
      d. Elevation and attachment of frames, covers, and openings,
      e. Pattern and machining of covers, and
      f. Drop connection arrangements.

H. Testing Pressure Sewers:
   1. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations backfilling and taps at such points and shall plug said holes after completion of the test.
   2. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
   3. Perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location).
   4. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period exceeds a rate of 10 gallons per inch of diameter per 24 hours per mile of pipeline the section shall be considered as having failed the test. All joints within chambers and all flanged joints shall have no visible leakage.
   5. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

I. Manhole Leakage Testing:
   1. Specified in the "Manholes, Covers and Frames" Section in Division 2.

END OF SECTION

SECTION 03319

CONCRETE CRADLES, ARCHES, ENCASEMENTS & THRUST BLOCKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and construct cradles, arches, encasements, and thrust blocks as required to rigidly support pipes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Mixture:
   1. Minimum strength at 28 days (psi) - 3000
   2. Maximum size, coarse aggregate (inches) - 1-1/2
   3. Percent air - 5
   4. Maximum slump (inches) - 3
   5. Minimum cement factor (pounds) - 564
   6. Maximum water/cement ration - 253

B. Aggregates - ASTM C33

C. Cement - Portland cement ASTM C150 Type I

D. Reinforcement - ASTM A615, Grade 60

PART 3 - EXECUTION

3.1 INSTALLATION

A. Construct cradles, arches, encasements, and thrust blocks the full width of the trench and/or as shown on the Drawings.

B. Secure pipe to prevent movement and floatation during the placement of the concrete.

C. Place polyethylene sheeting (6 mils, minimum thickness) against all fittings, valves, etc. prior to placement of concrete for thrust blocks. Keep concrete clear of bolts and joints.

END OF SECTION

SECTION 03420

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast concrete structures.
B. Joint sealants.
C. Waterproofing.

1.2 RELATED SECTIONS

A. Section 01340 - Submittals
B. Section 02200 - Earthwork
C. Section 02601 - Manholes, Covers and Frames
D. Section 03604 - Non-Shrink Grout
E. Division 11 - Pump Stations and Equipment
F. Section 15092 - Pipe Sleeves and Seals

1.3 REFERENCES

A. ACI 308-92 - Revised 1992 - Standard Practice for Curing Concrete
B. ACI 318-99 - Building Code Requirements for Structural Concrete and Commentary
C. ACI 350R-89 - Environmental Engineering Concrete Structures
D. ASTM A82-97a - Specification for Steel Wire, Plain, for Concrete Reinforcement
E. A185-97 - Specification for Steel Welded Wire Fabric, Plain for Concrete Reinforcement
F. ASTM A615/ A615M-00 - Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
G. ASTM C33/C94M-00 - Specification for Concrete Aggregates
H. ASTM C94-00 - Specification for Ready Mixed Concrete
I. ASTM C150-99a - Specification Portland Cement
J. ASTM C260-00 - Specification for Air Entraining Admixtures for Concrete
K. ASTM C309-98a - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
L. ASTM C494/C494M-99a - Specification for Chemical Admixtures for Concrete
M. Concrete Reinforcing Steel Institute - Manual of Standard Practice
N. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars

1.4 DESIGN REQUIREMENTS

A. Design shall be for "Normal Sanitary Exposure" (Z=115) and shall be done by "Alternate Design Method" ACI 318, Appendix B or "Strength Design Method" ACI 318 and as amended by ACI 350R.
B. Minimum 28 day compressive strength: fc' = 5,000 psi.
C. Reinforcing Steel: ASTM A615 grade 60 deformed bars.
D. Concrete cover on reinforcing steel: 1½ inches minimum.
E. The structures shall have a minimum of 8" thick walls, top slabs and base slabs.
F. The precast concrete structure shall support its own weight plus the following minimum superimposed loads:
    1. Live load on top slab: H-20 vehicular loading.
    2. Dead load of soil on top slab: 125 PCF.
    3. Equivalent lateral fluid pressure - 90 PCF. The top of the pressure diagram shall be assumed to originate at Finish Grade as shown on the drawings.
    4. Uniform live load surcharge of 125 psf applied horizontally to the sides of the precast structure.
    5. Ground water shall be assumed to originate at finish grade.
    6. Factor of safety of 1.15 shall be used against flotation based on weights of empty structure and soil directly over footing extensions.
G. Segmented structures with joints shall be designed and installed for watertight joints with no leakage at the joints.

1.5 SUBMITTALS

A. Manufacturer's Data:
    1. Submit manufacturer's specifications and instructions for all manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
    2. Contractor shall submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.
    3. A copy of handling and installation instructions and procedures shall be transmitted to the Erector.
B. Shop Drawings:
    1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units.
    2. Submit member dimensions and cross section, location, size, type and details of reinforcement, including special reinforcement and lifting devices necessary for handling and erection, joints and waterstops.
    3. Submit layout, dimensions, and identification of each precast unit corresponding to the sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at opening in precast units.
    4. Submit location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.

5. Submit structural design calculations and drawings demonstrating the structural integrity of all precast concrete units for the intended use and a buoyancy analysis with a factor of safety against flotation of 1.15 with the assumptions of the ground water table at finished grade and the precast concrete tank empty. Calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the State of Maine.
6. Submit concrete mix design including product data for concrete accessories and waterproofing materials.
7. Submit locations of wall penetrations for pipes. All openings shall be cast-in-place at the manufacturing plant. No field coring of pipe penetrations shall be allowed.

1.6 QUALITY ASSURANCE

A. The manufacture shall exhibit satisfactory performance on projects of similar magnitude under similar or equal service conditions for a period not less than five (5) years. Submit past job list with Owner contact information.

1.7 WARRANTY

A. The precast concrete manufacturer shall guarantee all precast concrete members against excessive movement after erection, causing separation of joints, cracking or misalignment of adjacent units. The Precaster shall further guarantee all joints between concrete sections against leakage and all members against infiltration of water through the concrete; the precast concrete erector shall repair and restore any unsatisfactory conditions or damage to the building resulting from and related to the precast concrete work, to the extent of replacement if so required.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver precast concrete units to the project site in such quantities and at such times as will assure the continuity of the installation.
B. Store units at the project site to ensure against cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at the designated lift points only.

1.9 JOB CONDITIONS

A. Erector must examine all parts of the supporting structure and the conditions under which the precast concrete work is to be erected, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until satisfactory conditions have been corrected in a manner acceptable to the Erector.
B. Deliver anchorage items which are to be embedded in other construction before the start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Superior Concrete Company, Inc., Auburn, Maine.
B. American Concrete Industries - Veazie, Maine.
C. Or equivalent.

2.2 MATERIALS

A. All precast units shall be tongue and grooved and of shape and section as shown on the Drawings.
B. Cement for all units shall be Type II Portland cement, ASTM C150.
C. Minimum compressive strength of concrete 5000 psi at 28 days.
D. Entrained air content of concrete: 6% ± 1%.
E. Reinforcing steel shall conform to ASTM A 615 grade 60 deformed bars.
F. Cast-in-place plates shall conform to ASTM A 36.
G. Liquid Asphalt Dampproofing: Non-fibrated asphalt emulsion for below grade wall dampproofing.
    1. First coat Sonneborn Building Products - Hydrocide 600 or equal.
    2. Second coat Sonneborn Building Products - Hydrocide 700 Mastic, or equal.
H. Entrance Hatches: Provide openings as shown on the Drawings.
I. Manhole Steps:
    1. Aluminum or polyethylene coated steel safety type designed with a minimum concentrated live load of 300 pounds.
    2. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.
    3. Aluminum surfaces to be embedded shall be given a protective coating of an approved poly-amide epoxy paint. The steps shall be thoroughly dry before being placed into the concrete.
    4. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps.
J. Manhole covers and frames shall be provided in Specification Section 02601.
K. Precast section joints shall use solid, continuous elastomeric gaskets to achieve watertight joints.

PART 3 - EXECUTION

3.1 FABRICATION AND PLACING REINFORCEMENT

A. Detailing and fabrication of reinforcement shall conform to details on drawings, and otherwise to the CRSI Code of Standard Practice.
B. Bars when placed shall be clean and free from loose mill scale and rust and from coatings that reduce bond.
C. Place reinforcement of structural members on accessory bolsters and chairs as specified in Specification Section 03300, for reinforcement of cast-in-place structural members. Accessories shall be stainless steel or have plastic tips.
D. Specifications for splicing bars given in the ACI Code are applicable to this work.

E. All reinforcing shall have adequate cover as required by ACI 318 and 350R.

3.2 PRODUCTION AND CURING

A. Production and curing of the precast units shall in all respects conform to the provisions of ACI Standards.

B. Each precast concrete unit shall be an integral placement without any construction or cold joints. Floor slabs shall be an integral placement with the bottom wall section.

C. Structures shall be fabricated from the minimum number of precast sections while keeping with transportation and installation restrictions.

3.3 STORAGE, HANDLING, TRANSPORTATION

A. Units shall be stored in moist condition for at least 14 days and shall be supported in such a way as to avoid any deformation, discoloration, or permanent set. Handling and transportation shall not produce stresses beyond the allowable stresses or cause cracks and spalls.

3.4 CONDITIONS OF UNITS AND PATCHING

A. Damaged, cracked, or chipped units shall be satisfactorily repaired and patched if structurally and architecturally acceptable. The District shall be sole judge as to acceptability and his decision shall be final if made within these specifications. The Precasters assumes responsibility for any damage or impairment of the precast units until the unit is erected and permanently fastened. All exposed to view units to be cleaned to obtain a uniform finish before acceptance is made.

3.5 INSPECTION

A. Material and workmanship shall be at all times subject to inspection by the Engineer and ready access for such inspection shall be permitted to all work during fabrication and erection.

B. Material and workmanship not in conformity with the provisions of this specification may be rejected at any time defects are found during the progress of the job.

3.6 EMBEDDED AND ATTACHED ITEMS

A. Pipe sleeves, inserts, bolts, lifting hooks dowels, and all other items required for transportation and erection shall be patched so that they shall have adequate concrete cover in the finished structure. Location to be as shown on Drawings or as required for handling and erection.

3.7 ERECTION

A. Install all precast structures and/or structure sections level and plumb to the elevations and in the locations shown on the Drawings.

B. Installation Tolerances: Install precast units without exceeding the following tolerance limits:

1. Variations from Plumb: 1/4" in any 20' run or story height ; 1/2" total in any 40' or longer run.
2. Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.
3. Variation from Theoretical Position in Plan: Plus or minus 1/4" maximum at any location.
4. Offsets in Alignment of Adjacent Members at Any Joint: 1/16" in any 10' run: 1/4" maximum.

C. Perform jointing in strict accordance with the manufacturer's recommendations.
D. Make sure all joints are watertight.

3.8 CLEANING, REPAIRING AND PROTECTION

A. After erection is complete, any chipped or damaged units and any depressions left by removal of lifting devices shall be properly repaired by the erector. Also, all erection dirt incurred during the erection process shall be removed. Muriatic acid or similar products are not to be used without the specific consent of the manufacturer and the Engineer.
B. All finished work in any way exposed shall be protected by the General Contractor against damage. Cutting and patching of any precast concrete shall only be allowed with the express permission of the District. Any such work shall only be done by the Erector, either at this own expense should the fault be his, or at the expense of the party responsible for the damage for the additional work required.

3.9 LIQUID ASPHALT DAMPPROOFING APPLICATION

A. Apply dampproofing to all concrete tank walls below grade.
B. First Coat - Brush or spray on at a rate of 125-150 square feet per gallon, filling all voids in concrete surfaces, completely.
C. Allow first coat to dry before applying second coat.
D. Second Coat - Trowel apply at a rate of 20-25 square feet per gallon.
E. Do not place backfill for at least 24 to 48 hours after application.

3.10 CLEANING

A. Clean any adjacent materials effected by the application of the penetrating dampproofing with a material recommended by the dampproofing manufacturer.

3.11 TESTING

A. General:
   1. Perform leakage tests on all precast concrete tanks.
   2. All testing must be performed in the presence of the District.
   3. Suitably plug all pipes entering precast concrete tank and brace plugs to prevent blow out.
B. Exfiltration Tests Prior to Backfilling:
   1. Fill precast concrete tank with potable water furnished by the Contractor to the top of the cover.

2. A period of up to 12 hours may be permitted, if the Contractor so wishes, to allow for absorption.
3. At the end of the absorption period, refill precast concrete tank with water to the top of the precast concrete tank cover and begin the 4-hour test period.
4. At the end of the 4-hour test period, refill precast concrete tank to the top of the precast concrete tank cover and measure the volume of water added. The leakage for each precast concrete tank shall not exceed 1 gallon per 50 square feet of tank wall per 4-hour period.

3.12 PRECAST CONCRETE TANK REPAIRS

A. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Engineer.
B. The use of lead-wool or expanding mortar will not be permitted.
C. Subsequent to the repair, tanks shall be refilled as previously described and re-tested until such time as the structures can demonstrate compliance with the testing requirements and at no additional cost to the Owner.
D. The Contractor shall dispose of the water as directed by the District.

END OF SECTION

SECTION 03604

NON-SHRINK GROUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Non-shrink grouting.

1.2 REFERENCES

A.	ASTM C33-99a	-	Specification For Concrete Aggregates
B.	ASTM C109/C109M-99	-	Test Method For Compressive Strength of Hydraulic Cement Mortars
C.	ASTM C827-95a	-	Test Method For Changes In Height at Early Ages of Cylindrical Specimens From Cementitous Mixtures
D.	CRD-C611-80	-	Test Method for Flow of Grout Mixtures
E.	CRD-C621-81	-	Specification for Non-Shrink Grout

1.3 SUBMITTALS

A. Submit product data and material safety data sheets for products to be used.
B. Submit test data when required.
C. Submit manufacturers installation instructions for products used.

1.4 QUALITY ASSURANCE

A. Conform to Army Corps of Districts Specification CRD-C621-81
B. Grouts shall exhibit non-shrink characteristics when tested according to ASTM C827.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver in sealed, labeled containers.
B. Store in dry conditions above freezing and below 90°F.
C. Keep unused portions of opened containers dry and warm.
D. Store aggregate covered and protected from the elements.

1.6 ENVIRONMENTAL CONDITIONS

A. Do not place grout when exposed to precipitation.
B. Place grout when temperature of substrate and ambient air are above 40°F and below 90°F.
C. Place grout outside these limits when approved by heating substrates, enclosing work, shading, cooling or other measure to mitigate adverse weather conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregates: ASTM C33 fine aggregate, washed
B. Pea Stone: ASTM C33 coarse aggregate, size number 8 (max. size 0.375 inches), washed

C. Water: Potable, from municipal water supply.

2.2 GROUT FOR INSTALLING DOWELS AND ANCHOR BOLTS

A. Super Por-Rok by Minwax Construction Products
B. Crystex by L&M Construction Chemicals
C. Masterflow 713 by Master Builders
D. Or equal.

2.3 GROUT FOR BEAM BEARING PLATES AND COLUMN BASE PLATES

A. Crystex by L&M Construction Chemicals
B. Masterflow 713 by Master Builders
C. Sikagrout 212 by Sika Corporation
D. Or equal.

2.4 GROUT FOR INSTALLING RAILING POSTS

A. Super Por-Rok by Minwax Construction Products
B. Crystex by L&M Construction Chemicals
C. Masterflow 713 by Master Builders
D. Or equal.

2.5 TESTS

A. All grouts shall achieve a minimum 28 day strength of 6,000 psi according to ASTM C109.
B. Grouts when tested by flow cone according to CRD-C 611-80 shall take more than 20 seconds to flow as a maximum limit on fluidity.
C. Test grout when requested.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of loose aggregate, dust, laitance, dirt, oil, grease by bush-hammering, chipping or brushing.
B. Thoroughly dampen the concrete substrate.
C. Follow manufacturers instructions.
D. Heat the substrate, enclose the area or make other necessary preparations.
E. Install forms, leak proof, to retain grout in shapes shown on Drawings.

3.2 MIXING

A. Mix only as much grout as can be placed in 20 minutes.
B. Mix according to manufacturer's instructions.
C. Minimize water for the application.
D. Add no more water after mixing.

E. For applications greater than 2 inches thick may add up to 50 lbs of pea stone per 100 lbs of grout, dry measure, to extend the grout. Test according to ASTM C109 and C827.
F. Do not exceed maximum flowability.

3.3 PLACING

A. Place quickly and continuously; pouring, pumping or by gravity pressure.
B. Obtain approval for dry pack placement.
C. Install horizontal anchor bolts or dowels using a trowel consistency grout.
D. Place so as to avoid entrapping air.
E. Trim grout shoulders.

3.4 CURING

A. Moist cure for 3 days.
B. Cover with moist cloths, curing blankets or curing compound.

3.5 PROTECTION

A. Protect from vibration due to adjacent operations until the grout is well set up.
B. Protect bolts and dowels from force or impact until grout has achieved 50% of its 28 day strength.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Apply specified finish coats of paint to all preprimed surfaces and complete finishing system to unprimed items.

B. Paint all existing items as noted in this Specification and as indicated on the Drawings.

1.2 RELATED SECTIONS

A. Division 2 - Piping

B. Division 11 - Equipment

C. Division 15 - Mechanical

1.3 PREFINISHED ITEMS NOT REQUIRING PAINT OR FINISH

A. Items and equipment that are specifically specified to receive the manufacturer's standard primer and finish coats in the factory, except as noted for color and for touch-up painting.

B. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals (unless otherwise noted).

1.4 REFERENCES

A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.

B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

D. Federal Test Method No. 141 - Method 6141, Stain Removal.

E. ANSI A13.1 - Scheme for the Identification of Piping Systems.

F. SSPC - Steel Structures Painting Council.

G. SSPC-PA1, “Standard for Shop, Field, and Maintenance Painting.”

H. SSPC-PA2, “Measurement of Dry Paint Thickness with Magnetic Gauges.”

I. SSPC-SP1, “Solvent Cleaning.”

J. SSPC-SP2, “Hand Tool Cleaning.”

K. SSPC-SP3, “Power Tool Cleaning.”

L. SSPC-SP6, “Commercial Blast Cleaning.”

M. SSPC-SP7, "Brush Off Blast."

N. SSPC-SP10, “Near-White Blast Cleaning.”

O. SSPC-PA Guide 3, Standard “A Guide to Safety in Paint Application,” latest revision.

P. USDOT 49 CFR Parts 173, 178 and 179.

Q. VOC Standards - All coatings shall be in accordance with all applicable State and Federal VOC Standards.

1. OSHA 29 CFR 1925.55 Gases, Vapors, Fumes, Dusts and Mists.
2. Ozone Transportation Commission (OTC) 2005 VOC Regulation.
3. 38 MRSA: Section 584A; Air Protection and Improvement Law.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01340.
B. Submit a minimum of three (3) color charts for color selection by District.
C. Submit coating manufacturer's certification that proposed field coatings are compatible with shop coatings.
D. Submit coating manufacturer's certification that the proposed coatings meet all state and federal VOC regulations.

1.7 QUALITY ASSURANCE

A. All materials used on work shall be exactly as specified in brand and quality.
B. Before purchasing materials for the work, the Contractor shall submit to the District a list of the products he proposes to use, and the list shall be reviewed by the District and no exceptions taken and reviewed by him before commitment for materials is made.
C. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.
D. Include on label of all containers:
    1. Manufacturer's name
    2. Type of paint
    3. Manufacturer's stock number
    4. Color
    5. Instructions for reducing, where applicable
    6. Label analysis
    7. Shelf life dates
E. Field Quality Control:
    1. Contractor shall request review by the District, of first finished room, space or item of each color, texture and method of applications, prior to proceeding with additional painting..
    2. Use first acceptable room, space or item as the project standard for each color scheme.
    3. For spray application, when applicable, paint a surface not smaller than 100 square feet as the project standard.
    4. Repainting of materials failing to meet the requirements of the Specifications or Drawings.
    5. The number of coats and total mil thickness specified in the paint schedule are minimums. If the specified minimum film thickness is not achieved, additional coats shall be applied to achieve the total film thickness specified.
F. Paints submitted shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance, and be in accordance with OTC 2005 Standards.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver coating materials in sealed containers with labels legible and intact.
B. Store only acceptable project materials on the project site.
C. All painting materials shall be stored and mixed in a single location coordinated with the District. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. The Contractor shall carry all necessary water to the mixing room, and shall dispose of all waste outside of the building in a suitable receptacle.
D. Restrict storage location to paint materials and related equipment and supplies.
E. Keep storage location neat and clean.
F. Remove all soiled and used rags, waste and trash from the storage location and building at the end of each work day.

G. Repair all damage to the storage location, caused by painting materials and equipment at the Contractor's expense.
H. Comply with all applicable health and fire codes and regulations including safety precautions recommended by the manufacturer. Storage space shall be provided with a suitable fire extinguisher fully charged at all times.
I. Heat shall be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F at all times.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems shall be applied.
B. Do not apply coatings in areas where dust is being generated.
C. Do not apply coatings when the air or material surface temperature is below 50 degrees Fahrenheit and unless the temperature is at least 5 degrees Fahrenheit above the dew point.
D. Do not apply exterior coatings in frosty, damp or rainy weather or while surfaces are exposed to hot sunlight.

1.10 EXTRA MATERIALS

A. For all materials with a shelf life of greater than 12 months, provide one gallon of each type and each color of touch-up paint to the District by the Contractor in unopened containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (PAINT)

A. Tnemec Company, Inc.
B. Sherwin Williams
C. ICI (Glidden/Devoe)
D. Or equal

2.2 MATERIALS

Refer to the paint schedule for specific products and application.

2.3 COMPONENTS

A. All finish coats shall be compatible with shop prime coats.
B. Turpentine shall be pure spirits of turpentine.
C. Shellac shall be four pounds and shall meet the U.S. Government specifications as issued by the Bureau of Commerce.
D. When interior or exterior wood and metal are primed in the mill or shop as part of painting contract, use the materials specified in every case for such surfaces and use in accordance with manufacturer's directions for first or priming coat.

2.4 MIXING AND TINTING

A. Deliver paints and enamels ready-mixed to project site.
B. Accomplish job mixing and job tinting only when required and no exceptions taken by the District.
C. Mix only in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.
D. Use only tinting colors recommended by the manufacturer for the specific type of finish.

E. Fungicidal agents, when applicable, shall be incorporated into the paints and stains by the manufacturer.
F. Mix and prepare paints in strict accordance with Manufacturers recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Part 3.2, Surface Preparation.
B. Immediately notify the District in writing when a surface to be finished cannot be put into an acceptable condition.
C. Do not proceed with surface preparation or coating application until conditions are suitable.
D. The Contractor shall be responsible for and shall rectify, at the Contractor's expense any unsatisfactory finish resulting from the application of coatings on surfaces not in acceptable condition.

3.2 SURFACE PREPARATION

A. Ferrous Metal Surfaces (Items not shop primed)
   1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10 immediately prior to priming.
   2. All other ferrous metals shall be sandblast cleaned in accordance to SSPC-SP6 immediately prior to priming.
   3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
   4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
   5. Feather edges of sound existing paint by grinding, if necessary.
   6. Clean and touch up weathered, worn or damaged shop coats of paint with the specified primer.
   7. Restore shop coats of paint with identical materials if removed for welding and fabrication.
B. Galvanized Metal:
   1. Thoroughly clean surface with mineral spirits to remove oily residue.
   2. Dry with clean cloth.
   3. Treat surface with copper sulphate or with a compound made for this purpose (Lithoform, Solfo Metallic Coating, etc.) in accordance with the manufacturer's directions, before applying the primer.
C. Previously Coated Surfaces (including existing items and new items that are shop primed)
   1. The areas of the coated surface that are blistered, eroded, brittle or otherwise failed shall be completely removed before beginning the specified surface preparation.
   2. The areas where the existing coating is intact shall be sanded to dull the finish.
   3. Before applying the new coating over an existing coating, a test section must be done to ensure compatibility of the new and old coatings.
   4. All other existing coatings shall be prepared as recommended by the manufacturer and as specified in this section.
   5. Ferrous metals arriving at the job site with shop primers other than the polyamide epoxy or rust inhibitive primers specified shall be provided with an intermediate coat as necessary for compatibility with specified topcoats.

6. Special attention shall be paid to the potential for epoxy shop and intermediate coats to chalk upon exposure to sunlight. The Contractor shall follow the manufacturer's required surface protection/covering and surface preparation recommendations before any intermediate or top coats can be applied over chalked surface. Epoxy primers and intermediate coats shall be top coated no later than 45 days after the application of the epoxy coating. If topcoats are to be applied later than 45 days, the following surface preparation shall be provided:
   a. The existing finish shall be etched by sanding with 80 grit paper or cloth.
   b. Surfaces shall be pressure washed with 3000 to 5000 pounds of pressure.
   c. The District, at their discretion, can require the Contractor to conduct adhesion tests of the topcoats.
7. The following shall be the minimum surface preparatory for existing surfaces that are to be painted, unless indicated otherwise:
   a. Existing submerged ferrous metals.
      - Clean
      - Sandblast in accordance with SSPC-SP10.
   b. Non-submerged ferrous metals.
      - Clean
      - Sandblast in accordance with SSPC-SP6.
   c. Existing concrete floors and all surfaces to receive secondary contaminant coatings.
      - Clean
      - Sand or shot blast to remove existing coatings and to provide an anchor profile for the new coating.
   d. Existing Concrete and Masonry Walls
      - Clean
      - Scrape existing paint to a sound surface.
      - Sand with 80 grit paper or cloth.
      - Pressure wash all existing epoxy coated surfaces.

3.3 APPLICATION

A. Workmanship:
   1. Employ skilled workmen to insure workmanship of the highest quality.
   2. Materials shall be applied only by craftsmen experienced in the use of the specific products involved.

B. General Requirements:
   1. Apply all coatings under adequate illumination.
   2. Perform no work in the rain, dew, or fog, when the temperature is below 50 degrees Fahrenheit and at least 5 degrees Fahrenheit above the dew point, or before the other coats have thoroughly dried.
   3. Do not apply coatings until the material surfaces are thoroughly dry.
   4. Apply paints and varnishes with suitable brushes, rollers or spraying equipment.
      a. The rate of application shall not exceed that as recommended by the paint manufacturer for the surface involved.
      b. Keep brushes, rollers and spraying equipment clean, dry and free from contaminates and suitable for the finish required.
      c. Apply stain by brush. Cover surfaces with a uniform coat and wipe off if required.

d. Make each coat a different tint from that of the preceding coat, with final coat tinted to the exact shade selected by the District. Lightly sand surfaces between each coat of gloss and semi-gloss finishes, and wipe clean.

5. Comply with the recommendation of the product manufacturer for drying time between succeeding coats. Contractor shall follow the manufacturer's specific curing requirements for rust inhibitive primer shop coats prior to allowing topcoating.
6. Sand and dust between each coat to remove defects visible from a distance of five feet.
7. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.
8. Inspection:
   a. Do not apply additional coats until the completed coat has been inspected by the District.
   b. Only inspected and reviewed coats will be considered in determining the number of coats applied.
9. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.
10. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.
11. Apply primer on all work before glazing.
12. Refinish entire wall where portion of finish has been damaged or is not acceptable.
13. Apply one coat of metal primer, of the types specified hereunder, and one coat of flat black metal enamel, to the surfaces of all ductwork behind grilles, for a distance of 18 inches.
14. Back prime all exterior and interior wood trim.
15. Runs on face are not permitted.
16. Back prime all wood siding with specified stain.
17. Adjust natural finishes as necessary to obtain identical appearance on veneers and solid stock.

3.4 PROTECTION

A. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done to adequately protect flooring and other work from damage during the prosecution of the painting work.
B. Remove all canopies of lighting fixtures, all electric switch plates, and similar equipment, set them carefully away, and cover adequately, protect the fixtures, etc.; replace the canopies, plate, etc. in as good condition as when found.
C. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

3.5 CLEANING

A. At the completion of the work of this Section, remove all paint spots and oil or grease stains, caused by this work from floors, walls, fixtures, hardware and equipment, leaving their finishes in a satisfactory condition. Remove all materials and debris and leave the site of the work in a clean condition so far as this work is concerned.

3.6 FINAL INSPECTION

A. Protect all painted and finished surfaces against damage until the date of final acceptance of the work. The District will conduct a final inspection of all painters' work. As part of the final inspection the Contractor shall demonstrate compliance with the specified film thickness with appropriate paint gauges. The Contractor shall be required to repaint, refinish, or retouch any areas found which do not comply with the requirements of this Section.

3.7 PAINT SCHEDULE

A. Definitions

1. Submerged surfaces are defined as:
    a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3-feet above the maximum water surface for uncovered tanks.
    b. All surfaces contained within covered tanks.
    c. The full height of all partially submerged items such as sluice, slide and weir gates, piping, etc.
    d. All surfaces contained within underground vaults, structures and manholes such as valve pits, dry wells, etc.
2. Enclosed surfaces shall be those non-submerged surfaces enclosed and/or protected within a building in such a manner that it can not be exposed to UV light or weather conditions.
3. Weather exposed surfaces shall be all other conditions including buried items which do not fall into the definition of submerged or enclosed surfaces as noted above.

C. Schedule

The product model and coatings system numbers listed below are based on products provided by the Sherwin William's Company and The Tnemec Company, Inc. and are listed to establish the standard of quality. Equivalent products from Devoe Coatings Inc. or Glidden will be accepted provided they meet or exceed the performance of the listed products.

SURFACE/ITEM	SURFACE PREPARATION	PRIMER	INTERMEDIATE	FINISH
METALS				
Submerged Ferrous Metals (see note 3)	SSPC-SP10 Near White Metal Blast Cleaning	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils **OR** SW High Solids Catalyzed Epoxy at 3 to 5 mils	Tnemec Series N69 Tneme-Epoxoline 11 at 4 to 6 mils **OR** SW High Solids Catalyzed Epoxy at 5 to 6 mils	Tnemec Series N69 Tneme-Epoxoline 11 at 4 to 6 mils **OR** SW High Solids Catalyzed Epoxy at 5 to 6 mils
Submerged Ferrous Metals, Piping and Equipment Specified to be Shop Primed in Their Respective Sections (see note 3)	SHOP	SHOP PRIME	Tnemec Series N69 Tneme-Epoxoline 11 at 4 to 5 mils **OR** SW Macropoxy 646 at 5 to 6 mils	Tnemec Series N69 Tneme-Epoxoline 11 at 4 to 5 mils **OR** SW Macropoxy 646 at 5 to 6 mils
Weather Exposed Ferrous Metals, Piping and Equipment Specified to be Shop Primed in Their Respective Sections	SHOP	SHOP PRIME	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils **OR** SW Macropoxy 646 at 5 to 6 mils	Tnemec Series 1080 WB Endurashield at 3 to 4 mils **OR** SW - Corothane II Polyurethane at 3 to 4 mils
Galvanized steel exposed to view. Enclosed and weather exposed. See note 15	SSPC-SP1 Solvent Cleaning Followed by SSPC-SP7	Tnemec Series N69 Tneme-Epoxoline 11 at 2 to 3 mils **OR** SW Recoatable Epoxy Primer 4 to 6 mils	Top coats as noted herein	Top coats as noted herein
Ferrous Metals, Non-Ferrous Metals and Galvanized Steel in Contact with or Embedded in Concrete and Masonry	SSPC-SP1 Solvent Cleaning Followed by SSPC-SP7	Tnemec Series N69 Tneme-Epoxoline 11 at 3 to 5 mils **OR** SW Recoatable Epoxy Primer 4 to 6 mils	Top coats as noted herein for the surfaces exposed to view	Top Coats as noted herein for the surfaces exposed to view
All other Weather Exposed and Enclosed Ferrous Metals Including Metal Doors, Pressed Steel Frames, Steel Lintels and Bollards (See Note 7)	SSPC-SP6	Tnemec Series 594 Omnithane Gray at 2.5 to 3 mils (Observe Minimum topcoat times) **OR** SW Recoatable Epoxy Primer at 4 to 6 mils	Tnemec Series 1080 WB Endurashield at 2 to 3 mils **OR** SW Corothane II Acrylic Urethane at 3 to 4 mils	Tnemec Series 1080 WB Endurashield at 2 to 3 mils **OR** SW Corothane II Acrylic Urethane at 3 to 4 mils

NOTES:

1. Surface preparation shall be as specified within this section and as noted in the table above.
2. All dry film thickness indicated are the minimum required.

3. All epoxy coatings subjected to UV Exposure shall receive an additional Polyurethane top coat with a minimum dry film thickness of 3 mils. No epoxy coating shall be left exposed to UV light. This shall include all equipment drives, motors, gear reducers, etc.
4. All ferrous metals, piping and equipment delivered to the site with shop primers other than the specified primer shall receive an intermediate coat as necessary for compatibility with the indicated top coats.
5. All ferrous, nonferrous and galvanized metals in contact with concrete or masonry shall receive a POLYAMIDE epoxy primer with a minimum dry film thickness of 4 mils applied to the contact area.
6. Galvanized surfaces shall be treated as required by manufacturer to be compatible with the primer and top coats specified.
7. If the polyurethane top coats are not compatible with the manufacturer's alkyd primer apply a polyamide epoxy as the intermediate coat.
8. The hollow metal doors and frames shall receive the primer indicated above, applied over the manufacturer's shop coatings.
9. Painting of the piping system shall include all ferrous valves, levers, valve handles, fittings, stands, supports, hangers, pumps and appurtenances.
10. Paint motors for color coordination.
11. Epoxy primers and intermediate coats that have been in place for more than 45 days shall be prepared as indicated under the "Surface Preparation" Section of this Specification.
12. Verify the products provided are compatible with the existing coatings in the existing facility.
13. Paint all exterior building components and items mounted to the building(s).
14. Tnemec N69F can be used where the cold temperatures affect cure and dry times
15. Submerged galvanized metals shall be finished as indicated for submerged ferrous metals, unless specifically indicated otherwise.
16. Refer to Section 03930 - Special Concrete Coatings at tanks and concrete structures.

END OF SECTION

SECTION 09905

SURFACE PREPARATION AND SHOP COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and application of shop coatings on materials, equipment, and piping indicated in the various specification sections relating thereto, and as specified herein, including primers and topcoats for materials, equipment and piping that are finished at the point of manufacturer or fabrication.

B. Examine the various Sections of the Specifications and be thoroughly familiar with all provisions regarding shop coatings.

1.2 RELATED SECTIONS

A. Division 2 - Piping
B. Section 09900 - Painting
C. Division 11 - Equipment
D. Division 15 - Mechanical

1.3 PREFINISHED ITEMS NOT REQUIRING PAINT OR FINISH

A. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals, except surfaces in contact with or embedded within concrete or masonry, unless otherwise specified elsewhere.

1.4 REFERENCES

A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
D. Federal Test Method No. 141 - Method 6141, Stain Removal.
E. SSPC - Steel Structures Painting Council.
F. SSPC-PA1, “Standard for Shop, Field, and Maintenance Painting”.
G. SSPC-PA2, “Measurement of Dry Paint Thickness with Magnetic Gauges”.
H. SSPC-SP1, “Solvent Cleaning”.
I. SSPC-SP6, “Commercial Blast Cleaning”.
J. SSPC-SP10, “Near-White Blast Cleaning”.
K. SSPC-PA Guide 3, Standard “A Guide to Safety in Paint Application”, latest revision.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01340.

B. As a minimum, the following shall be included in the submittal package for all items, products, material or equipment, as specified.
   1. Submit data on the proposed shop coatings, details on surface preparation methods, application procedures and dry mil thickness.
   2. Submit coating manufacturer's certification that proposed shop coatings are compatible with field coatings, as specified in Section 09900.

1.6 QUALITY ASSURANCE

A. All Shop Coatings shall meet the requirements of the materials section, and shall be guaranteed by the manufacturer to be compatible with the field coatings, as specified in Section 09900. The Contractor shall coordinate this requirement during the Shop Drawing Phase.

B. All Shop Coatings shall meet all Federal and [State] regulations pertaining to Volatile Organic Compounds (VOC) compliance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Part 3 - EXECUTION for specific products and applications.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Definitions
   1. Submerged surfaces are defined as:
      a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3'-0" above the maximum water surface for uncovered tanks.
      b. All surfaces contained within covered tanks.
      c. The full height of all partially submerged items such as sluice gates, slide gates, weir gates, piping, etc.
      d. All surfaces contained within underground structures, vaults and manholes such as valve pits, drywells, etc.
   2. Enclosed surfaces are those non-submerged surfaces enclosed and/or protected within a building in such a manner that it can not be exposed to UV light or weather conditions.
   3. Weather exposed surfaces are all other conditions including buried items which do not fall into the definition of submerged or enclosed surfaces, as noted above.

B. Ferrous Metal
   1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10, near white, immediately prior to priming.

2. All other ferrous metals, Enclosed and Weather exposed surfaces, shall be sandblast cleaned in accordance to SSPC-SP6, commercial grade, immediately prior to priming.
3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.

C. Non-Ferrous Metals
1. Surfaces in contact with or embedded within concrete or masonry that are to be primed, shall be cleaned in accordance to SSPC-SP1, Solvent Clean, immediately prior to priming.
2. Remove dirt, oil and grease by washing surfaces with mineral spirits.
3. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.

D. Galvanized Metals
1. Thoroughly clean surface with mineral spirits to remove oily residue.
2. Dry with clean cloth.
3. Treat surface with copper sulphate, or with a compound made for this purpose. (Lithoform, Solfo Metallic Coating, etc.), in accordance with the manufacturer's directions, before applying the primer.

3.2. APPLICATION

A. Pipe, Fittings and Valves
1. The following surfaces shall be prepared in accordance with the manufacturer's recommendations and shall receive a shop coat of asphaltum varnish meeting Federal Specifications TT-C-494A or fusion bonded epoxy coating.
   a) Interior surfaces of all ductile iron pipe, fittings and valves.
   b) The exterior surfaces of buried valves and miscellaneous piping appurtenances.
2. The exterior surfaces of all ductile iron pipe and fittings buried shall receive the standard factory applied asphaltic coating (in accordance with AWWA C151).
3. The exterior surfaces of ductile iron pipe, fittings and valves submerged, enclosed or weather exposed shall receive a factory applied shop primer in accordance with Section 3.2.C
4. Machined surfaces shall be cleaned and coated immediately after being machined, with a suitable rust resistant coating per manufacturer's recommendations.
5. All other ferrous surfaces shall be factory primed in accordance with Section 3.2.C, except ferrous surfaces obviously not to be painted shall receive a heavy shop coat of grease or other suitable rust resistant coating per manufacturer's recommendations.
6. These coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection until final acceptance by the owner.

C. Schedule

The product model and coatings system numbers listed below are based on products by the Sherwin Williams Company and Tnemec Company Inc. Other acceptable manufacturers are Glidden Company and Devoe Coatings, Inc., or Equal.

SURFACE / ITEM	SURFACE PREPARATION	Tnemec SHOP PRIME	Sherwin Williams SHOP PRIME
METALS			
Enclosed Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP10 Near White Metal Blast Cleaning	Series 1 Omnithanie At 3 to 5 mils	Copoxy Shop Primer At 4 to 6 mils
Enclosed Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP10 White Metal +Blast Cleaning	Series 1 Omnithanie 3 to 5 mils	Opoxy Shop Primer 4 to 6 mils
Weather Exposed Ferrous Metals, Piping, Fittings, Valves and Equipment specified to be shop primed in their respective sections.	SSPC-SP6 Commercial Blast Cleaning	Series 1 Omnithanie Prime 3 to 5 mils	Recoatable Epoxy Primer 4 to 6 mils
Enclosed Ferrous Metals in areas designated to receive an epoxy coating. See Note 6.	SSPC-SP6 Commercial Blast Cleaning	Series 1 Omnithanie Prime 3 to 5 mils	Recoatable Epoxy Primer 4 to 6 mils
Non-Ferrous and Galvanized Metals in contact with or embedded in concrete or masonry	SSPC-SP1 Solvent Wiping followed by	Series N69 Epoxolime 11 3 to 5 mils	Recoatable Epoxy Primer 4 to 6 mils
Ferrous Metals in contact with or embedded in concrete or masonry	SSPC-SP6 Commercial Blast Cleaning	Series N69 Epoxolime 11 3 to 5 mils	Recoatable Epoxy Primer 4 to 6 mils
All Other Weather Exposed and Enclosed Ferrous Metals, including steel frames, overhead door, steel lintels and bollards	SSPC-SP6 Commercial Blast Cleaning	Series 1 Ommithame Primer 3 to 5 mils	Recoatable Epoxy Primer 4 to 6 mils

Notes:

1. Surface preparation shall be as specified within this section and as noted in the table above are minimums. Surface preparation shall be in accordance with the manufacturer's written recommendations.
2. All dry film thickness indicated are the minimum required.
3. All ferrous metals and equipment delivered to the site with shop primers other than polyamide epoxy or alkyd primer indicated above, shall receive an intermediate coat as necessary for compatibility with epoxy top coats.
4. All ferrous, nonferrous and galvanized metals in contact with concrete or masonry shall receive a polyamide epoxy primer with a minimum dry film thickness of 4 mils applied to the contact area.
5. Galvanized surfaces shall be treated as required by manufacturer to be compatible with the primer and top coats specified.
6. Areas that are designated to receive an epoxy coating as noted either on the Drawings or in Specification Section 09900 - Painting.
7. Galvanized metals shall be finished as indicated for ferrous metals, unless specifically indicated otherwise.

END OF SECTION

SECTION 11250

ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install the activated carbon filter at the wetwell as shown on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturer's:
   1. Calgon Corporation, Pittsburg, PA
   2. Or approved equal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Canister:
   1. Shall be self supporting and constructed of steel with full open head.
   2. Included with a removable cover and bolt-type closing ring with a polyclad cellulose gasket.
   3. Interior coated with two coats of a heat-cured epoxy-modified phenolic material.
   4. Exterior shall be primed and finish coated in accordance with the manufacturer's standard finish and suitable for the intended service.
   5. Equipped with a two inch outlet centered on the canister cover and two inch inlet near the base of the canister.
   6. Shall hold 150 pounds of carbon supported on a gravel underbed.
   7. Pressure drop through the unit shall be less than 15 inches of water at an air flow of 100 CFM.

B. Carbon:
   1. Shall be high activity, sodium-hydroxide impregnated activated carbon with enhanced capacity for hydrogen sulfide and methyl mercaptan odors.
   2. Shall have the following properties:

Base Material	Bituminous Coal
60 CCl_4 Number, Minimum	
Apparent Density	
g/cc, minimum	0.55
lb/ft^3, dense packing	34
Mesh Size, U.S. Sieve Series	4x6
Mean Particle Diameter, minimum mm	3.7
Hardness Number, minimum	90
Moisture, maximum %	15
H_2S Breakthrough, minimum in air, g H_2S Removed/cc Carbon (TM 41R)	0.12

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install using manufacturer's written instructions and as shown on the Drawings.

END OF SECTION

SECTION 11307

ABOVE GROUND SELF PRIMING CENTRIFUGAL PUMP STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Applicability: This section covers all sewage pump stations, with the exception of individual household pump stations. Individual household pump stations do not fall under the jurisdiction of the Wells Sanitary District.

B. Work Included: Furnish and install factory built, above ground self priming, automatic pumping stations. The pump stations shall be complete with all needed equipment.

C. System Description: Pump stations include package, duplex, self-priming, non-clog centrifugal pumps that are base mounted with a motor and liquid level and pump controls; a station management system to perform flow rate calculations, control start/stop of pumps, alternative sequencing and alarms; suction and discharge piping; local alarms with contacts for a remote transmission of alarms by a radio telemetry system; electrical service; and Doppler effluent flow meter.

1.2 QUALITY ASSURANCE

A. General:

1. The Specifications and Drawings direct attention to certain required features of the equipment and materials of construction, but do not purport to cover all details entering into its design. Nevertheless, the Contractor shall furnish all materials and equipment complete in all details and ready for operation for the intended purpose.
2. Equipment design, construction and installation in accordance with best practice and methods and conforming to the standards of the Hydraulic Institute.
3. All equipment and accessories shall be the manufacturer's latest and proven design.
4. All parts of the equipment shall be amply proportioned for long, continuous, and uninterrupted service.
5. Suitable provisions shall be made for easy access for service and replacement of parts.
6. Workmanship shall be first class in all respects.

B. Acceptable Manufacturers:

1. Gorman-Rupp, Mansfield, Ohio. (No equivalent)

1.3 SUBMITTALS TO THE DISTRICT

A. Plans and Calculations - Submit five sets of complete layout plans with all construction details, dimensions and support calculations for the proposed pump station(s) for review and approval by the Wells Sanitary District. Plans and

Specifications are to be prepared by a Professional Engineer with licensed by the State of Maine.

B. Shop Drawings - If the pump stations(s) are to be operated and maintained by the Wells Sanitary District, submit two sets of shop drawings for review and approval prior to construction. The pump station manufacturer shall integrate all the required shop drawings into a common bound submittal package for each pump station. The shop drawings shall include the following information:
   1. Sufficient information to verify compliance with the requirements herein and shall include equipment warranties and pump performance curves showing total dynamic head, pump input horsepower and pump efficiency over the rated capacity range of each pump.
   2. Manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements. .
   3. Letter from the Manufacturer stating that that they have: reviewed the Construction Documents, the intended installation by the Contractor, and the intended functional and operational conditions; determined all conditions to be acceptable; and found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.
   4. Structural design calculations and drawings demonstrating the structural integrity of all precast concrete units for the intended use and a buoyancy analysis of the pre-cast wet well with a factor of safety against flotation of 1.15 with the assumptions of the ground water table at finished grade and the wetwell empty.
   5. Installation instructions.
   6. Extended Warranty in the name of the District.

C. Operations and Maintenance Manuals - If the pump station(s) are to be operated by the Wells Sanitary District, submit three sets of complete O&M manuals for each piece of equipment prior to construction. The manuals are to be in a single binder for each pump station and shall include detailed information on the installation, assembly, alignment, start-up, normal operation, shut down, lubrication, maintenance and troubleshooting of all equipment along with parts lists and detailed drawings.

1.4 WARRANTEE

A. The Contractor shall obtain a warrantee by the self-priming centrifugal pump manufacturer, in the name of the District.

B. All equipment, apparatus, and parts furnished shall be warranted for five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

1.5 DESIGN CRITERIA

A. References:

1. Maine Subsurface Wastewater Disposal Rules (10 CMR 241), Department of Health & Human Services, 2005.
2. Guides for the Design of Wastewater Treatment Works, TR-16. New England Interstate Water Pollution Control Commission, 1998
3. Design of Wastewater and Stormwater Pumping Stations, WPCF MP FD-4. Water Pollution Control Federation, 1981.

B. Design Criteria:
1. Pump station capacity shall be based on design flow rates as determined by the Maine Subsurface Wastewater Disposal Rules (Chapter 5) and by TR-16. The design flow rate shall included allowances for infiltration and a peaking factor.
2. The minimum pump capacity for pump stations shall be 75-gpm per pump. In some cases where the design flow is very low, the District may consider the use of an alternative pumping station.
3. Calculations of total dynamic head (TDH) for pump sizing shall generally conform to MOP No. FD-4. Complete calculations of TDH and manufacturer's pump curves shall be submitted to the District.
4. The pump station wetwell shall be sized in order to limit the maximum number of pump starts per hour to four or less, based on the design pumping rate.
5. The pump station wetwell shall also be sized in order to provide 30 minutes of wetwell storage between the high level alarm elevation and the invert of the lowest incoming sewer invert, based on the design average daily wastewater flow rate to the pump station.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pumping units shall draw unscreened, raw sewage from a wet well and discharge into a force main against a total dynamic head as calculated using the above references.

B. The pumps shall be controlled automatically by the changes in liquid level in the wet well. All equipment for the station shall perform automatically.

C. The pump station shall be field assembled from individual components and prefabricated factory manufactured units. The following principal items of equipment shall be factory fabricated for modular field assembly:
1. Base mounted duplex self-priming pumps including: base, pumps, motors, drive units, motor controls, liquid controls, alarms, and power distribution panels.
2. A fiberglass reinforced plastic modular enclosure complete with: door, lighting, insulation, heat, ventilation, wiring in conduit and attachment hardware.
3. Precast concrete wet well and cover including: cast in watertight flexible wall penetrations for influent sewers and discharge pipes, cast in sleeves for suction, discharge and electrical conduits.

D. The major individual components for field assembly include, but are not limited to:

1. Suction and discharge piping
2. Electrical service
3. Sewer connections
4. Force main connections
5. Wet well
6. Pipe supports

2.2 DUPLEX, SELF PRIMING, CENTRIFUGAL PUMP PACKAGE

A. The Contractor shall furnish and install factory built skid mounted automatic pumping system. The station shall be complete with all equipment specified herein, and be factory assembled on a steel base. The principle items of equipment shall include self-priming, horizontal, centrifugal, V-belt motor driven sewage pumps, valves, piping, motor controllers with thermal-magnetic circuit breakers, magnetic motor starters, automatic liquid level control systems, alarm contacts for local alarm and remote annunciation via a radio telemetry system, internal wiring and flow meter.

B. Base unit shall consist of:
   1. Base plate, perimeter flange and reinforcements of fabricated steel not less than 1/4 inch thick, designed to support the pumps, drive units, valves and piping in correct alignment with each other and to secure the whole assembly to the pump station base.
   2. The base shall incorporate openings for access to all internal cavities and to permit draining of water contained within the base unit after installation.
   3. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions.
   4. Base plate and/or flange shall be drilled for hardware used to secure the base unit to the concrete pad as shown on the Drawings.
   5. The base unit shall contain provisions for lifting the complete pump unit during shipping and installation.

C. Pumps:
   1. General
      a. The pumps are horizontal, self-priming, centrifugal pumps specifically designed for pumping raw, unscreened domestic sanitary sewage.
      b. The pumps shall be manufactured by Gorman-Rupp.
      c. All openings, internal passages, and internal recirculating ports shall be large enough to permit the passage of 3 inch diameter spherical solids and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.
      d. All parts shall be designed and proportioned to have liberal strength, stability and stiffness to perform the required functions.
   2. Pump Components
      a. Pump casing: Shall be constructed of gray cast iron Class 30.
      b. Impeller: The impeller shall be two-vaned, semi-opened, non-clog, cast in ductile iron with integral pump out vanes on the back shroud. Impeller

shall be threaded onto the pump shaft and be secured with a socket head lockscrew and conical washer.

c. Shaft: Pump shaft shall be 4140 alloy steel

d. Shaft seal:

(1) Shall be oil lubricated and of the mechanical type. The seal shall be oil lubricated from a dedicated reservoir. The same oil shall not be used to lubricate both the shaft seal and the shaft bearings.

(2) The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped with tree light bands flatness (35 millionths of an inch).

(3) The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock.

(4) Elastomers shall be viton

(5) Cage and Spring to be 316 stainless steel.

e. Shaft bearings: The pump shaft bearings shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Bearings shall be lubricated with oil from a separate reservoir from the shaft seal.

3. Pump suction lift and reprime performance:

a. Each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

b. Each pump shall be capable of a reprime lift that meets the design elevations and conditions.

D. Pump Motors:

1. Motor Rating

a. The motors shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit.

b. The motor horsepower rating shall have sufficient capacity to operate the driven equipment as given by the design parameters.

c. All electric motors shall have either UL or FM approval ratings.

d. Motor shall have a service factor of 1.15, unless otherwise specified.

2. Motor Type

a. The motors shall be inverter duty rated provided with Class F insulation and a Class B Insulation system rise at a 1.15 service factor. Motors shall be wound with inverter duty wire and multi-dipped and baked in a polyester, Class H varnish. Nameplate on motor shall be stamped indicating motor is certified for use with VFD's.

c. Motors shall be manufactured by General Electric Co., Reliance, Toshiba, Siemens, or be an equivalent product.

e. All motors shall be NEMA Efficiency type. The nominal and/or minimum guaranteed efficiency shall be printed on the motor nameplate. The efficiency values shall conform to Energy Policy Act of 1992, unless exempted, and shall be as indicated in the following table:

Nominal Full Load Motor Efficiencies			
	Totally Enclosed Fan Cooled Motors		
HP	2-Pole	4-pole	6-Pole
1	77.0	85.5	82.5
1.5	84.0	86.5	87.5
2	85.5	86.5	88.5
3	86.5	89.5	89.5
5	88.5	89.5	89.5
7.5	89.5	91.7	91.0
10	90.2	91.7	91.0
15	91.0	92.4	91.7
20	91.0	93.0	91.7
25	91.7	93.6	93.0
30	91.7	93.6	93.0
40	92.4	94.1	94.1
50	93.0	94.5	94.1

2. Drive transmission:
   a. Power shall be transmitted from motors to pumps by means of V-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
   b. The drive assembly shall have a minimum of two V-belts. Single V-belt drives are not acceptable. Each V-belt assembly shall be sized to adequately transmit the power from the motor to the pump.
   c. Drive systems shall have a safety factor of 1.5 or greater.
3. Belt guards:
   a. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or a combination of materials consisting of expanded, perforated or solid sheet metal, except that openings shall not exceed 1/2 inch.
   b. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the base.
   c. All metal shall be free of burrs and sharp edges. Structural joints shall be welded continuously. Tack welds shall not exceed 4 inch spacing. Panels may be riveted to the frame.
   d. The guard shall be primed with a minimum of 1.5 mils of a zinc-based synthetic primer. A finish acrylic enamel coating (minimum of 1.5 mils.) shall be applied in accordance with section 3, Color definitions of ANSI 253.1: 1976, Safety Color Code for Marking Physical Hazards

E. Valves and Piping:
   1. Check Valves:

a. Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external level and spring.
b. The valve seat shall be constructed of stainless steel and shall be replaceable.
c. The valve body shall be cast iron and incorporate a 3" cleanout port.
d. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings.
e. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double O-rings. O-rings shall be easily replaceable without requiring access to interior of valve body.
f. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure.

2. Plug Valve:
   a. The discharge header shall include a 3-way plug valve to permit either or both pumps to be isolated from the common discharge header.
   b. Valves shall have ports designed to pass spherical solids equal to the pump's capability.
   c. The plug valve shall be non-lubricated, tapered type.
   d. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard.
   e. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface.
   f. The lever shall be equipped with a locking device to hold the plug in the desired position.
3. Air Release Valves:
   a. Each pump shall be equipped with one (1) automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
   b. All wetted parts shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
   c. A cleanout port, 3-inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.
   d. Valves shall be field adjustable for varying discharge heads.
4. Gauge Kit:
   a. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet of water column. Rated accuracy shall be 1 percent of full scale reading. Suction/compound gauges shall be graduated

-34 to +34 feet water column minimum. Discharge gauges shall be graduated 0 to 140 feet of water column minimum.

b. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

5. Doppler Flowmeter:
   a. The discharge header shall be provided with an external strap-on type dual-head doppler flow meter consisting of two transducers and a transmitter.
   b. Produces 4-20 mA signal to display flow rate on Pump Control Panel and Radio Telemetry Panel via an output terminal block.
   c. Acceptable Manufacturer: Greyline Instruments Inc. Model DFM-IV Doppler Flow Meter or equal
   d. Provide one year warrantee against defects in materials and workmanship.
6. Pump Drain Kit:
   a. Ten feet of plastic flexible hose with quick connect female camlock fittings on one end.
   b. Pipe nipple, bushing, bronze gate valve and quick connect male camlock fitting on each pump drain port.

F. Lubrication Fittings
1. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, or without creating falling hazards by unusual elevations. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible.
2. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type.
3. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.
4. Oil drains shall be piped to a location outside the equipment frame for ease of draining. Provide ball valve for positive shutoff. Pipe shall be galvanized steel.

G. Fiberglass Enclosure:
1. The pump station shall be enclosed by two-piece, sliding fiberglass cover with a thick resilient gasket at the joint between the sections and a suitable drip-lip around all the edges. Fiberglass enclosure sections shall be secured to their mounting hardware with tamper proof fasteners.
2. Cover dimensions shall be as required to enclose the pump station facilities.
3. The cover shall be designed so that only one half need be opened to allow full access to the pump station controls and to observe station operation. Both halves of the fiberglass cover shall be completely removable without the use of tools or hoisting equipment, for 360 degree access to all parts of the station.

4. The enclosure slide mechanism, hardware and exterior latches shall be constructed of corrosion resistant materials, with anodized extruded aluminum tracks and precision molded Acetyl rollers which do not require lubrication.
5. Provide heavy extruded aluminum, adjustable ventilating louvers on each end of the cover that can be manually opened and closed.
6. The fiberglass cover shall be made of molded reinforced orthophthalic polyester resins with a minimum of 30% glass fibers with a minimum average length of 1'1/4". The outside of the enclosure shall be coated with a polyester protective in-mold coating for resistance to weathering, ultra-violet radiation, yellowing and chalking. The fiberglass enclosure shall be resistant to mold, mildew, fungus and corrosive liquids and gasses normally found in pump station environments.
7. The fiberglass cover shall have a minimum of 1" thick urethane insulation, protected by fiberglass, with an "R" value of at least 7.
8. Provide a 1300/1500 watt, dual range auxiliary heater with automatic circulating fan, thermostat control and an on/off switch. The auxiliary heater shall be plugged into the station duplex receptacle.
9. Provide ventilating blower capable of 250 CFM at 0.1"of static water pressure to exhaust heat generated by the pumps, motors, and controls. The ventilating blower shall be turned ON and OFF automatically by an adjustable electronic thermostat. The discharge of the blower shall be covered by a heavy extruded aluminum louvered grille with adjustable openings. The air intake will be from the second louver on the other side of the enclosure.

H. Manway:
1. Provide a two piece manway cover of ¼" aluminum treadplate, with stainless steel piano hinges and hardware, located exterior to the fiberglass pump enclosure, with padlocking provisions. A two piece manway shall be required to facilitate visual checking of the wet well and float switches. The minimum open area of the manway access shall be at least 4.2 square feet.
2. The aluminum manway cover sections shall be secured with tamper proof fasteners to prevent unauthorized removal.

I. Bolts, Anchor Bolts, Nuts, Washers and Miscellaneous Hardware:
1. All anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be a minimum of 304 stainless steel unless otherwise indicated or specified. Type 316 stainless steel hardware is required in all submerged applications.
2. All anchor bolts shall be suitable size for the intended purpose. In no case shall anchor bolt size be less than 3/8" diameter.

2.3 ELECTRICAL AND INSTRUMENTATION EQUIPMENT

A. General:
1. All power distribution equipment shall be rated to withstand no less than 22,000 amps RMS available fault current at each pump station.

B. Control Panel Enclosure:
1. The electrical control equipment shall be mounted within NEMA 1, enclosures fabricated of stainless steel with stainless steel hardware.

2. The enclosure shall be provided with a suitable lockable hinged access door gasketed with neoprene and quick open latching devices and equipped with captive closing hardware (screwed or bolt type devices are unacceptable.)
3. Grouped together on the door, convenient to the operator, shall be all circuit breaker handles, selector switches, indicator lights, all reset buttons, run time meters, ampere meters and two (2) convenience outlets (one (1) inside panel, one (1) outside panel). All devices shall be clearly labeled.
5. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.
6. Supply all control and power transformers necessary to make panel functional. All transformers shall have both primary legs and all "hot" secondary legs fused. One (1) secondary leg shall be grounded.
7. Indicator lights within the control panel shall be heavy duty, oil tight type with plastic lenses. They shall be provided with chrome-plated metal or anodized aluminum mounting rings and name plates.
8. A terminal strip with box type connectors shall be supplied to make all power and control connections. All terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided. At least 20 percent of terminals supplied shall be spare.
9. Provide surge suppressors on all coils and field instrumentation.
10. Provide an incoming power circuit breaker, distribution circuit breakers for all panel functions and equipment, phase failure/single phase protection, motor starters/MCP disconnects, thermal overload heaters, 2 NO/2 NC auxiliary contacts, CPT indicating lights and controls.
11. Provide fluorescent light and duplex ground fault receptacle in control panel.
12. Refer to Section 16160 for additional details on panel construction.

C. Electric distribution panel (for control panel use only):
1. In addition to the motor branch circuits described below a distribution panel with 480V/120V control power transformer. 5 KVA minimum will provide thermal magnetic breakers with interrupting capacity compatible with the main breaker for the following 120 VAC circuits (where applicable):
   a. Pump controls (liquid level system);
   b. Alarm system (12 VDC charger/converter);
   c. Duplex 20 amp ground fault receptacle (in control panel);
   d. Lights (in Control Panel)
   e. Flowmeter
   f. Spare (4)
2. Refer to the Electrical Drawings for additional information.

D. Motor Branch Components:
1. Mounting: All motor branch components shall be of the highest industrial quality, securely fastened to a removable sub-plate with screws and lockwashers. The sub-plate shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.
2. Circuit Breakers and Operating Mechanisms:

a. A properly sized heavy duty magnetic only circuit breaker (MCP) shall be furnished for each pump motor. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

3. Motor Starters:
   a. An open frame, reduced voltage starters, NEMA rated magnetic motor starters shall be furnished for each pump motor.
   b. Starter shall employ magnetic contactor rated to match the equipment served, with thermal overload protection for each phase and with a magnetic type (MCP) circuit breaker/disconnect sized per circuit breaker manufacturer's recommendation for coordination with the thermal overload protection.
   c. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts.
   d. Starters rated "0", "00", or fractional sizes shall not be acceptable.
   e. Power contacts shall be double-break and made of cadmium oxide silver.
   f. All motor starters shall be equipped to provide undervoltage release and overload protection on all three phases.
   g. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.
4. Overload Relays:
   a. Overload relays shall be of block-type, utilizing melting alloy type spindles, and shall have visual trip indication with trip-free operation. Pressing of the overload reset lever shall not actuate the control contact until such time as the overload spindle has reset. Resetting of the overload reset lever will cause a snap-action contact to reset only and no convertible to circuit.
   b. Overload relays shall be manually reset only and not convertible to automatic reset.
   c. Trip setting shall be determined by heater element only and not by adjustable settings.
   d. An overload reset push button shall be mounted through the door of the control panel in such a manner as to permit resetting the overload relays without opening the control panel door.

E. Pump Control Components:
1. Control Circuit: The control circuit shall be protected by a thermal-magnetic air circuit breaker which shall be connected in such a manner as to allow power to be disconnected from all control circuits.
2. Pump Mode Selection: Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually, and to select automatic operation of each pump under control of the level control system. Manual operation shall override all shutdown systems, except for the motor

overload relays and low level cut out. Selector switches shall be oil tight rotary switches. Switch contacts shall be rated 15 amperes minimum at 120 volts non-inductive.

3. Alternator Relay: An automatic alternator shall be provided to reverse the sequence of lead, lag operation on the completion of each pumping cycle. The unit shall be designed so that at least one pump will continue to operate if the alternator fails and allow the lag pump to operate if the lead pump fails to start. Pump alternator relay shall be of electromechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.
4. Pump Run Indicators: Control panel shall be equipped with three pilot lights for each pump motor. Additional red alarm lights shall be as shown on the Drawings. Green light shall be wired in parallel with the related pump motor starter to indicate that the motor is running. The second light indicates the control system is on Automatic. The white light shall indicate that control has been switched to Manual operation. Indicator lights shall be heavy duty, oil tight, transformer type with glass lenses. They shall be provided with chrome plate metal or anodized aluminum mounting rings and name plates. Provide contacts for wiring to the radio telemetry system indicating Pump Run status.
5. Elapsed Time Indicators: Six digit elapsed time indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".
6. Sequence Selector: A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number 1 to be the lead pump for each pumping cycle, or to select pump number 2 to be the lead pump for each pumping cycle.
7. High Pump Temperature Protection:
    a. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
    b. A thermostat shall be mounted on each pump to detect its temperature, and a relay shall be supplied for each thermostat. If the pump temperature should rise to a level which could cause pump damage, the thermostat shall cause a magnetic switch to drop out the motor starter. An indicator, visible on the front of the control panel shall indicate that the pump motor has been stopped because of a high temperature condition. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.
8. The pump controls shall include a solid state, adjustable time delay relay to prevent both pumps from starting simultaneously after a power failure. Time delay shall be continuously adjustable from 0.2 to 10 seconds.
9. Provide a power failure time delay relay having an adjustment range of 0-180 seconds and alarm circuit as shown on the Drawing. The circuit will prevent nuisance alarms from occurring do to short intermittent outages.
10. Provide single phase protection for the motors.

F. Wiring:

1. The pump station as furnished by the manufacturer shall be completely wired, except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices. All wires shall be color coded and numbered and indicated on the wiring diagram. Refer to Drawings.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electrical Code (NEC).
3. All user serviceable wiring shall be Type MTW or THW, 600 volts, and shall be color coded.
4. Wire identification and sizing:
   a. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16 gauge minimum, Type MTW or THW, 600 volts. Wiring in conduit shall be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
   b. Motor branch conductors and other power conductors shall not be loaded above 60^{o} C temperature rating, on circuits of 100 amperes or less, nor above 75^{o} C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.
5. Wire Bundles: Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

G. Conduit:
1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Sufficient flexible conduit shall be provided on the motors to allow the motors to be removed without detaching power leads.
4. Conduit shall be supported in accordance with Articles 346, 347, and 350 of the NEC.
5. Conduit shall be sized according to the NEC.
6. Grounding: The pump station manufacturer shall ground all electrical equipment inside the pump station to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections. The contractor shall provide an earth driven ground

connecting to the pump station at the main ground lug in accordance with the NEC.

H. A complete panel wiring diagram shall be encased in a clear resealable plastic pouch and shall be mounted on the inside surface of the panel door.

2.4 A.C. LEVEL CONTROL SYSTEM

A. Controls:

1. Functional Description:

a. To control the operation of the pumps with variation in sewage level in the wet well shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be as required by the wet well operating range in feet of water column with an over-pressure rating 3 times full scale. The transducer shall have output capability of 1.5-7.5VDC or 4-20mA. The transducer's polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

b. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

c. Sequence of Operation: The level control system shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the pressure transducer output signal shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the pressure transducer output signal shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the pressure transducer output signal shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating to pump down the well. Pumps shall stop at their respective "stop" levels. High water and low water levels are also indicated.

d. Automatic Pump Alternations: The level control system shall utilize the alternator relay to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.

2. Submersible Pressure Transducer:

a. Submersible level sensor shall be capable of measuring liquid pressure with temperature compensation from 32^{o}F to 122^{o}F, and converting the sensed pressure to a 4-20 mA signal corresponding to liquid depth in feet.

b. Accuracy shall be ±0.25% for non-linearity, hysteresis and non-repeatability.
c. Case and wetted parts shall be constructed of 316 SS and viton.
d. The sensor shall be fitted with an open nose cap suitable for water applications.
e. The signal cable shall be a polyurethane-coated cable containing control and power wiring, shielding and a reference vent tube. Cable shall be provided with sufficient continuous length between the level elements and a NEMA 4X stainless steel junction box located outside the tank.
f. The pressure transducers shall be mounted in a 2-inch diameter schedule 80 PVC pipe (stilling well), installed adjacent to the tank/channel wall, extending to within 6-inches of the tank bottom and within 12-inches below tank cover (where enclosed). The pipe shall be rigidly supported along its length with stainless steel brackets and hardware. The installation must also be in complete compliance with the pressure transducer manufacturer's installation requirements, and applicable sections of the specifications.

3. Level Indicator Display
   a. Display: 0.5 inch LED, 4 digit numerical display.
   b. Digital Format: ###.#
   c. Units: feet
   d. Rating: NEMA 4X, IP65
   e. Input Signal: 4-20 ma
   f. Programming: Setup and programming of the indicator shall be by using keys on the front of the bezel. All settings shall be held in non-volatile memory.
   g. Indicator shall have two user configurable Form C (SPDT) relays.
4. Electronic Comparators
   a. Level adjustments shall be electronic compactor setpoints to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable, and accessible to the operator without opening the control panel or any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
5. Output Relays
   a. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The ON state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing fused overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4

contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

6. High Water Alarm and Low Water Alarm
   a. The pressure transducer shall be equipped with an additional electronic comparators and solid state output relays to alert maintenance personnel to a high and low liquid levels in the wet well. In the event that the wet well liquid reaches a preset high or low water alarm level, the high or low water alarm output shall energize a signal relay. The signal relay shall complete a 12 volt DC circuit for an external alarm device. A mechanical indicator, visible on the front of the control panel, shall indicate that a high or low wet well level exists. The signal relay shall maintain the alarm signal until the wet well level has been lowered and the circuit has been manually reset for high water alarms. The low water shall also shut off the pumps but shall automatically reset and turn the pumps on again when the wet well level rises to the standard start level. Annunciation of the alarms are further described in the following Alarm System paragraph.

C. Alarm system:
   1. A manual reset and silence 12 VDC alarm system shall be furnished and installed as specified.
   2. The alarm system shall activate indicator lights located in the control panel for any of the following conditions:
      a. High water - Wet Well
      b. Low water - Wet Well
      c. Loss of power supply
      d. High pump temperature (for each pump)
      e. Low building temperature
      f. Back-up power failure
      g. High building temperature
      h. Engine Overcrank
      i. Engine Overtemp
      j. Engine Low Oil Pressure

      An indicator light shall be provided for each of the above conditions with common manual reset button. The interruption of normal power, transfer to battery backup, and retransfer to normal power after its restoration shall not change alarm indicator light status.
   3. The alarm indicator lights shall be powered by means of a suitable 12 volt D.C. power supply with standby battery pack. Lead-calcium type batteries shall be supplied. The battery pack shall have sufficient capacity to power the load for a period of 8 hours at a battery voltage not below 87½% of nominal voltage. The batteries shall be protected from excessive discharge by an automatic low voltage battery cut out circuit. Cut out to be at least at 85% of nominal battery voltage. Connect power supply to dedicated 120V, 20 A circuit.
   4. Power supply shall provide means for keeping the battery pack in a constant state of full charge readiness. Power supply shall have capacity to recharge batteries to full charge within 16 hours even under an alarm condition.

5. Each alarm point shall be provided with a double set of auxiliary dry contacts. One (1) set of contacts shall be wired in parallel to a terminal strip to activate the common local light. The second set of alarm contacts shall be provided for wiring to the radio telemetry system that will transmit the separate alarm signal to the treatment plant for annunciation. See the Electrical Drawings to coordinate work.
6. All wiring from the pump control panel alarm points intended to interconnect with the radio telemetry system shall be terminated on a terminal strip located in the control panel. All wires and terminals shall be clearly labeled describing each specific alarm as well as wire numbers in order to facilitate future field connections to the telemetry system if not within the alarm control panel.
7. Dry contacts used for radio telemetry inputs shall be bifurcated cross bar gold overlay silver and rated dry circuit. These contacts will be provided through dedicated interposing relays activated by the alarm circuit as shown on the schematic diagrams of the Drawings. Relays shall be provided with plug-in type sockets with screw terminal wiring connections to facilitate relay change out and wiring. Relays shall be Potter and Brumfield type KHAU-17A16 - 120 or 12V as shown on Drawing.

2.5 FINISHES

A. Provide the following finishes on all equipment supplied by the pump station manufacturer:
   1. SSPC-SP6, surface preparation.
   2. One (1) 6.8 mil dry film thickness (DFT) coating of Vers-pox® self-priming Cycloaliphetic Amide Epoxy factory applied to pump station base.
   3. One (1) 2-3 mil DFT top coat of Xtr-Thene™, moisture cured Aliphatic Polyurethane factory applied to top of base and all other structural, pump and piping assemblies.
   4. One (1) 6-8 mil DFT coat of Extra Guard™ epoxy applied to the bottom of base.
   5. All other carbon steel surfaces not otherwise protected shall be coated with suitable non-handling rust preventative compound.
   6. Pump station shall be completely finish coated prior to shipment.
   7. Provide paint touch-up kit to repair any damage to coatings that may occur during installation.
B. For all other pump station equipment not supplied finish coated, provide surface preparation, shop coatings, and top coats in accordance with Division 9.

2.6 SPARE PARTS

A. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts listed below shall be provided for each package pump station.
B. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
C. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.

D. Mechanical pump spare part kit for each pump station shall include:
   1. One (1) complete spare mechanical seal with all gaskets, seals, sleeves, O-rings, and packing required to replace the seal.
   2. One (1) set of impeller clearance adjustment shims.
   3. One (1) quart of seal lubricant.
   4. One (1) cover plate O-ring.
   5. One (1) rotating assembly O-ring.
   6. One (1) rotating assembly.

E. Electrical spare parts for each pump station shall include:
   1. One (1) control switch of each type complete with contact blocks.
   2. Ten (10) indicator lamp bulbs.
   3. O/L Blocks.
   4. One (1) strobe light lamp bulb.
   5. Parts shall be contained inside of panel, packaged in such a way to prevent breakage.

2.7 FACTORY TESTING

A. All components of the pump station shall be given an operational test at the manufacturer's facility to assure proper operation prior to shipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the self-priming centrifugal pumping system and related appurtenances shall be done in accordance with written instructions provided by the pump station manufacturer.

B. The Contractor shall provide for the supervisory service of the self-pump station manufacturer's factory trained engineer or personnel, who are specifically trained on the type of equipment supplied. These personnel shall assist the Contractor in installation and start-up of the pump station. The station manufacturer shall provide as part of his bid price, the services of the factory trained representative for a period of one day at each pump station for initial start up and operation instructions. These personnel shall provide one routine service call during the first year of operation at no additional cost to the Owner.

C. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the District.

D. All piping and control tubing that penetrate the concrete wet well slab shall be sealed tightly to prevent the passage of any vapor or moisture, utilizing pipe sleeves and expansion seals, as approved by the District.

3.2 START-UP AND TESTING

A. In accordance with the manufacturer's written requirements.

B. Contractor shall provide all necessary power, tools, equipment, piping, labor, water, fuel or other materials needed for start-up and testing.

C. Demonstrate the equipment's ability to operate without overloading jamming, excessive vibration, etc. during normal operation conditions. In addition, demonstrate the equipment's ability to meet the performance requirements specified for the equipment system to make a complete operational system, suited for its intended use.

1. If sufficient sewage or water is not available for tests, Contractor will provide water at his expense for testing.
2. During tests, observe and record head, output, rpm and motor input. Sufficient test points shall be obtained to develop accurate pump system curve. Fully demonstrate ability to operate at specified conditions without motor overload.
4. For mechanical seals, after a run-in period of 30 minutes, the seal area shall be wiped dry. The pump shall be operated for a 10 minute period. No measurable leakage shall be detected from the mechanical seal.

D. Use all precautions necessary to protect the pump station enclosure and prefinished equipment from scratches, nicks, gouges, dents, and the material during assembly and after installation.

E. Clean fiberglass products in strict accordance with manufacturer's recommendations and instructions.

3.3 FINAL ADJUSTMENT

A. Make all adjustments necessary to place equipment in satisfactory working order made at the time of testing.

B. All defects or defective equipment shall be corrected or replaced promptly at the Contractor's expense.

END OF SECTION

SECTION 15050

PIPE & PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test pipe and pipe fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere (When Applicable):

1. Excavation and backfill are specified in Division 2.
2. Concrete cradles, arches, and encasements are specified in Division 3.
3. Painting and Pipe Identification are specified in Section 09900.
4. Surface Preparation and Shop Coatings are specified in Section 09905.
5. Valves, gates, pipe hangers, pipe supports, pipe and equipment insulation, heating, and plumbing are specified in the appropriate Sections in Division 15.
6. Pipe materials are specified in the appropriate sections of Division 2 and/or Division 15.

1.2 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI B31.1 – Power Piping
2. ANSI B31.3 – Process Piping
3. ANSI B31.4 – Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohol.
4. ANSI B31.5 – Refrigeration Piping
5. ANSI B31.9 – Building Services Piping
6. ANSI B31.8 – Gas Transmission and Distribution Piping Systems

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01340.

B. Submit manufacturer's "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.

C. Submit other documents as specified in the appropriate Sections of this Division.

D. Submit complete pipe support system design. The support system shall be designed for dead weight and dynamic loads, including system thermal effects and pressure thrust on seismic forces.

1.4 DELIVERY, STORAGE AND HANDLING

A. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings.

B. Do not drop pipe and fittings.

C. Store materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the District.

D. Assure that materials are kept clean and dry.
E. Do not store materials directly on the ground.
F. Follow manufacturer's specific instructions, recommendations and requirements.
G. Store in a manner to protect items with epoxy shop coatings from exposure to UV light which can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer's recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be topcoated as specified in Section 09900.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials are specified in the following Sections in this Division and in Division 2.

2.2 SURFACE PREPARATION AND SHOP COATINGS

A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the District to inspect pipe, fittings, gaskets, and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
   1. Defects and damage.
   2. Deviations beyond allowable tolerances for joint dimensions.
   3. Removal of debris and foreign matter.
D. Examine areas and structures to receive piping for:
   1. Defects, such as weak structural components that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerances for pipe clearances.
E. All materials and methods not meeting the requirements of this Contract will be rejected.
F. Immediately remove all rejected materials from the project site.
G. Start work only when conditions are corrected to the satisfaction of the District.

3.2 INSTALLATION

A. General:
   1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations and as specified herein.
   2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation.
   3. Install adapters, acceptable to the District, when connecting pipes constructed from different materials.

4. Support all piping not being installed in trenches in accordance with the "Pipe Hangers & Supports" Section in Division 15.

B. Installation in Trenches:
   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. Set the pipe true to line and grade.
   7. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
   8. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.
   9. 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.
   10. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
   11. Take all necessary precautions to prevent floatation of the pipe in the trench.
   12. Bedding and backfill for all pipe materials shall be as specified in Section 02200, Earthwork, and as shown on the Drawings.

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.

3.3 CLEANING AND TESTING

A. Cleaning & Testing Piping - General:
   1. Thoroughly clean all piping prior to testing. Remove all dirt, dust, oil, grease and other foreign material. Exercise care while cleaning to avoid damage to linings and coatings.
   2. When the installation is complete, test all pipelines in the presence of the District and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes and the appropriate Sections of these Specifications. When requested by the District or local plumbing inspector, building gravity drains shall be tested prior to backfilling or concealing. All other piping must be tested after backfilling.
   3. Equipment: Supply all labor, equipment, materials, taps, gauges, and pumps required to conduct the tests.

4. Retesting: Perform all retesting required by the District at no additional cost to the Owner.

B. Outside Sewer Lines Pipe testing shall be performed in accordance with Section 02755.

C. All Other Piping Systems:

1. Hydrostatic Pressure Test:
   a. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air the Contractor shall make the necessary excavations, backfilling and taps at such points and shall plug said holes after completion of the test.
   b. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
   c. Perform pressure and leakage test at the test pressure shown on the Pipe Schedule. If no test pressure is indicated, perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi which ever is greater (based on the elevation of the lowest point of the section under test and corrected to the gauge location).
   d. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period on buried pipelines exceeds a rate calculated by the equation, the section shall be considered as having failed the test:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

L = allowable leakage in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure, in pounds per square inch

Leakage, if any, shall be equal to or less than the amounts as determined by Section 4.2 of AWWA C 600. All pipes within structures and chambers and all flanged joints shall have no visible leakage.

   e. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

2. Connection to Work by Others.
   a. If work involves connection of pipe lines to pipes or structures provided by others, pressure tests pipe line prior to making the connection.
   b. After successfully passing the pipe line pressure test, make the necessary connections to the work by others, and pressure test the connection.
   c. The connection shall be pressurized to the pipe line test pressure, for a minimum of 4 hours. The connection shall have no visible leakage.

d. Correct any leakage at no cost to the Owner and retest until connection passes.

3.Cleaning: Perform all specialized cleaning as specified or required by system.

END OF SECTION

SECTION 15062

DUCTILE IRON PIPE & FITTINGS
(INTERIOR APPLICATIONS)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install ductile iron pipe and fittings of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere:
   1. Pipe and Pipe Fittings - General is specified in Section 15050.
   2. Surface Preparation and Shop Coatings are specified in Section 09905.
   3. Ductile Iron Pipe & Fittings for Buried Applications is specified in Section 02615.

1.2 QUALITY ASSURANCE

A. Standards (As Applicable):
   1. Cement-mortar lining for water: ANSI A2l.4 (AWWA C104).
   2. Rubber gasket joints: ANSI A2l.ll (AWWA C111).
   3. Ductile iron pipe thickness: ANSI A2l.50 (AWWA C150).
   4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A2l.5l (AWWA C151).
   5. Pipe flanges and fittings: ANSI Bl6.l and ANSI A21.10 (AWWA C110).
   6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
   7. Cast and ductile iron fittings: ANSI A2l.l0 (AWWA C110).
   8. Ductile Iron Compact Fittings: ANSI 21.53 (AWWA C153).

B. Acceptable Manufacturers:
   1. Tyler
   2. Griffin
   3. Union
   4. US Pipe
   5. Or equivalent.

1.3 DELIVERY, STORAGE & HANDLING

A. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.

B. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General:
   1. Unless otherwise shown on the Drawings, the minimum thickness of ductile iron pipe shall be Class 53.
   2. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
   3. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings.
   4. The outside of all interior pipe shall be coated in accordance with Section 15050.

B. Pipe Interior Lining:
   1. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings and except for air piping lines which shall be completely unlined.
   2. When required, glass lining shall meet the following requirements:
      a. Glass lining shall be fused to metal base by firing entire pipe or fitting to a temperature above 1,400 degrees F and held at that temperature for sufficient time to develop a smooth vitreous lining which has a molecular bond to the metal.
      b. Glass lining shall be a minimum of 0.008-inch thick and shall be capable of withstanding an instantaneous thermal shock of 350 degrees F temperature differential without crazing, blistering or spalling. Lining shall be free of pinholes which expose the metal.
      c. Glass lining shall have a hardness of 5-6 on the Mohs scale and a density of 2.5 to 3.0 grams per cubic centimeter.

C. Joints (as shown on Drawings or as specified):
   1. Flanged:
      a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
      b. Flanges shall be flat face, long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
      c. Gaskets:
         (l) Full face gaskets only.
         (2) Thickness of gaskets l2 inches in diameter and smaller: l/l6 inch.
         (3) Thickness of gaskets larger than l2 inches in diameter: 3/32 inch.
         (4) On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 250°F.
      d. Fasteners:
         (l) Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.

(2) The number and size of bolts shall meet the requirements of the applicable ANSI standard.
(3) Nuts, bolts, and studs shall be Grade B meeting the requirements of ASTM A307.

e. When applicable, provide and install flange clamps as shown on the Drawings.

2. Grooved split ring couplings, sleeve couplings, flexible joints and couplings, shall be supplied as specified in "Couplings and Connectors" Section.
3. Joint Bracing:
   a. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings.
   b. Types of bracing:
      (1) Pipe and fittings furnished with approved 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 bituminous paint in buried installations and shall be coated with the same coatings as the piping system in interior installations after assembly or, if necessary, prior to assembly.
      (2) Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:
   1. Either gray cast iron or ductile iron fittings may be furnished.
   2. Pressure rating of 250 psi unless indicated otherwise on the Drawings or as specified.
   3. Flange fittings shall be ANSI B16.1, Class 125 unless indicated otherwise. Flanges shall be flat faced, with full face gaskets.
   4. Joints the same as the pipe with which they are used or as shown on the Drawings.
   5. Provide fittings with standard bases where shown on the Drawings.
   6. Cement lining and seal coat unless noted otherwise on the Drawings, and except for air piping applications where the fittings shall be unlined.
   7. All interior fittings shall receive coating in accordance with Section 15050.
   8. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F. to 250° F.

B. Non-Standard Fittings:
   1. Fittings having non-standard dimensions shall be subject to the Engineer's review and acceptance.
   2. Non-standard fittings shall have the same diameter and thickness as standard fittings and shall meet the specification requirements for standard fittings.

3. The lengths and types of joints shall be determined by the particular piping to which they connect.
4. Flanged fittings not meeting the requirements of ANSI A21.10 (i.e., laterals or reducing elbows) shall meet the requirements of ANSI B16.1 in Class 125.

C. Wall Castings:
1. Size, type and location as shown on the Drawings.
2. Dimensions shall conform to ANSI A21.10 except where required. A flange substantially flush with the face of a concrete or masonry wall shall be drilled and tapped for studs.
3. Other dimensions shall be identical to the corresponding parts of standard bell and spigot fittings.
4. A central fin not less than 1/2 inch thick and of the same diameter as a flange shall be cast on the barrel at a point that will locate it midway through the wall to form a waterstop.
5. Alternate wall sleeve system as manufactured by Omni Sleeve, Malden, MA. can be utilized as approved by Engineer, in place of above specified wall casting system.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
2. Deviations beyond allowable tolerances for pipe clearances.
D. Immediately remove all rejected materials from the project site.

3.2 INSTALLATION

A. General:
1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.
2. Acceptable thrust resistant system is required at all fittings on pressure pipe.
B. Assembling Joints:
1. Flanged Joints:
a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.

2. Bolted Joints:
    a. Remove rust preventive coatings from machined surfaces prior to assembly.
    b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.

C. Fabrication:
1. Tapped Connections:
    a. Make all tapped connections as shown on the Drawings or as required by the Engineer.
    b. Make all connections watertight and of adequate strength to prevent pullout.
    c. Drill and tap normal to the longitudinal axis of the pipe.
    d. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANSI A2l.5l based on 3 full threads for ductile iron.
    e. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.

D. Castings in Masonry:
1. Accurately set and align castings to be encased in masonry.
2. Thoroughly clean castings immediately prior to being set in place. Remove all rust, scale and other foreign material.

END OF SECTION

SECTION 15088

COUPLINGS & CONNECTORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install couplings and connectors of the type(s) and size(s) as specified herein.

1.2 QUALITY ASSURANCE

A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.

B. Couplings and connectors, other than those specified herein, are subject to the District's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All Couplings and Connectors:
   1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.
   2. Diameters to properly fit the specific types of pipes on which couplings and connectors are to be installed.

B. Sleeve Type Couplings (When Applicable):
   1. Exposed Couplings (When Applicable):
      a. Steel middle ring,
      b. Two steel follower rings,
      c. Two wedge-section gaskets,
      d. Sufficient steel bolts to properly compress the gaskets,
      e. Acceptable Manufacturers:
         (1) Dresser Manufacturing Co. - Style 38,
         (2) Rockwell - Style 431,
         (3) Or equivalent.
   2. Buried Couplings (When Applicable):
      a. Cast iron or epoxy coated steel middle rings with pipe stops removed,
      b. Two malleable iron or epoxy coated steel follower rings with ribbed construction,
      c. Two wedge-section gaskets,
      d. Sufficient AWWA C-111 or galvanized steel nuts and bolts to properly compress the gaskets,

e. Acceptable Manufacturers:
(1) Dresser Manufacturing Co. - Style 38 and/or 153,
(2) Rockwell - Style 431, and/or 441,
(3) Or equivalent.

C. Split Type Couplings (When Applicable):
1. Constructed from malleable or ductile iron.
2. For use with grooved or shouldered end pipe with minimum wall thickness as required so as not to weaken pipe.
3. Cast in two segments for 3/4 inch through l4 inch pipe sizes, four segments for l5 inch through 24 inch pipe sizes, and six segments for pipe sizes over 24 inch.
4. Coating: Enamel.
5. Bolts: Carbon steel.
6. All gaskets shall be Manufacturers Standard or as required for intended service with respect to fluid, temperature and pressure.
7. Acceptable Manufacturers:
a. Victaulic Company of America, Style 77 for IPS Pipe, Style 31 for Ductile Iron Pipe.
b. Gustin-Bacon Co.,
c. Or equivalent.

D. Flanged Adapters (When Applicable):
1. For joining plain end or grooved end pipe to flanged pipes and fittings.
2. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges l25 or l50 pound standard unless otherwise required for connections.
3. Exposed Sleeve Type:
a. Constructed from steel.
b. Coating: Enamel.
c. Bolts: Carbon steel or ASTM A588 steel.
d. Acceptable Manufacturers:
(1) Dresser Manufacturing Co. - Style l28 for cast iron, ductile iron and steel pipes with diameters of 2 inches through 96 inches,
(2) Or equivalent.
4. Buried Sleeve Type:
a. Constructed from cast iron.
b. Bolts: ASTM A588 steel or galvanized steel.
c. Acceptable Manufacturers:
(l) Dresser Manufacturing Co. - Style l27 locking type for cast iron, ductile iron, asbestos cement and steel pipes with diameters of 3 inches through l2 inches,
(2) Or equivalent.
5. Split Type:
a. Constructed from malleable or ductile iron.
b. For use with grooved or shouldered end pipe.

c. Coating: Enamel.
d. Acceptable Manufacturers:
(1) Victaulic Company of America - Style 74l for IPS pipe, or Style 341 for Ductile Iron Pipe, for pipe diameters of 2 inches through l2 inches,
(2) Victaulic Company of America - Style 742 for IPS pipe, or Style 342 for Ductile Iron Pipe, for pipe diameters of l4 inches through l6 inches,
(3) Or equivalent.

E. Flexible Joints:
1. Expansion Joints:
a. Materials shall be capable of withstanding the temperature, pressure and type of material in the pipeline.
b. Shall be the filled arch type that will prevent sediment build up for all sludge, sewage, and other lines with similar service.
c. Supplied with control rods to restrict elongation and compression.
d. Metal retaining rings shall be split and bevelled galvanized steel for placement against the flange of the expansion joint.
2. Deflection Joints:
a. Joints designed to permit a nominal maximum deflection of l5 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under l5 degrees.
b. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
c. Supplied with control rods as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeve Type Couplings (When Applicable):
l. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
3. Insert the other pipe length into the middle ring the proper distance.
4. Press the gaskets and followers evenly and firmly into the middle ring flares.
5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
6. Insert and tighten the tapered threaded lock pins.

7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange to the torque recommended by the manufacturer.

B. Split Type Flange Adapters (When Applicable): Install in the same manner as Split Type Couplings.

C. Buried Cast Iron Couplings, Adapters and Connectors (When Applicable): Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the District with a heavy-bodied bituminous mastic as approved by the District.

D. Buried Epoxy Coated Steel Couplings: Thoroughly coat all exterior surfaces, including nuts and bolts after assembly and inspection by the District with a coal tar approved by the District. Prior to coating, roughen the epoxy with emory paper and follow with a solvent cleaner (aeromatic similar to xylol). Dry film thickness of the coal tar is to be 12-16 mils.

E. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

F. All interior sleeve interior couplings shall be restrained with tie rods when used on pressurized lines. All buried couplings on pressure lines shall be restrained (solid sleeve) type.

END OF SECTION

SECTION 15092

PIPE SLEEVES & SEALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install wall sleeves and seals of the type(s) and sizes(s) specified herein.

1.1 QUALITY ASSURANCE

A. Provide and install all sleeves of the types specified herein, as shown on the Drawings and as directed by the District.

B. Provide sleeves that are airtight, gastight or watertight as required.

PART 2 - PRODUCTS

2.1 TYPES AND LOCATIONS

A. New Construction:

1. Concrete Walls - Liquid Containing Structures to Air or Ground:
    a. For ductile iron and steel piping systems, utilize wall castings. Materials, schedule, class and size to match pipe.
        i. For galvanized steel piping systems, use sleeve with 1 inch x 1/2 inch welded sealing and anchoring collar in middle, hot-dip galvanized after fabrication.
        ii. For ductile or cast iron piping systems, use casting with 1 inch x 1/2 inch integrally cast sealing and anchoring collar in middle.
        iii. Refer to details on Process Drawings.
    b. For plastic piping systems, sleeve and seals to be in accordance with Concrete Walls - Air to Ground requirements noted above. These type penetrations will be allowable only in those locations specifically depicted on the drawings.
2. Other conditions shall be sleeved as shown on the Drawings or as reviewed and accepted by the District.

B. Penetrations Through Existing Walls:

1. Concrete Walls - Liquid Containing Structures to Air or Ground:
    a. Limited to only those locations shown on the Drawings.
    b. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
    c. Size of cored opening as required by seal manufacturer.
    d. Seal with rubber link compression seal.
2. Other conditions shall be installed as reviewed and accepted by the District.

C. Rubber Link Seals:

1. Multi-rubber link type with pressure plates, bolts, nuts and sealing element providing a leakproof seal.
2. General Service:
    a. Glass Reinforced Nylon Pressure Plate.

b. Carbon steel zinc-phosphated nut and bolt.
c. Sealing element: EPDM rubber.
d. -40°F. to 250°F. rating.

3. Corrosive Service: (Where Applicable):
   a. Use: Sludge tanks, scum tanks, digesters, wetwells, manholes, as shown on the Drawings.
   b. Glass Reinforced Nylon Pressure Plate.
   c. Bolt and nut, l8-8 stainless steel.
   d. Sealing element: EPDM rubber.
4. Acceptable Manufacturers:
   a. Link Seal by Thunderline Company
   b. Or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. New construction:
   1. Concrete: Set sleeves in proper location prior to placing concrete.

B. Existing Construction:
   1. The location will be reviewed and accepted by the District prior to cutting hole.
   2. For concrete, holes shall be located to avoid the reinforcing steel when possible.
   3. Patch all damaged work as required to maintain a neat and clean appearance.

C. Rubber Link Seals: Install as required and in strict accordance with the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 15094

PIPE HANGERS & SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install pipe hangers and supports to rigidly support pipes, maintain the necessary pitch, prevent vibration, prevent movement, and to allow expansion and contraction of the pipe.

1.2 RELATED WORK

A. Concrete is included in Division 3.

B. Pipe and fittings are included in respective sections in Divisions 2, 11 and 15.

1.3 SUBMITTALS

A. Submit to the District complete sets of shop drawings of all items to be furnished under this Section. Submittals shall include complete layouts, schedules, location plans and complete total bill of materials for all pipe support systems.

B. Submittals shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support. Provide detailed information on anti-seize compound.

PART 2 - PRODUCTS

2.1 GENERAL

A. All of the products specified herein are intended to support the various types of piping systems shown on the Drawings. It shall be the responsibility of the Contractor to develop final details associated with special conditions (in particular system temperatures and pressures) associated with this project.

B. All pipe and appurtenances connected to the equipment shall be supported in a matter to prevent any strain from being imposed on the equipment or piping system.

C. Unless otherwise specified, all rods, clamps, hangers, inserts, anchor bolts, brackets and components for interior pipe supports shall be furnished with galvanized finish, hot dipped or electro-galvanized coated, except where field welding is required, where cold-applied galvanizing may be used. Interior clamps on plastic pipe shall be plastic coated. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, piping subject to moisture or corrosive atmosphere, submerged pipe and pipe within outdoor structures shall be of Type 316 stainless steel.

D. All insulated pipe shall be furnished with a rigid form insulating saddle at each pipe support location as specified under respective pipe insulation. Provide protection shields as specified in each support location.

E. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MCC-SP-58 and -69; an shall be as manufactured by Anvil International Inc., Portsmouth, NH; Carpenter & Patterson Inc., Woburn, MA; F&S Central, Brooklyn, NY, or equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.

F. Expansion anchors shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Minneapolis, MI or Wej-it by Wej-it Expansion Products, Inc., Bloomfield, CO. The length of expansion bolts shall be sufficient to p lace the wedge portion of the bolt a minimum of 1-inch behind the steel reinforcement.

2.2 MATERIALS

A. Overhead Hangers:
   1. For pipes 8 inches in diameter and smaller:
      a. Adjustable clevis.
      b. Acceptable manufacturers:
         (1) Anvil International, Inc.
         (2) Carpenter & Patterson Inc.
         (3) Or approved equal.
   2. For pipes larger than 8 inches in diameter:
      a. Single pipe rolls and sockets.
      b. Acceptable Manufacturers:
         (1) Anvil International, Inc.
         (2) Carpenter & Paterson Inc.
         (3) Or approved equal.
   3. For insulated pipe use insulation protection shield:
         (1) Anvil International, Inc.
         (2) Carpenter & Paterson Inc.
         (3) Or approved equal.
   4. For copper piping:
      a. Copper plated malleable iron.
      b. Acceptable manufacturer:
         (1) Anvil International, Inc.
         (2) Carpenter & Paterson Inc.
         (3) Or approved equal.
   5. Threaded hanger rods:
      a. Right-hand and left-hand machine threads.
      b. Suspended from beam clamps or galvanized inserts in concrete.
      c. Acceptable manufacturers:
         (1) Anvil International, Inc.
         (2) Carpenter & Paterson Inc.
         (3) Or approved equal.

B. Pipe Saddle Supports:
   1. Adjustable type with pipe and floor flanges.

2. When used under base fittings, substitute matching floor flanges for saddle sections.
3. Acceptable manufacturers:
   a. Anvil International, Inc.
   b. Carpenter & Paterson Inc.
   c. Or approved equal.

C. Wall and column supports:
1. Welded steel brackets with anchor chairs.
2. Install additional wall bearing plates where required for wall brackets.
3. Acceptable manufacturers:
   a. Anvil International, Inc.
   b. Carpenter & Paterson Inc.
   c. Or approved equal.

D. Brick and Concrete Piers:
1. Locate where shown on the Drawings and/or where required for proper support.
2. Construct piers to accurately conform to the bottom one-third to one-half of the pipe.

E. Plastic Pipe Hangers:
1. Plastic coated hangers.
2. Acceptable manufacturers:
   a. Anvil International, Inc.
   b. Carpenter & Paterson Inc., Fig. 800PVC.
   c. Or approved equal.

F. Miscellaneous Hangers: Submit shop drawings for review and acceptance by District prior to use.

G. All additional supports, braces, brackets, etc. which are not specifically described above, but which are required to provide a system in accordance with the applicable paragraphs of this section, shall be provided and installed. Submit all such devices for shop drawing review and acceptance by the District prior to use.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install in at all changes in direction and at the end of piping runs. Provide additional devices as required to meet the intent of the specification with respect to support, pitch, vibration, movement, and expansion and contraction.
2. Install all hangers, supports, rods, inserts, clamps, brackets, braces, bolts and other supporting devices of sizes and spacings to prevent loads from exceeding the manufacturer's maximum recommended loading with a safety factor of 5.
3. Provide lock washers or locknuts on hangers, supports, rods, inserts, clamps, brackets, braces, bolts and other supporting devices.
4. Secure hangers to beams or approved concrete inserts where possible.
5. When piping is installed on structural steel supports, provide blocking of pipe rolls to prevent lateral pipe movement.

6. Do not support piping from other pipes or from stairs and walkways.
7. Set all inserts before the concrete is placed.
8. Hangers secured to precast concrete plank construction shall be attached by means of steel plates placed on the upper side of the plank, with the hanger rod extending through the plate and secured by means of a nut and lock washer. The hole in the plank shall be grouted to fill the void through which the hanger rod protrudes in order to distribute the load over the full area of the hanger plate. Plates shall conform to the following schedule.

Size of Pipe Supported (inches)	Plate Thickness (inches)	Minimum Plate Size (inches)
1 & smaller	3/16	4 x 4
1-1/4 to 2	3/16	5 x 5
2-1/2 to 4	1/4	6 x 6
5 to 6	1/4	10 x 10
Over 6	1/4	12 x 12

B. Expansion and Contraction:
   1. Rigidly support all piping with adequate provisions for expansion and contraction.
   2. Firmly anchor horizontal runs over 50 feet in length at the midpoint of the runs to force expansion equally toward the ends.

C. Spacing:
   1. Install hangers and supports at sufficiently close intervals to maintain alignment and prevent sagging.
   2. Maximum spacing of hangers and supports:

Pipe Size (inches)	Spacing (feet)
1 & smaller	6
1-1/4 to 2	9
2-1/2 to 3	11
4 and larger	14
C.I. Soil Pipe (all sizes)	5
P.V.C. (all sizes)	As recommended by manufacturer
Fiberglass	As recommended by manufacturer

D. Supporting Vertical Piping:
   1. Support at each floor level.
   2. Support at all points necessary to insure rigid installation with adequate provisions to allow expansion and contraction and prevent vibration.
   3. Support by approved pipe collars, clamps, brackets, or wall rests.

E. Supporting PVC and Fiberglass Piping (when applicable):
   1. Support in strict accordance with the manufacturer's instructions and recommendations for the conditions of operation temperature and size of pipe.
   2. Support in a manner which will prevent subsequent visible sagging of the pipe between supports due to plastic deformation.

F. Drain, waste, and vent piping: Support by adjustable hangers.
G. Valves, Fittings & Specialties: Independently support pipe connected to pumps, equipment and piping systems.
H. Temporary pipe supports:
    1. Lay out each section of pipeline and make connections while the pipe is held in temporary supports.
    2. After the completion of connections in each section of pipeline, hold the section in place with temporary clamps.
    3. Do not remove the temporary clamps until the piping is correctly installed on the permanent supports.

3.2 TESTING

B. Systems which do not meet the requirements of this section with respect to support, pitch, vibration, movement, and expansion and contraction will be supplemented with additional devices as required and re-demonstrated until compliance is achieved.

END OF SECTION

SECTION 15100

VALVES AND SPECIALTIES - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test valves, gates, hydrants, cocks, stops, and faucets, when applicable, (hereinafter referred to as "valves") in the location(s) and of the size(s) as specified herein.

1.2 QUALITY ASSURANCE

A. Provide valves of proven reliability manufactured by reputable manufacturers.

B. Acceptable manufacturers are listed in each section of this Division. Substitute or "or-equal" valves will be allowed only when indicated.

1.3 SUBMITTALS

A. Provide shop drawings of proposed valves as specified herein. Shop drawings shall contain the following information at a minimum:

1. Manufacturer's certification that the valves and accessories meet or exceed the requirements of these Specifications and that the valves are suitable for the intended service.
2. Manufacturer's literature and illustrations for all valves.
3. Operation & Maintenance Manuals for each valve type and size.

1.4 DELIVERY AND HANDLING

A. Shipping:

1. Prepare valves and accessories for shipment as required for complete protection.
2. Seal valve ends to prevent entry of foreign matter into valve body.
3. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.

B. Storage:

1. Store valves and accessories in an area on the construction site protected from weather, moisture, or possible damage.
2. Do not store valves or accessories directly on the ground.

C. Handling: Handle valves and accessories to prevent damage of any nature to the interior and the exterior surfaces.

1.5 INSPECTION

A. Carefully inspect all materials for:

1. Defects in workmanship and materials.
2. Removal of debris and foreign material in valve openings and seats.

3. Proper functioning of all operating mechanisms.
4. Tightness of all nuts and bolts.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials are specified in appropriate Sections in this Division.

B. The specifications direct attention to certain required features of the valves and gates but do not purport to cover all details entering into their design and construction. Nevertheless, the Contractor shall furnish the valves and gates complete in all details and ready for operation for the intended purpose.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations, as shown on the Drawings and/or as specified herein.

B. Carefully erect all valves and support them in their respective positions free from distortion and strain.

C. Independently support all valves connected to pumps and equipment, and in piping systems that cannot support valves.

D. Repair any scratches, marks and other types of surface damage etc. with original coating as supplied by the factory.

E. Install valves such that "open" and "close" position indicators are easily visible.

F. All valves (and actuators where specified) shall be installed in a manner that will provide for proper clearances and ease of operation. In addition, valve operators must be capable of being rotated in 90° increments to facilitate field installation.

G. Check and adjust all valves and accessories for smooth operation.

3.2 TESTING

A. The Contractor shall test all valves and gates in the presence of the District to demonstrate that each valve and gate complies with specified requirements and allowable leakage rates.

END OF SECTION

SECTION 15101

GATE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test gate valves of the type(s) and size(s) as specified.

1.2 QUALITY ASSURANCE

A. All gate valves of same type and style shall be manufactured by one manufacturer.
B. Acceptable Manufacturers: as noted herein.

PART 2 - PRODUCTS

2.1 VALVE, LOCATION AND USE

A. As shown on the Drawings.
B. General Service Piping (liquids containing solids):
   1. 3 inches and larger: Non-rising stem; resilient wedge.
D. Accessories: As shown on the Drawings and required for proper operation.

2.2 MATERIALS

A. General Service NRS - 3 inches and larger:
   1. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber, except for guide and wedge nut areas.
   2. Non-rising stem (NRS).
   3. Bolted bonnet (stainless steel Type 18-8, ASTM F593, GP1 bolts and nuts).
   4. 125 class body.
   5. Meet or exceed AWWA C-509.
   6. All valves shall be fitted with a resilient wedge.
   7. Flanged ends: 125 pound drilling, ANSI B16.1.
   8. Face to Face dimensions: ANSI B16.1.
   9. Water working pressure:
      a. 12 inches and smaller: 200 psi.
      b. 14 inches and larger: l50 psi.
   10. Operator:
      a. Handwheel standard.
      b. 2 inch square operating nut when shaft extension, floor box, valve box or floor stand is required or shown on the Drawings.
      c. Chain wheel:
         (1) Required for all valves shown.
         (2) When required for proper operation.

(3) For all valves with centerline 7 feet above finished floor or equipment stand.
(4) With chain guides.
(5) Chain shall extend to 3 feet above floor.
(6) Provide wall hooks for chain.

11. Buried Valves:
    a. Mechanical joint type with AWWA bituminous coating system
    b. Gate box required.
    c. Sufficient quantity of tee-handle valve wrenches for operating valves of various depths.
    d. 2-inch square operating nut, securely fastened to shaft.
12. Acceptable Manufacturers:
    a. Waterous.
    b. Clow.
    c. Or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and test in accordance with Section 15100, AWWA C500 and AWWA C-509, latest revision.
B. For horizontal piping, install valves with stem position between horizontal to vertical upward.

END OF SECTION

SECTION 15127

AIR RELEASE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test air release valves of the size(s), types(s) and locations(s) specified herein. Related work specified elsewhere: "Valves and Specialties - General" is specified in this Division.

1.2 QUALITY ASSURANCE

A. All air release valves, for the same service, shall be manufactured by one manufacturer.

B. Acceptable Manufacturers:
   1. Valve & Primer Corporation (APCO Valves).
   2. Or equivalent.

1.3 SUBMITTALS

A. Submit shop drawing information on the proposed valves. Refer to requirements in Section 15100.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. All valves shall be suitable for the intended services.
   2. Valve sizing shall be as recommended by the manufacturer to suit the pressure and flow condition of each application.
   3. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

B. Sewage and Sludge Service:
   1. Air Release Valves.
      a. Shall be designed to operate (open) while pressurized, allowing entrained air to escape through the air release orifice. After entrained air escapes through the air release orifice, the valve orifice shall be closed by a needle mounted on float energized compound lever mechanism and prevent sewage media from escaping
      b. Shall be specially adapted for use with sewage and sludge.
      c. The venting orifice and mechanism and the valve body shall be capable of being back-flushed with water.
      d. Cast iron body and covers, stainless steel float and lever pins, bronze seat with the mechanism cast bronze and Buna-N needle.
      e. Furnished with 2-inch inlet shutoff valve; 1-inch blow off valve; ½-inch valve, quick disconnect coupling and 6-feet of hose to permit backflushing without dismantling valve.

f. Valve shall be capable of with standing 500 psi line pressure.
g. Equal to Model 400 APCO sewage air release valve.

2. Air and Vacuum Release Valves:
   a. Shall allow unrestricted venting or re-entry of air, through it, during filling or draining of the force main, to prevent water column separation or pipeline collapse due to vacuum.
   b. Valve shall incorporate one upper and one lower stainless steel float, connected by a common stainless steel float guide, thereby maintaining an air gap between the bottom float and top shut-off float. The air gap shall retard waste solids from fouling or clogging the top shut-off float.
   c. The internal baffle shall be fitted with a guide bushing and act to protect the shut-off float from direct air flow. The baffle shall retain the 45 Durometer Buna-N seat in place without distortion, for tight shut-off.
   d. Cast iron body, cover and baffle; brass internal parts.
   e. All internals shall be easily removed through the top covers without removing the main valve from the lines.
   f. Both floats shall withstand 1,000 psi or more.
   g. Valve shall be fitted with blow off valves, shutoff valves, quick disconnect couplings and minimum 6-feet of hose, to permit backflushing after installation without dismantling valve.
   h. The valve inlet shall have 2-inch N.P.T. and the outlet 1-inch N.P.T.
   i. Equal to Model 400 APCO sewage air and vacuum valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves in accordance with manufacturer's instructions and recommendations and as shown on the Drawings.
B. Install all valves in the vertical position and allow sufficient clearance around valve for proper maintenance and removal.
C. Provide gate valve between air release valve and pipeline.
D. Inlet piping to the air valves shall be brass.
E. The exhaust lines from the air valves shall terminate in down turned position 18 inches above the floor. For water applications, the end of the line shall be covered with a 24 mesh stainless steel screen attached with a stainless steel clamp.

END OF SECTION

SECTION 16000

ELECTRICAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials, equipment, operations, methods and procedures as specifically noted herein these specifications and as indicated in the Contract Documents, together with all items necessary for, or incidental to, the completion of the work.

B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.

C. All systems shall be adjusted, tested and inspected to ensure they are in perfect working order.

D. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install", as used in DIVISION 16, or as indicated on the Drawings related to DIVISION 16, shall mean a complete and properly functioning Electrical installation performed by the Contractor.

E. References:
   1. Refer to each individual drawing within the Contract Documents in order to coordinate material and equipment locations and electrical requirements.
   2. Refer to "SECTION 01100 - ALTERNATES", for work affecting DIVISION 16; and as specified herein regarding substitutions of materials and equipment.

F. Work Specified Herein:
   1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed. No additional compensation will be allowed for failure to be so informed.
   2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work specified under DIVISION 16 includes, but is not necessarily limited to, the following:
      a) The work specified under Division 16 is inclusive of the electrical work for this project as indicated on the Drawings and in related sections of the Specifications. The Pump Station is to be supplied as a “packaged” system which shall include all associated electrical devices, installation and wiring. The supplier of the pump station shall be responsible for providing all electrical devices, conduit, wiring, installations, etc., as shown on the Drawings for a complete system. The electrical subcontractor shall furnish and install the following:

- Incoming electrical service requirements to the pump station and related electrical service distribution equipment.
- Kilowatt-hour meter and socket and extension of the electrical service to the main circuit breaker and associated electrical distribution equipment as shown on the Contract Drawings.
- Electrical system grounding and connections.
- Underground electrical service, conduit, wiring, etc., to sewage pumps and wetwell controls as shown on the Drawings.

b) Provide Electrical Service and Distribution System as indicated on the related drawings and as specified herein.

G. The work shall also include, but not be limited to, the furnishing and installing of the following:
1. Extension of overhead electrical service to the site location and service equipment
2. Underground electrical work as required and as shown on the Drawings
3. Raceways and fittings
4. Wires and cables
5. Service distribution equipment
6. Miscellaneous electrical distribution equipment
7. Grounding system
8. Underground power and control wiring to pumps
9. Underground power and control wiring to wetwell controls
10. Make all required connections to the pumping station for the electric connections to properly operate the pumping system
11. Demolition of electrical service and distribution to the extent shown on Contract Drawings; this may not be applicable in a case where no demolition is indicated.

1.2 QUALITY ASSURANCE

A. In general, the workmanship of the electrical installation shall be as described in the N.E.C.A. Electrical Design Guidelines. All methods of construction, details of workmanship, etc., that are not specifically described therein or indicated in the Contract Documents, shall be subject to the control and approval of the Wells Sanitary District.

B. Equipment and materials shall be of the quality and manufacturer indicated in their respective description within the specifications.

C. Work determined by the District to be unsatisfactory according to industry standards will provide grounds for rejection of ownership of the Pump Station. A list of unsatisfactory work can be provided by the District and must be redone at the Developer's expense before acceptance of ownership by the District will be reconsidered.

1.3 SUBMITTALS

A. Submittals required under this section include, but are not limited to, the following for each of the locations specified:
1. Conduit and Conduit Fittings

2. Enclosures
3. Wiring
4. Service distribution equipment
5. Main circuit breaker
6. Meter socket
7. Lightning arrestor and line surge protection
8. Mounting hardware and materials
9. Electrical distribution equipment
10. Miscellaneous electrical equipment

B. Submit all other equipment as required by the Contract.

C. Submit one (1) Operation and Maintenance Manual in accordance with Section 01340.

D. At the completion of the project, submit one copy of reproducible Record Drawings in accordance with Section 01720.

1.4 DELIVERY STORAGE AND HANDLING

A. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the District, or shall be replaced at no additional cost to the Owner.

1.5 DESIGN CRITERIA

A. Service and Metering

1. The power company serving this project is the Central Maine Power Company.
2. Extend new overhead service cables from the identified riser pole and service transformers to the new pump station electrical service distribution equipment.
3. Furnish and install the new meter socket per power company requirements.
4. When applicable, disconnect, remove and demolish existing electrical service and distribution equipment in its entirety upon installation, testing, and acceptance of the new service and distribution equipment. Maintain existing service and existing pump station operation at all times until completion and acceptance of the new electrical system and pump station for the entire requirements and completion of this project.
5. Provide temporary electrical service and carry all costs for this requirement as necessary for the sequence of construction of the completion and acceptance of this project.
6. Coordinate all shutdowns and activations of the services with the power company as part of this work.
7. Make all arrangements with the power company for obtaining service and pay all charges and furnish all labor and material for the service.

B. Codes, Inspection and Fees
   1. All material and installation shall be in accordance with the latest edition of the National Electrical Code and the codes and ordinances of the Town of Wells.
   2. Pay all fees required for permits and inspections.
   3. Compliance with Codes, Standards, etc doe not relieve the Contractor from the requirements of the Drawings and these specifications which may exceed the current codes, standards, etc.
   4. If it is found that the Drawings and/or Specifications are in variance with any of the Codes and Standards, promptly notify the Wells Sanitary District in writing.

C. Tests and Settings
   1. Test all systems furnished under DIVISION 16, ELECTRICAL and repair or replace all defective work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment used shall be Underwriters Laboratories, Inc. listed and labeled for the intended use and installation.

2.2 RACEWAYS AND FITTINGS

A. Rigid steel or aluminum conduit shall be used for all locations except underground unless specifically noted for the complete installation of the pumping station. Rigid steel or aluminum conduit shall be hot-dipped galvanized as manufactured by Republic Steel Corp., Allied Tube and Conduit Corp., Wheeling-Pittsburg Steel Corp., or equal.

B. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.

C. PVC coated rigid steel conduit as manufactured by Robroy shall be used at all Class 1, Division, 1 Group C and D locations and for all signal conduit runs.

2.3 WIRES AND CABLE

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. All conductors No. 8 AWG and larger sizes shall be stranded.

B. Power wiring installed in the underground system shall be Type XHHW. Type XHHW shall be cross-linked polyethylene, as manufactured by Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company, or equal.

C. Control wiring shall be Type THHW/THHN No. 14 AWG stranded. Type THHW/THWN shall be cross-linked polyethylene, as manufactured by the Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company or equal.

D. Ground wires shall be THW and color coded green.

E. Wire markers shall be "OMNI-GRIP" as manufactured by W.H. Brady Company, or equal.

F. Instrumentation signal wiring shall be 2/C #16 twisted shielded pair with drain wire and aluminum sheath and shall be cross-linked polyethylene as manufactured by Beldon or equal.

2.4 MISCELLANEOUS EQUIPMENT

A. Meter Socket
   1. Meter socket shall be of the type approved by the power company. The power company shall furnish and install the meter.

B. Electrical Enclosures
   1. The cabinets and enclosures provided for this project are located in non-hazardous outdoor locations; the enclosures are intended to protect internal equipment from environmental conditions existing in the areas in which the enclosures are to be installed.
   2. Enclosures shall be supplied in accordance with:
      a. Underwriter's Laboratory, Inc. listed.
      b. National Electrical Manufacturers Association Standard 250-1991.
      c. American National Standards Institute.
      d. National Electrical Code.
   3. The pad mounted, double door, enclosure shall be constructed of 3/16-inch 316 Stainless Steel and rated NEMA 3R. The cabinet seams shall be continuously welded, ground smooth. The stiffener bar supporting the front of the cabinet shall be bolt fastened to the remainder of the enclosure to allow for removal; however, the stiffener shall typically be left in place and be fastened in such a manner that the doors are secure when in the closed position.
      a. All fastening bolts shall be of 304 SS at a minimum. Bolts shall be a minimum of 16 gauge.
      b. The double doors shall have an internal linkage, driven by the exterior T-handle, which is adequately supported by stationary points on the inside of the door. The driven linkage shall secure the upper and lower portions of the door while in the closed position and not interfere with the typical operation of the door.
      c. Each exterior T-handle shall be provided with a locking mechanism that is operated by the same key. The Owner shall be provided 6 keys.
      d. Penetrations on the top of the enclosure or on the vertical exterior of the enclosure are not allowable or acceptable. This will prevent water from entering the enclosure. All penetrations to the enclosure shall use gasketed connections.
      e. Enclosures to be installed outdoors shall be provided with drip shields. Large enclosures shall be provided with lifting eyes.
      f. The doors shall have piano-type hinges with stainless steel pins. Provide oil-resistant door gaskets. All enclosure hinges, clamps, etc., shall be stainless steel.
      g. Panels/enclosures shall be equipped with map pockets, and provisions for locking access doors.
      h. All panels/enclosures, and all contained equipment/telemetry, shall be provided with a nameplate providing identification of the unit.

Identification wording shall be as noted on the drawings. In the absence of specific identification of name tag wording, provide general descriptive information of unit function.

i. Provide a 500W, 120 Volt, strip heater with thermostat for condensation control.

2.5 MAIN CIRCUIT BREAKER

A. Circuit breaker shall be molded case, 600 Volts, 100 Amperes with not less than 22,000 Amperes RMS interrupting capacity. Circuit breaker shall have a NEMA 3R enclosure. A neutral and ground lug shall be provided in the enclosure. Circuit breaker shall be UL Listed and Labeled for service entrance duty.

2.6 GROUND RODS

A. 10 foot long by 3/4 inch diameter copper cladded steel ground rods shall be provided as shown on the drawings.

2.7 LIGHTNING AND SURGE PROTECTION

A. Lightning and surge protection unit shall be rated for three phase, 600 VAC phase to ground, equal to a Square D Model Number SDSA 3650. Provide one spare lightning and surge protection unit to the Owner for spare parts.

2.8 EXPANSION FITTINGS

A. Conduit expansion fittings shall be watertight expansion type designed to compensate for movement and shall be installed in all locations dictated by the most recent National Electrical Code. Acceptable manufacturer shall be O.Z. Gedney Type EX or approved equal.

2.9 RECEPTACLES AND LIGHT SWITCHES

A. Receptacle shall be specification grade, 20 Amperes, 125 Volt ground fault type with weatherproof lift covers and gasketed. Hubbell Catalog No. GT-5362 or equal. Receptacle shall be provided with a weatherproof in-use type cover.
B. Light switches shall be rated 20 Amperes, single pole, 125 Volt type. Hubbell Catalog No. 1221 or equal.

2.10 LIGHT FIXTURES

A. Provide a 2 foot long fluorescent lighting strip for lighting in the pad-mounted enclosure as shown in these specification drawings. The light shall be ~~s~~switch operated.

2.11 GENERATOR CIRCUIT BREAKER

A. Circuit breaker shall be molded case, 600 Volts, 100 Amperes with not less than 22,000 Amperes RMS interrupting capacity. Circuit breaker shall have a NEMA 3R enclosure. A neutral and ground lug shall be provided in the enclosure. Circuit breaker shall be UL listed and labeled for service entrance duty.

2.12 MINIPOWER ZONE

A. The minipower zone provides components internal to the pad-mounted enclosure single phase, 120/240 VAC, 60 Hz power. Provide a 5kVA, 480:120/240V transformer and 10, single pole ~~phase~~, 20 Amp breakers. Acceptable manufacturer is Square D or equal.

PART 3 - INSTALLATION

3.1 RACEWAYS AND FITTINGS

A. No wire shall be pulled until the raceway system is complete in all details.
B. The ends of all raceways shall be tightly capped to exclude dust and moisture during the construction period. Caps shall be of an approved type specifically used for this purpose. Rags, paper, etc., shall not be used.
C. Raceways terminating in gasketed enclosures shall be terminated with conduit hubs.
D. Raceways installed underground shall be encased in concrete and laid on trenches on mats of bank gravel or sand not less than six inches thick and well graded.
E. Provide long radius rigid steel conduit sweeps at entrances to equipment from underground.

3.2 WIRES AND CABLES

A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
B. Alarm wires shall be uniquely identified at each end with wire markers. A typed list of the numbers used and their function (alarm served) shall be submitted to the Engineer by the Contractor.
C. All 600 Volt wire insulation shall be tested with a megohm meter ("Meggar") after installation. Tests shall be made at not less than 500 Volts. A written test report of the results shall be submitted to the Engineer by the Contractor.
D. After installation of service conductors, seal conduits entering pump station with approved waterproofing sealant.

3.3 GROUNDING

A. Provide grounding conductors from ground electrodes to equipment as shown on the Drawings.
B. Do not use conduit as the ground and/or bonding conductor.
C. Bond ground terminal of receptacles to outlet boxes with #l2 AWG green insulated wire.
D. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service breaker.

E. The grounding network shall be connected to metallic water piping system, at two or more locations, with stranded copper, AWG, Green Insulated Conductor of the same size as grounding electrode conductor shown on the drawings or required by the National Electrical Code (NEC).
F. Make connections to ground rods with an exothermic welding process. Mechanical connections may be made at equipment only.
G. Ensure that a ground loop is not formed between equipment ground in electrical conduit and grounding electrode conductors directly connected to ground electrodes.
H. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
I. Make connection to water pipe with a suitable ground clamp or lug connection. If flanged pipes are encountered, make connection with lug bolted to flange connections.
J. Bond and ground all conduit systems.

3.4 TESTS

A. The entire grounding network resistance is to be meggered and certified results recorded and submitted to the District for approval. Resistance shall not exceed 25 ohms.

END OF SECTION

SECTION 16620

STANDBY POWER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete standby power system as indicated in the Contract Documents. The system shall be a factory built, prototype tested, production tested, field tested, complete and operable emergency / standby electric generating system, including all devices and equipment specified herein, shown on the Drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation. This system shall include the following:
   1. A propane engine driven electric plant to provide standby electric power.
   2. Engine-generator control console resiliently mounted on each generating set shall include complete engine start-stop control and monitoring system.
   3. Starting batteries with battery charger for each engine-generator set.
   4. Automatic load transfer controls to provide automatic starting and stopping of the electric plant and switching of the load.
   5. Mounted and loose accessories, control devices, and other equipment as specified herein and/or as shown on Drawings.
   6. Such other components, accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
   7. All necessary interconnecting wiring and connections to provide proper system operation. NOTE: Manufacturer of generator enclosure may opt to provide a separate 120V panelboard for interior lighting, battery charger and receptacle branch circuits. Electrical Contractor to coordinate branch circuits, feeds and pad mounted enclosure layout with the type of service provided by the generator set enclosure manufacturer.

B. This equipment, including engine-generator sets, shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten years.
   1. The electric generating system described herein, including these components, shall be factory built, factory tested, and shipped by this single manufacturer, so there is one source of supply and responsibility for warranty, parts, and service. This manufacturer shall have a representative based within 300 miles of the installation site who can provide factory trained servicemen on a 24-hour per day basis, the required stock of replacement parts, and any technical assistance required.
   2. Different manufacturers for the engine-generator set and the automatic load transfer controls will be acceptable providing that the equipment is fully tested

together before shipment and the engine-generator set manufacturer is the source of supply and responsibility for warranty, parts and service.

3. The responsibility for performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set.
4. All controls shall be the standard of the manufacturer who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or subcontractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are not acceptable.

C. The automatic load transfer control shall be installed in the location shown on the drawings. The generator set manufacturer shall coordinate the installation of these load transfer controls with Contractor and shall provide controls capable of running the system under emergency situations.

1.2 QUALITY ASSURANCE

A. The electric generating system must meet all requirements of NFPA 110 (Level 2) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.
B. The performance of the electric generating system shall be certified by the manufacturer verifying the electric generating system's full power rating, stability, and voltage and frequency regulation.
C. The complete standby power system installation, start-up and operating instructions shall be performed under the supervision of a factory-trained engineer/representative of the system manufacturer.
D. Acceptable Manufacturers:
   1. Electric Plant:
      a. Cummins Power Generation
      b. Kohler
      c. Caterpillar
      d. Generac
   2. Automatic Load Transfer Controls:
      a. Cummins Power Generation
      b. Kohler
      c. Caterpillar
      d. Automatic Switch Company
      e. Russelelectric
   3. Equipment as described herein is that as manufactured by Cummins Power Generation of Minneapolis, Minnesota, and all equipment furnished shall be equal in every way to that specified herein, including quality, operation, and function.

4. The equipment spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components, have all been sized and designed around the manufacturers listed. If alternate equipment is substituted, the contractor shall be responsible for changes in the facility's work made necessary from installation of equipment other than Cummins Power Generation, without additional cost to the Owner, and shall verify all work with the equipment manufacturer.
    a. Any bidder wishing to use substitute equipment shall submit detailed data to the District. Complete shop drawings, diagrams and details shall be prepared specifically for this project. Standard and typical drawings will not be acceptable. Data for substitute equipment shall include complete information for the following:
        1) Enclosure detailed drawings showing all fuel, electrical and miscellaneous connections. The sheet shall indicate the shipped weight of the unit.
        2) Allowance for proper cooling and combustion air.
        3) In order to verify that all interconnecting wiring and piping is accounted for, provide complete interconnecting wiring diagrams and piping diagrams.
        4) Provide the results of engineering to show compliance with the requirements for "prototype testing".
        5) Complete load study and load profile to show that engine-generator set will not be overloaded during any phase of operation, including motor starting and steady-state load conditions.
        6) Specification information, factory literature, catalog sheets, etc., to show compliance with specifications.
        7) Deductions or additions to contract price for use of proposed substitute equipment.
        8) Complete list of deviations from these specifications.
        9) Short circuit study of the load circuits to verify that selective coordination and thermal and magnetic stresses on components will be equal to that specified.
        10) List of projects using similar equipment for the last 5 years.
        11) Subtransient reactance listed.

E. Service:
    1. Replacement parts and competent service shall be available within the New England states.

1.3 SUBMITTALS TO THE DISTRICT

A. Provide complete shop drawings for each piece of equipment specified, including all auxiliary devices. Shop drawing submittals shall consist of a single soft cover binder with index tabs, and shall include:

1. Complete typewritten description of system operation, and ratings, including a listing of all auxiliary devices.
2. Manufacturer's data sheets and detailed dimensioned drawings for all pieces of equipment and auxiliary devices.
3. Complete interconnecting wiring diagrams, cross referenced with equipment designations indicated in the Contract Documents, indicating all required wiring between the generator control panel, the automatic load transfer controls and all auxiliary devices.
4. Independent testing laboratory reports indicating the performance test results of the generator set, including power rating, stability and voltage and frequency regulation.
5. Unless specified otherwise herein, all performance data and other information shall be as on the manufacturer's printed literature. Performance data shall be the result of test procedures in accordance with nationally recognized standards, plus such other procedures that are judged necessary by the manufacturer to insure maximum service reliability for emergency systems, and shall be available for inspection by the Engineer upon request.
6. Equipment supplier shall submit calculations to demonstrate compliance with the motor starting and performance criteria as specified elsewhere in this Section.

1.4 TESTING

A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed:
   - Factory Prototype Model Tests,
   - Factory Production Model Tests, and
   - Field Tests.

   1. Factory Prototype Model Tests: The electric generating system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110. The tests, being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110, and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall have included:
      a. Maximum power level (maximum kW).
      b. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
      c. Structural soundness (Short-Circuit and Endurance Tests).
      d. Torsiograph Analysis: The manufacturer of the engine-generator set shall verify that the engine-generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer

output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specifier on request. Calculations based on engine and generator separately are not acceptable.

e. Engine-generator cooling and combustion air requirements.
f. Transient response and steady-state speed control and voltage regulation.
g. Generator temperature rise per NEMA MG1.
h. Harmonic analysis and voltage waveform deviation per MIL-STD-705B.
i. Three-phase short-circuit test for mechanical and electrical strength. With system operating at rated Volts, Amperes, power factor, and speed, the generator terminals must be short-circuited ten times on all three phases for a duration of thirty seconds. Engine-generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.
j. Failure mode test for voltage regulator: With engine-generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operational after the test, and without evidence of damage.
k. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.

2. Field Tests after Installation: After installation the engine generator set and automatic load transfer controls shall be fully tested as specified herein.

1.5 WARRANTY

A. The complete standby electric power system, including 1800 r/min engine-generator set and transfer switch equipped with set exerciser, and running time meter, shall be warranted for a period of five (5) years or fifteen hundred (1500) operating hours, whichever occurs first, from the date of Substantial Completion. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be detailed in available written documents. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. This system shall include an engine-generator set meeting or exceeding the minimum ratings as tabulated below, on a continuous standby basis.

kW	**kVA**	**Power Factor**	**Hz**	**Volts**	**Phase/Wire**
		0.8	60	480/277	3 Phase, 4 Wire

Maximum Allowable Starting Voltage Dip	**Maximum Allowable Peak Voltage Dip**	**Maximum Allowable Freq. Dip**	**Maximum Surge kW Capability**	**Maximum Surge kVA Capability**
10%	10%	3%		

2. The engine generator set shall be capable of reliably starting the connected loads in the order listed in the table below. This shall be accomplished without exceeding the voltage and frequency dip specifications, and without causing unacceptable operation of electrical equipment.

Load Name	**Load Rating (HP / kVA)**	**Starting Method**
Step 1:		
Sanitary Sewerage Pump No. 1; 120V Loads		FVNR
Step 2:		
Sanitary Sewerage Pump No. 2		FVNR

VFD PWM = Variable Frequency Drive, Pulse-Width-Modulated
FVNR = Full Voltage Non-Reversing Motor Starter
RVSS = Reduced-Voltage Solid-State Motor Starter

3. The Standby Power System supplier shall have a complete understanding of the loads to be started and operated on emergency power, and the generator shall be properly sized and configured to perform the intended function.
4. Each engine-generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components, and each set shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set.

B. Engine:

1. Each engine shall be certified to US EPA Non-Road Source Emissions Standards, 40CFR 89, in effect as of the date of submittal to the district.
2. Engine shall use propane fuel. Design shall be turbocharged and intercooled where required by engine manufacturer.
3. Engine shall be certified by the engine manufacturer as capable of driving a generator yielding a kW rating as specified herein. Engine shall be capable of

driving the generator at this rating on a continuous standby basis for the duration of normal utility source interruptions per SAE J1349 conditions.

4. Fuel injection and valves shall not require adjustment while in service.
5. Maximum ambient air temperature: 122°F.
6. Engine equipment shall include the following:
   a. An electric starter(s) as required by the manufacturer.
   b. Positive displacement, mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements and dipstick oil level indicator.
   c. Fuel filter with replaceable element, and an engine driven, mechanical positive displacement fuel pump, all mounted on the engine. Replaceable dry element air cleaner.
   d. Engine speed mechanical governing system to automatically control generator frequency to 5% of rated frequency from no load to full load rated output.
   e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
      1) Low coolant temperature alarm
      2) Low lubrication oil pressure alarm
      3) High coolant temperature alarm
      4) Low lubrication oil pressure shutdown
      5) High coolant temperature shutdown
      6) Overspeed shutdown
      7) Overcrank lockout
      8) Low coolant level shutdown
   f. Engine starter battery charging alternator with solid-state voltage regulator.
   g. Engine-mounted, thermostatically-controlled, water jacket heater(s) for ambient 40 degrees F, to aid in quick starting. Heater(s) shall be rated 1500 Watts, 120Volts, single phase, 60 Hz.
7. Cooling System:
   a. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Performance of components shall be as required by set manufacturer.
   b. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
8. Engine Exhaust System:
   a. Exhaust muffler shall be provided for each engine of size as recommended by the set manufacturer. Muffler shall be of the residential type. Provide support for the muffler so its weight is not supported by the engine.

b. Stainless steel flexible exhaust connection shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
c. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings.
d. Exhaust line shall be insulated as indicated in Specification Section 15180.

C. Generator

1. Generator shall be single-bearing, 2/3rd pitch, self-aligning, four-pole, synchronous type, revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless PMG exciter system. No brushes will be allowed. Telephone influence factor less than 50 per NEMA MG1.
2. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to insure permanent alignment; gear driven generators are not acceptable under this specification.
3. Insulation shall meet NEMA standards for Class H.
4. The maximum alternator temperature rise shall not exceed 125°C above ambient. Generator design shall prevent potentially damaging shaft currents.
5. In order to limit generator voltage distortion caused by harmonic currents, the generator sub-transient reactance shall not exceed 0.12 per unit as calculated by the generator supplier using the generator set base rating.
6. The three-phase, broad range, reconnectible generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
7. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage within ± 1% during steady-state conditions.
   a. The engine-generator set and regulator must sustain at least 90% of no load voltage for ten (10) seconds with 250% of rated load at near zero power factor connected to its terminals.
   b. The voltage regulator shall be insensitive to severe load induced waveshape distortion from SCR or thyrister circuits, such as those used in battery charging (UPS) and motor speed control equipment.
   c. A rheostat shall provide a minimum of ±5% voltage adjustment from rated value.
8. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime mover. This design allows the prime mover to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to provide the fastest possible system recovery from transient speed dips. A system that routinely selects a linear-type (straight line) constant volts/hertz

characteristic, without regard for the engine power and torque characteristics, will not meet this specification.

9. PMG Exciter shall be three-phase, full-wave rectified, with heavy-duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads.
10. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "Testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.
11. When engine-generator sets will be paralleled with another source, each set shall be equipped with a cross-current compensation control and rotating exciter transient suppressers.

D. Engine-Generator Set Control:

1. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The generator set mounted control shall include the following features and functions.
2. Control Switches
   a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position, the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
   b. EMERGENCY STOP switch. Switch shall be Red “mushroom-head” pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
   c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after if has shut down for any fault condition.
   d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
3. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
   a. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW

meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.

b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output kW, kW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line-to-line or line-to-neutral) simultaneously.

c. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

4. Generator Set Alarm and Status Display

a. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:

- low oil pressure (alarm)
- low oil pressure (shutdown)
- oil pressure sender failure (alarm)
- low coolant temperature (alarm)
- high coolant temperature (alarm)
- high coolant temperature (shutdown)
- engine temperature sender failure (alarm)
- low coolant level (alarm or shutdown—selectable)
- fail to crank (shutdown)
- fail to start/overcrank (shutdown)
- overspeed (shutdown)
- low DC voltage (battery)(alarm)
- high DC voltage (battery)(alarm)
- weak battery (alarm)
- low fuel-day tank (alarm)(diesel only)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (alarm) (optional—when required by code or specified)
- overload (alarm)
- emergency stop (shutdown)

b. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

5. Engine Status Monitoring
   a. The following information shall be available from a digital status panel on the generator set control:
      - engine oil pressure (psi or kPA)
      - engine coolant temperature (degrees F or C)
      - engine oil temperature (degrees F or C)
      - engine speed (rpm)
      - number of hours of operation (hours)
      - number of start attempts
      - battery voltage (DC volts)
   b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
6. Engine Control Functions
   a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with a 15-second rest period between cranking periods.
   b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
   c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
   d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
   e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components and actual failure conditions.
7. Alternator Control Functions
   a. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from malfunctions due to load-induced voltage waveform distortion and

provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58-59 HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

b. Controls shall be provided to monitor the output current of the generator set and initiate and alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70.

c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70.

d. Controls shall be provided to monitor the kW load on the generator set, and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating in excess of 5 seconds. Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

f. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a “weak battery” alarm shall be initiated.

g. When required by National Electrical Code or indicated on project drawings, the Control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include

adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

E. Auxiliary Equipment:
   1. Starting Battery: Two (2) batteries shall be supplied for each engine (24VDC control system) and shall be mounted in a battery rack within the engine-generator set skidbase. Batteries shall be 12 Volt, heavy duty, lead-acid type.
   2. Battery Charger(s): A voltage regulated battery charger shall be provided for each engine-generator set. Chargers shall be equipped with float, taper, and equalize charge settings.
   3. Provide a remote emergency stop station, break-glass type, for mounting outside room housing the prime mover.
   4. Remote Audible Annunciator. Provide remote audible annunciator for engine-generator set with light emitting diode (L.E.D.) indicators. Annunciator shall be located in the generator set enclosure provided by the manufacturer. Annunciators shall include the following:
      a. High Battery Voltage
      b. Low Battery Voltage
      c. Normal Battery Voltage
      d. Generator Running
      e. Normal Utility Power
      f. Pre-Low Oil Pressure
      g. Low Oil Pressure
      h. Pre-High Coolant Temperature
      i. High Coolant Temperature
      j. Low Engine Temperature
      k. Overspeed
      l. Overcrank
      m. Low Fuel Tank-Main Tank or Day Tank (Diesel only)
   5. Outdoor Weather-Protective Enclosure
      a. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet-metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electro-coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:
         - Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
         - Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
         - Crosshatch adhesion, per ASTM D3359-93, 4B-5B.

- Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
- Salt Spray, per ASTM B117-90, 1000+hours
- Humidity, per ASTM D2247-92, 1000+ hours
- Water Soak, per ASTM D2247-92, 1000+ hours

b. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

c. Sound-attenuation enclosure shall reduce sound levels to 85dB at 25 feet.

F. Automatic Load Transfer Switch:

1. General: The automatic transfer switches shall be designed, built, tested, furnished and warranted by the manufacturer of the engine-generator set to ensure one source of responsibility and equipment compatibility. A transfer switch manufactured by a different manufacturer may be equivalent providing the engine-generator and transfer switch is tested, furnished and warranted by the manufacturer of the engine-generator set.
2. An approved transfer switch manufacturer shall have been regularly engaged in the production of UL (Underwriters Laboratory) Standard 1008 Listed transfer switches. The transfer switches shall be documented, and have been offered for sale on the open market for a minimum of five (5) years. The manufacturer shall provide factory trained parts and service support through a factory authorized distributor that is regularly doing business in the area of the installation.
3. The manufacturer shall supply literature containing diagrams, parts lists and descriptions sufficient for the owners personnel, or subcontract supplier to install, operate and perform normal maintenance on the equipment.
4. Testing: To provide proven reliability of the system, transfer switches shall be completely tested as follows:
   a. Representative production samples of the transfer switches supplied, shall be demonstrable, through tests, the ability to withstand at least 10,000 mechanical operating cycles. An operating cycle shall consist of one (1) electrically operated transfer from normal to emergency and back to normal.
   b. During the development of the original transfer switching mechanism for this family of transfer switches, a prototype of the transfer switching mechanism shall have passed the environmental tests listed in Military Standard, Mil-Std-202E. These tests shall include Method 101D-Condition B, Salt Spray-Corrosion; Method 103B-Condition B, Humidity; Method 107D-Condition A, Thermal Shock; Method 110A Sand and Dust.
   c. Transfer switches shall be UL Listed per Standard 1008. The minimum WCR (Withstand and Closing Current Ratings) shall meet the requirements of UL Standard 1008 and shall be obtained without contact welding. Where the line side overcurrent protection is provided by

circuit breakers at 480 Volts AC or less, the short circuit WCR shall be as follows:

TRANSFER SWITCH CONTINUOUS CURRENT RATINGS	K & J/L* FUSES	WITHSTAND AND CLOSING RATINGS
40A, 70A, 100A	125A/200A*	14,000A RMS
150A, 260A	400A/600A*	30,000A RMS
400A, 600A	1200A/1200A*	65,000A RMS
800A, 1000A	2000A/2000A*	65,000A RMS

* Class J and L Fuses WCR = 200,000A RMS

1) The RMS (root mean square) symmetrical fault current ratings shall be verified by UL witnessed tests on representative test samples. All WCR tests shall be performed with the overcurrent protective devices located external to the transfer switch. Tests conducted with overcurrent protective devices internal to the transfer switch, in such a manner that the transfer switch interrupts the current rather than withstanding the current, are not acceptable under this definition of withstand.
2) Where the line side overcurrent protection is provided by current-limiting fuses, the fuses shall be UL Class RK1, RK5, J, or L (with the fuse sizes being no larger than the UL listed maximum ratings or component recognition procedures for the transfer switches supplied). The transfer switch closing rating shall be suitable for 200,000A available fault current, as verified by UL witnessed tests on representative test samples.

d. Provide testing as specified herein.

5. Ratings: All transfer switches shall be UL Listed per Standard 1008. All transfer switches shall be suitable for use on emergency and legally required standby systems in accordance with ANSI-C1 and NFPA-99, rated for total system load. These loads shall include motors, electric discharge lamps, resistive loads, and tungsten lamps as described in Section 1 of UL 1008 Standard.
6. Transfer switches shall be 60 Hz. Refer to drawings for the number and locations of transfer switches, number of phases, number of poles, voltage, and ampere ratings.
7. Transfer switches shall be rated to carry 100 percent of their rated current continuously when in an enclosure. Transfer switches which must be derated when installed in an enclosure (due to integral overcurrent devices or any other reasons) do not meet this specification. Transfer switches shall be rated for continuous operation in ambient temperatures of -40° C (-40°F) to 67°C (142°F).
8. Construction: Transfer switches shall be over center operation, double-throw construction, positively electrically and mechanically interlocked by a simple

mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions.

a. Transfer switches shall be quick-break, quick-make operation so that the speed of opening and closing is not controlled by an operator during manual operation. Transfer switches shall provide a center "Programmed Transition" position for manual switching.
b. Transfer switches shall be approved for manual operation under full load by integral mounted, permanently attached, high dielectric, manual operating handles. Manual operating handles, which are normally stored and must be installed for manual operation, do not meet this specification.
c. The electrical operating means shall be a direct-acting, constant force in both directions, bi-directional linear induction motor to provide minimum friction, straight-line switch action. Motor shall be attached directly to the switching mechanism without the use of gears, cams, or other complex mechanical linkage methods.
d. Transfer switches shall not contain any integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
e. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching.
f. Manual operating handles and controls (other than key- operated switches) shall be accessible to authorized personnel only by opening the keylocking cabinet door. Transfer switches located on the outside of the cabinet do not meet this specification.
g. Unless noted or specified otherwise, each transfer switch shall be mounted in separate NEMA 1 cabinet enclosures with key-locking front doors
h. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is furnished.
i. All transfer switches shall have transparent protective covers to protect operating personnel during manual operation, and to allow an operator to visually determine that the main contacts are "Open" or "Closed".
j. The main switch contacts shall be of the no maintenance type and high pressure silver cadmium oxide to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs quickly and effectively; arc chutes shall have insulating covers to prevent interphase flashover.
k. Transfer switches shall have one (1) S.P.D.T. (Single Pole Double Throw), 480 Volt auxiliary switch on both the normal and emergency-sides, operated by the transfer switch. These auxiliary switches shall be factory wired to an easy access terminal block and may be used to monitor transfer switch position for controlling indicator lamps or other peripheral equipment.

l. Complete AL-CU (Aluminum-Copper) lugs, UL listed and CSA certified, shall be provided for both normal and emergency load positions. For 150A and larger transfer switches, top or bottom feed for load connections shall be provided for slimmer design, requiring less wall space. Load connections shall be field changeable either from top-to-bottom or bottom-to-top. Wiring space at normal, emergency, and load lugs inside the transfer switch cabinet shall comply with NFPA 70. Fully-rated neutral bar with lugs for normal, emergency, and load neutral conductors shall be provided inside the cabinet.

m. Relay, with 2 N.O. and 2 N.C. contacts, that is energized whenever the normal source is available regardless of switch position.

n. Relay, with 2 N.O. and 2 N.C. contacts, that is energized whenever the emergency source is available regardless of switch position.

o. Provide additional relays as required to satisfy process control requirements.

9. Transfer Switch Control (Level II):

a. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R / IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

1) High intensity LED lamps to indicate the source that the load is connected to (Source 1 or Source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

2) High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch {when used} enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.

3) “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

4) “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.

5) “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

6) The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each

source has failed. This information shall be available via a PC-based service tool or an operator display panel.

7) Security Key Switch to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless key is in place and operated.
8) Vacuum fluorescent alphanumeric display panel with pushbutton navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The alphanumeric display panel shall be capable of providing the following functions and capabilities.
    a) Display source condition information, including AC voltage for each phase of normal and emergency source, and frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
    b) Display source status, to indicate source is connected or not connected.
    c) Display load data, including 3-phase AC voltage, frequency, kW, kVA, and power factor. Voltage data for all phases shall be displayed on a single screen.
    d) The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
        i. Set nominal voltage and frequency for the transfer switch.
        ii. Adjust voltage and frequency sensor operation set points.
        iii. Set up time clock functions.
        iv. Set up load sequence functions.
        v. Enable or disable control functions in the transfer switch, including program transition.
        vi. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
    e) Display Real Time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
    f) Display service history for the transfer switch. Display source-connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
    g) Display information for other transfer switches in the system, including transfer switch name, real time load in kW on the transfer switch, current source condition, and current operating mode.

h) Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

b. Internal Controls

1) The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within $\pm$ 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2) Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

a) Monitoring all phases of the normal service (Source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level.

b) Monitoring all phases of the emergency service (Source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level.

c) Monitoring all phases of the normal service (Source 1) and emergency service (Source2) for voltage imbalance.

d) Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for loss of a single phase.

e) Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for phase rotation.

f) Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).

g) Monitoring all phases of the normal service (Source 1) and emergency service (Source 2) for over or under frequency conditions.

3) All transfer switch sensing shall be configurable from a Windows PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other

electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.

4) The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
5) The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cool-down) (adjustable in a range of 0-30 minutes).
6) The control system shall be designed and prototype tested for operation in ambient temperatures from –40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
7) The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
8) The transfer switch shall be provided with a battery charger for the generator set starting batteries. The battery charger shall be a float type charger rated at 10 Amps. The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs. The charger shall also include fault indications for high and low dc voltage, and supply power failed, and dry contacts for external indication of these fault conditions. Supply power failed indication shall be displayed on the ATS control panel.

c. Control Interface
1) The transfer switch will provide an isolated relay contact for starting a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2) Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 Amps, 250 VAC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be made in complete accordance with manufacturer's recommendations.
B. Install unit on concrete base to provide for servicing access and oil pan removal.
C. Flexible connections shall be used on all connections to unit.

D. Fill the engine cooling system with a solution of 50 percent ethylene glycol and water unless otherwise advised by the manufacturer.
E. Support muffler so that its weight is not supported by the engine. Exhaust pipe sizing shall be as required to maintain exhaust backpressure within the limits established by the generator set manufacturer.
F. Bond steel base, generator and engine frames and all equipment enclosures to main ground electrodes.

3.2 FIELD TESTS AFTER INSTALLATION

A. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine-generator set manufacturer. The engine lubrication oil as recommended by the manufacturer for operation under environmental conditions specified, shall be provided by the engine-generator set supplier.
B. Upon completion of initial start-up and system checkout, the supplier of the system shall perform a field test in the presence of the Contractor, Engineer and Owner's operating personnel to demonstrate load carrying capability and voltage and frequency stability.
C. The Contractor shall supply fuel for generator, water for pumps, and complete electrical system operating and functional in order to verify that generator will start the connected loads in the order specified.
D. 100% Load shall consist of resistive load bank. Unity power factor is suitable for on-site testing, provided that rated load tests at power factor have been performed by the manufacturer prior to shipment.
    1. Records shall be maintained throughout the tests consisting of:
        a. Time-of-day
        b. Coolant temperature
        c. Cranking time until prime mover starts and runs
        d. Time required to come up to operating speed, voltage and frequency overshoot
        e. Time required to achieve steady-state condition with all switches transferred to the emergency position
        f. Voltage
        g. Frequency
        h. Current
        i. Oil pressure
        j. Ambient air temperature
        k. Kilowatts
        l. Power factor
        m. Battery charger rate at 5 minute intervals for the first 15 minutes
    2. Data shall be recorded at 15 minute intervals throughout the test.
    3. Continue this load test for 2 hours per NFPA 110, observing and recording load changes and the resultant effect on voltage and frequency.

4. Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cooldown period and shutdown.

STANDBY POWER SYSTEM - RESISTIVE LOAD BANK TEST

Owner: _____ Date: _____

_____

Project:

_____

_____

Contractor: _____

_____

Equipment Manufacturer: _____

_____

Equipment: _____

_____

This certifies that the entire equipment/system has met the RESISTIVE LOAD BANK TESTING requirements of Section 16620 and all other applicable requirements of the contract documents.

_____ _____

(Authorized Representative of the Manufacturer (Date)

_____ _____

(Contractor) (Date)

_____ _____

(Engineer) Wright-Pierce (Date)

STANDBY POWER SYSTEM - BUILDING LOAD TESTS

Owner: _____ Date: _____

_____

Project:

_____

_____

Contractor: _____

_____

Equipment Manufacturer: _____

_____

Equipment: _____

_____

TEST #1 ☐ TEST #2 ☐ TEST #3 ☐

This certifies that the entire equipment/system has met the BUILDING LOAD TESTING requirements of Section 16620 and all other applicable requirements of the contract documents.

_____ _____

(Authorized Representative of the Manufacturer (Date)

_____ _____

(Contractor) (Date)

_____ _____

(Engineer) Wright-Pierce (Date)

END OF SECTION

APPENDIX A
STANDARD DETAILS & FORMS

APPENDIX A

STANDARD FORMS

- Sanitary Sewer Service Location Form
- Manhole Form (New or existing)

STANDARD DETAILS

- Pipe Trench
- Trench Pipe Insulation
- Pipe Crossing
- Multiple Pipe Trench Section
- Culvert Crossing
- Concrete Encasement
- Concrete Cradle Detail
- Trench Paving - Without Overlay
- Trench Paving - With Overlay
- Typical 4-Foot Manhole
- Flat Top Slab Manhole
- Manhole Frame Installation
- Manhole Cover and Frame
- Inside Drop Manhole with PVC Pipe
- Sewer Service Connection
- Chimney Detail
- Valve Box Detail
- Water Main Relocation Detail
- Air Release Manhole
- Doghouse Type Manhole
- Typical Cleanout Detail
- Chain Link Fence and Locking Gate Detail
- Typical Pump Station, Site Plan and Details
- Typical Pump Station Electrical Details

Subsystem No. ☐

MH No._____

(MH No. t*o completed by District*)

Wells Sanitary District

MANHOLE REPORT

PROJECT LOCATION: _____ PROJECT NO.: _____

DATE: _____ WEATHER: _____ TIME: _____ INSPECTOR: _____

MANHOLE LOCATION DATA:

STREET: _____

BURIED: Yes/No PAVED AREA: Yes/No

MANHOLE DATA:

MANHOLE DIAMETER 4FT 5FT 6FT

MANHOLE IS: BRICK BLOCK PRECAST

DEPTH OF MANHOLE: _____

RIM ELEVATION _____

NUMBER OF SECTIONS: 2 3 4

COVER DIAMETER: 24" 30"

COVER MATERIAL: _____

FRAME MATERIAL: _____

RISER MATERIAL: _____

PIPE DATA: _____

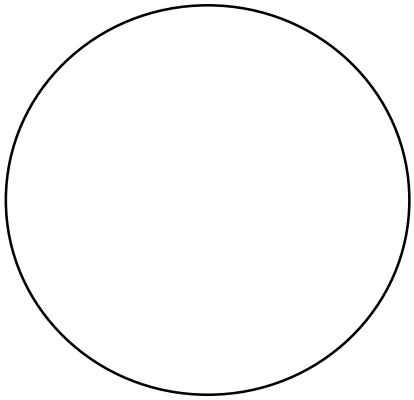
NUMBER OF PIPES IN _____

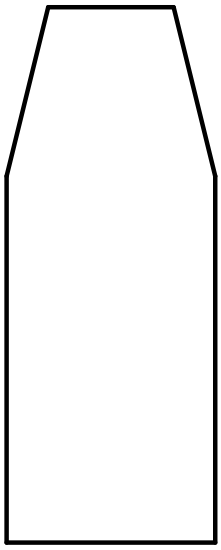
DIAMETER OF PIPES _____

PIPE MATERIAL _____

INVERT ELEVATIONS _____

COMMENTS:





Plan and Profile View

Please include all pipe details (size, elevation, angle to next pipe, etc). Include a North arrow to orient the viewer.

COMPLETE FOR EVERY NEW AND EXISTING MANHOLE THAT IS WITHIN THE LIMITS OF YOUR PROJECT. FOR EXISTING MANHOLES DIFFERENTIATE BETWEEN NEW AND EXISTING PIPING AND CALL OUT CONNECTION DETAIL.

SANITARY SEWER SERVICE LOCATION

Project: _____ Date: _____

Date Installed: _____ Town, City of _____

Type, Size of Service Pipe		Street	
Connection at Sewer Main		Dwelling No.	
Depth, End of Service		Occupant	
Length of Service Pipe Laid		Owner	
Measured, Located By		House No.	
Project Contractor		Complete	
		Incomplete	

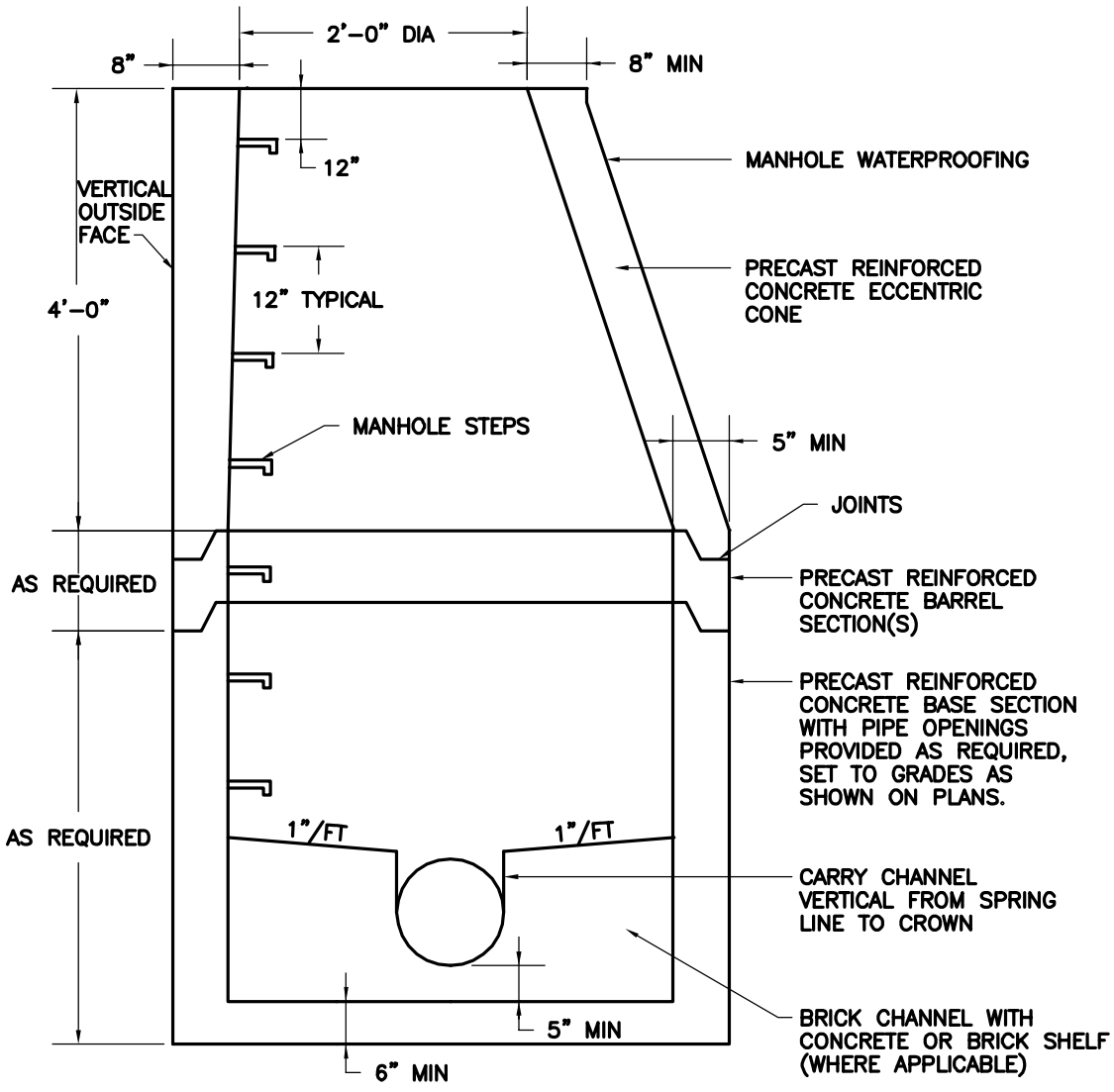
N.T.S.

Comments: _____

Observed By:

_____ _____
Contractor (Date)

_____ _____
WELLS SANITARY DISTRICT (Date)



NOTES:
1. MANHOLE CHANNELS REQUIRING CHANGE IN ALIGNMENT ARE TO BE BUILT ON A SMOOTH RADIUS. IF SIDE PIPES ENTER CHANNEL, SHAPE TO RECEIVE ADDED SIDE FLOW.
2. USE FLAT SLAB TOP MANHOLE WHEN THE DIFFERENCE BETWEEN INVERT AND RIM IS LESS THAN 6'-0" AND WHEN MANHOLE DIAMETER IS GREATER THAN 4'-0".

TYPICAL 4-FT MANHOLE

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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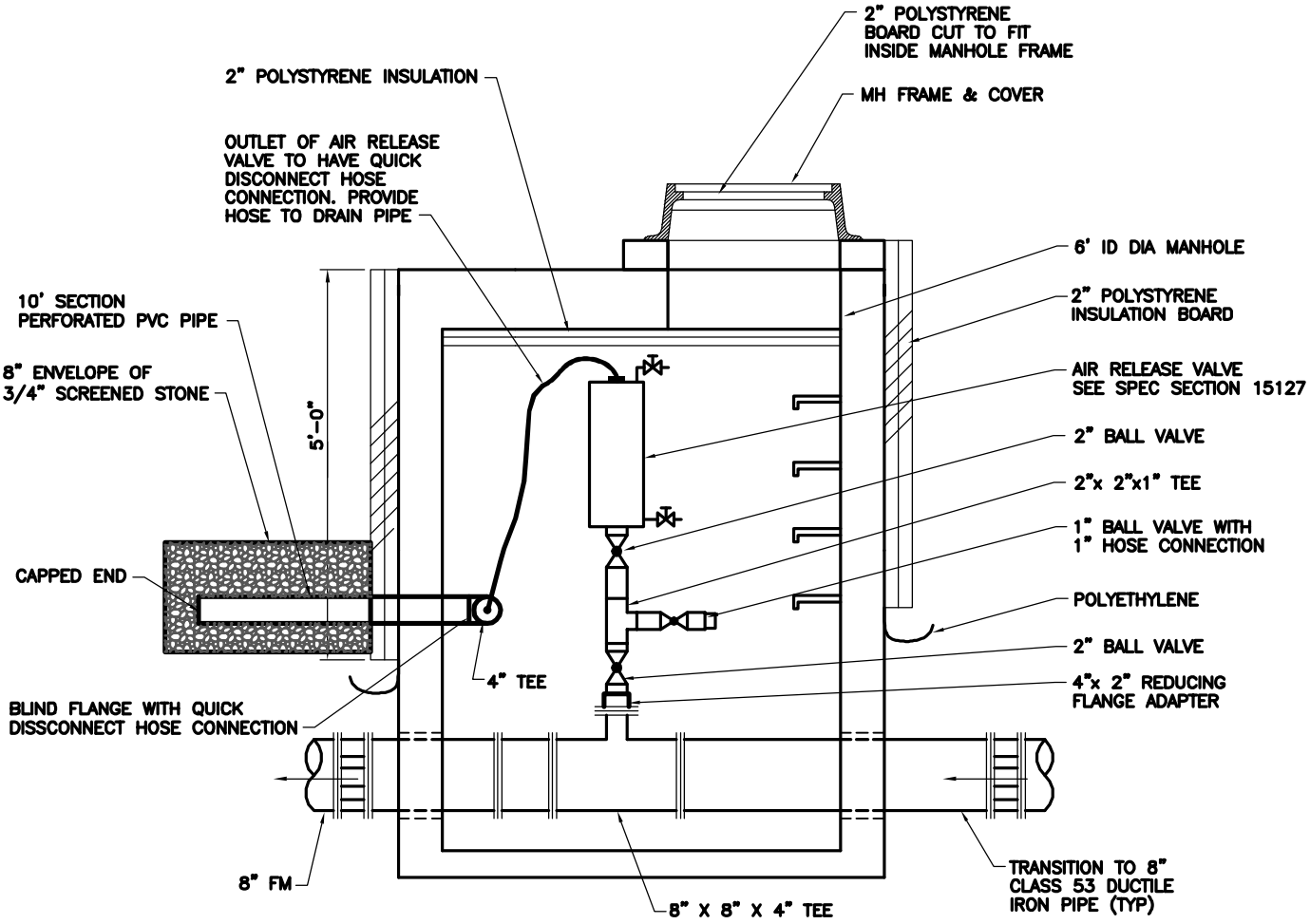

NOTE:
PROVIDE PIPE SUPPORTS FOR 8" FORCE MAIN AS REQUIRED

AIR RELEASE MANHOLE

NTS

WELLS SANITARY DISTRICT WELLS, MAINE STANDARD SPECIFICATIONS AND DETAILS	
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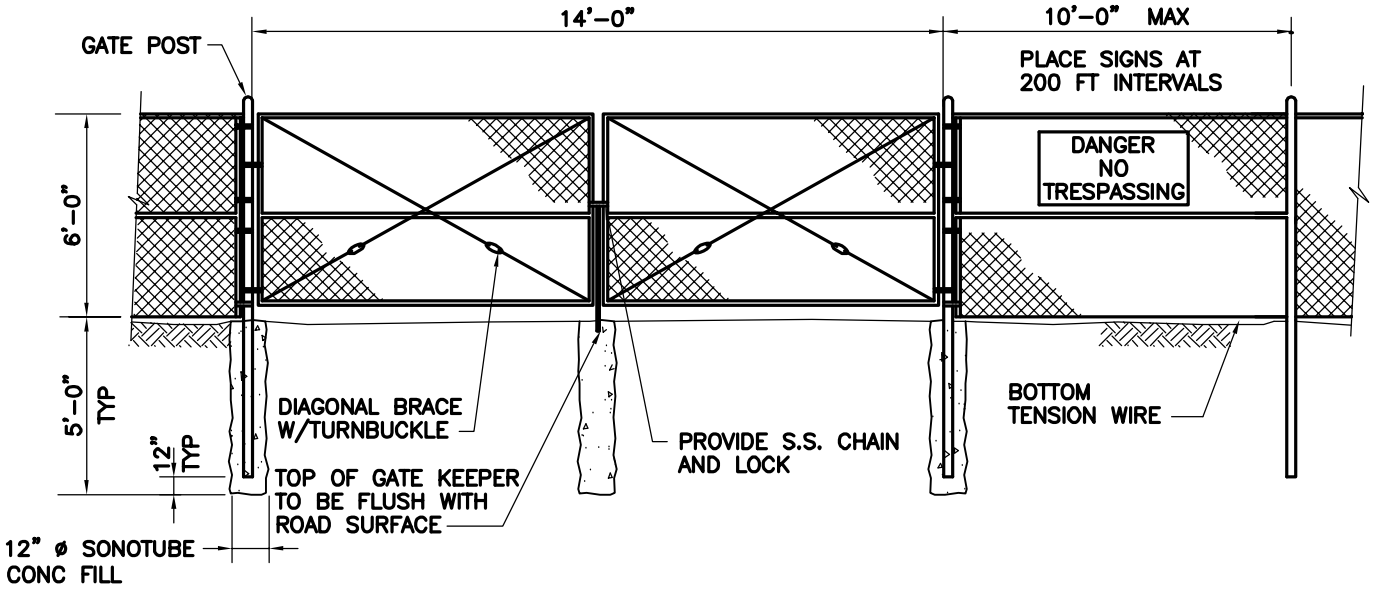
DATE: FEB 2008	
SCALE: NONE	



CHAIN LINK FENCE AND LOCKING GATE DETAIL

NTS

WELLS SANITARY DISTRICT	
WELLS, MAINE	
STANDARD SPECIFICATIONS AND DETAILS	
PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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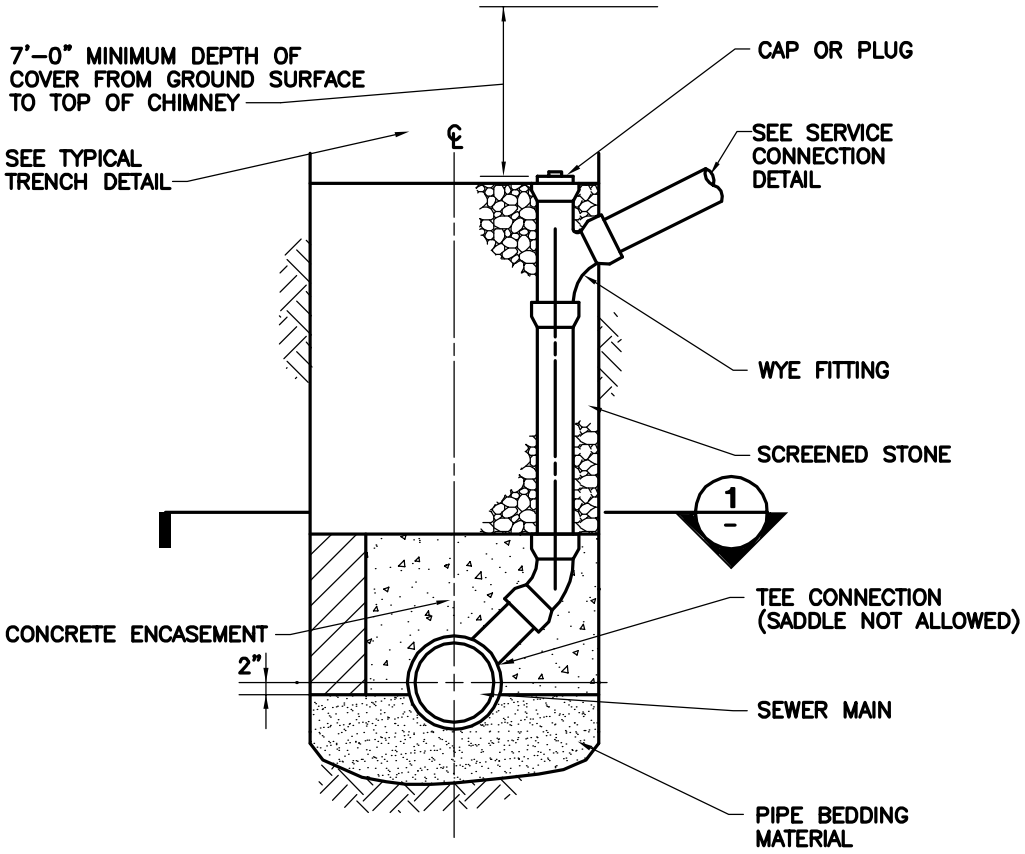

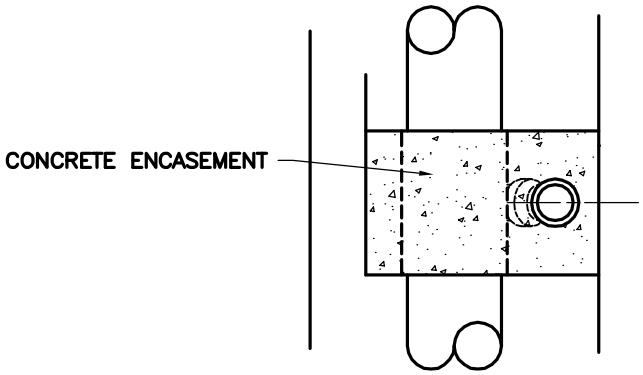

NOTES:
1. MINIMUM CHIMNEY HEIGHT SHALL BE 3.0 V.F.
2. SEE TYPICAL TRENCH DETAIL AND SPECIFICATIONS FOR BEDDING AND BACKFILL REQUIREMENTS.
3. CHIMNEY CONSTRUCTION SHALL BE USED WHENEVER A SERVICE CONNECTION ENTERS THE SEWER 30° OR LESS FROM VERTICAL.

SECTION 1 / -
SCALE: NTS

CHIMNEY DETAIL
NTS

WELLS SANITARY DISTRICT
WELLS, MAINE
STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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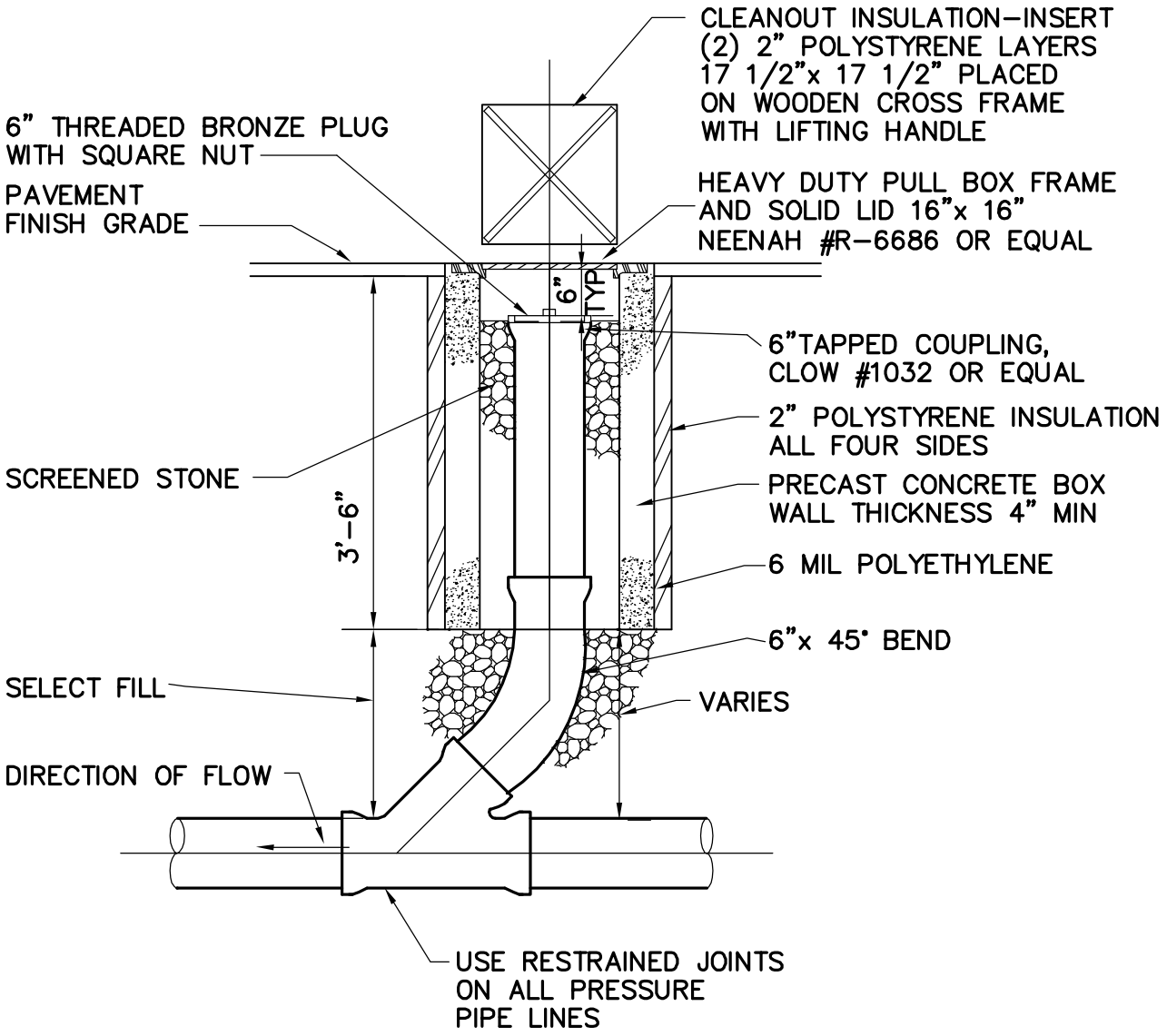

TYPICAL CLEANOUT DETAIL

NTS

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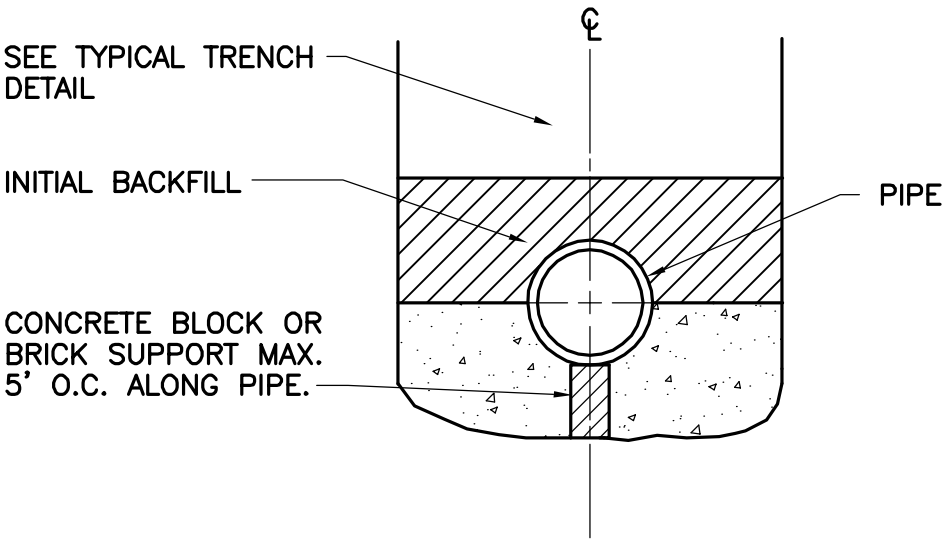
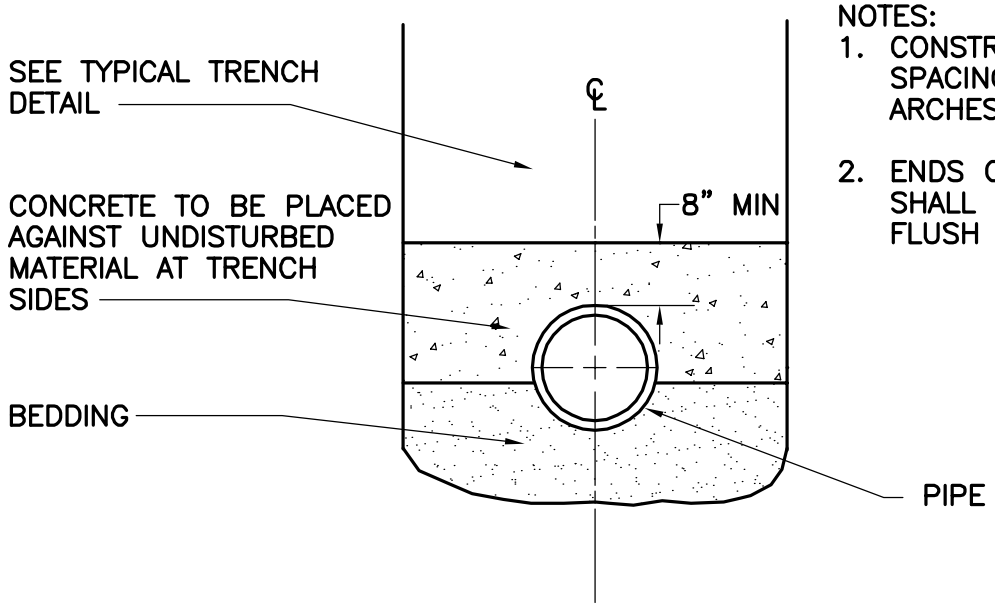
SCALE: NONE	



CONCRETE CRADLE DETAIL

NTS



NOTES:

1. CONSTRUCTION JOINT MAXIMUM SPACING FOR CRADLES AND ARCHES IS 24 L.F.
2. ENDS OF CRADLE OR ARCH SHALL BE CONSTRUCTED FLUSH AT A PIPE JOINT.

CONCRETE ARCH DETAIL

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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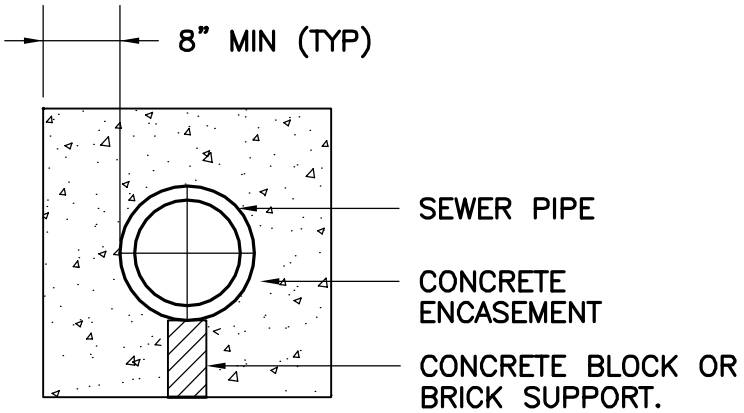

NOTES:

1. CONSTRUCTION JOINT MAXIMUM SPACING IS 24 L.F.
2. END OF CONCRETE ENCASEMENT SHALL BE CONSTRUCTED FLUSH AT A PIPE JOINT.

CONCRETE ENCASEMENT

NTS

WELLS SANITARY DISTRICT
WELLS, MAINE
STANDARD SPECIFICATIONS AND DETAILS

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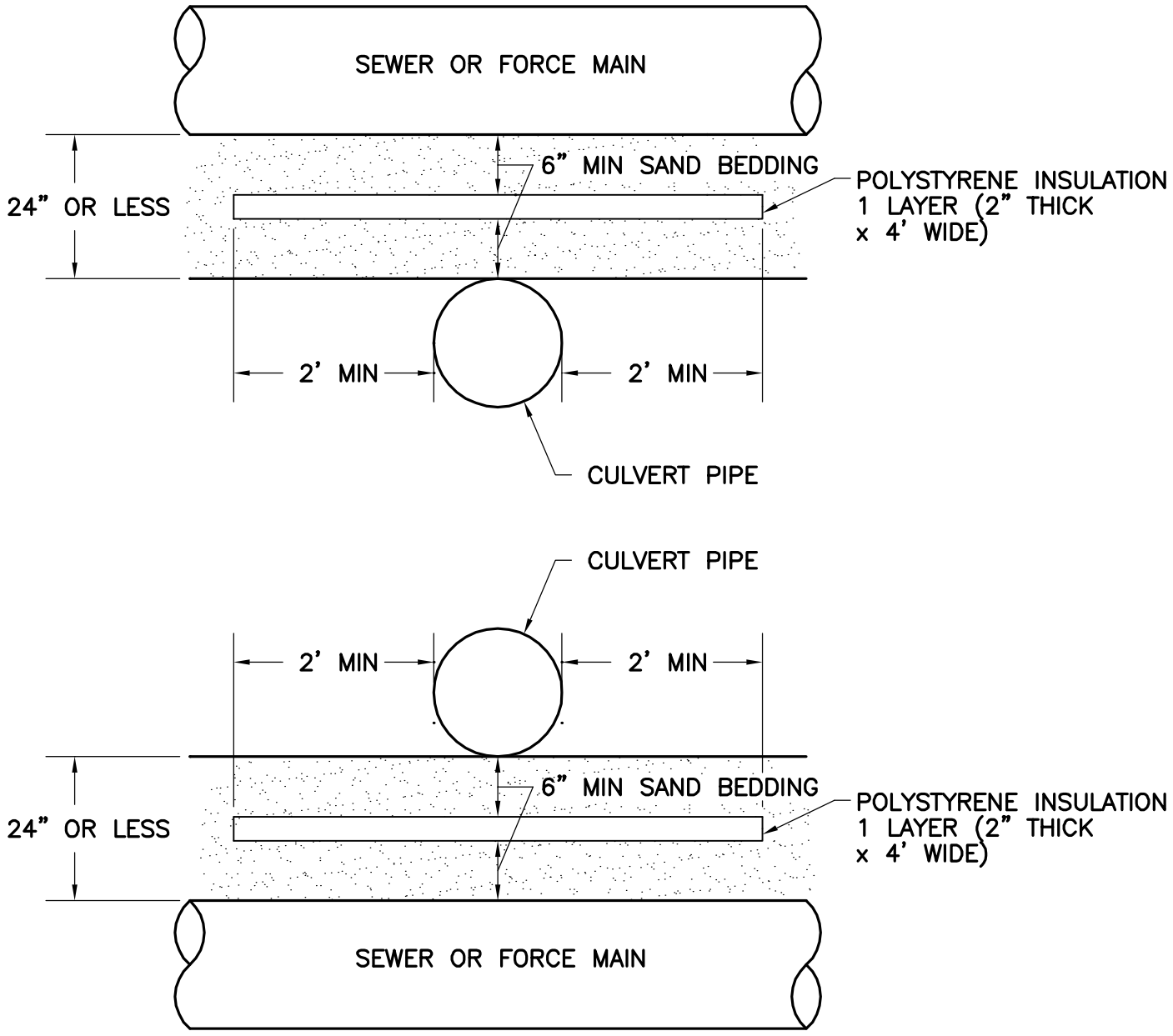

NOTE: INSULATION TO BE USED WHERE PIPE SEPARATION IS 24" OR LESS.

CULVERT CROSSING DETAIL

NTS

WELLS SANITARY DISTRICT	
WELLS, MAINE	
STANDARD SPECIFICATIONS AND DETAILS	
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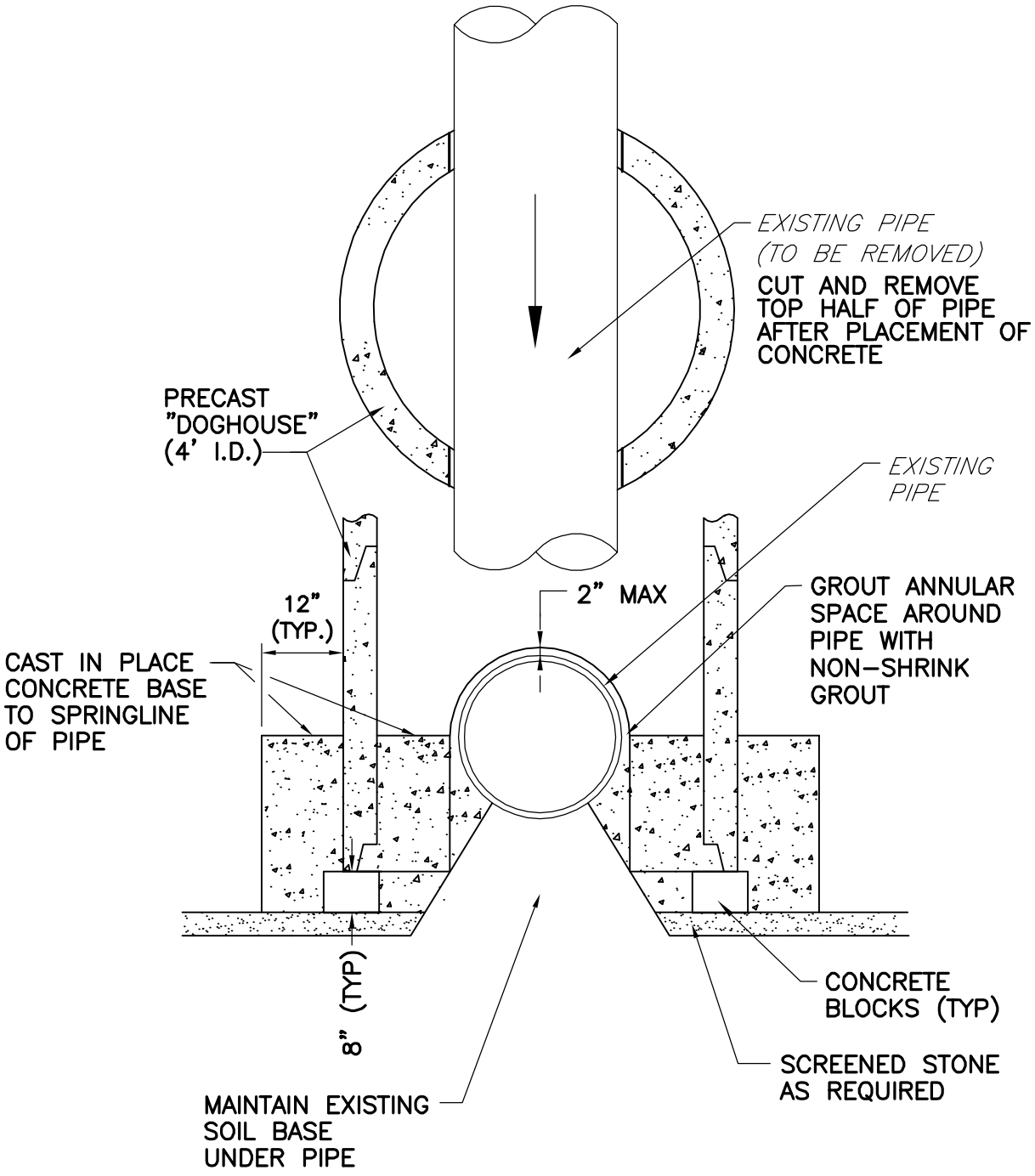
SCALE: NONE	



DOGHOUSE TYPE MANHOLE

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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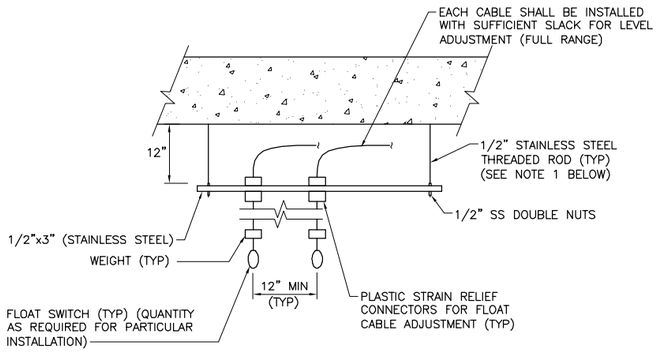


TYPICAL FOR WETWELL HIGH-HIGH AND LOW-LOW LEVEL FLOAT SWITCHES

NOTES:

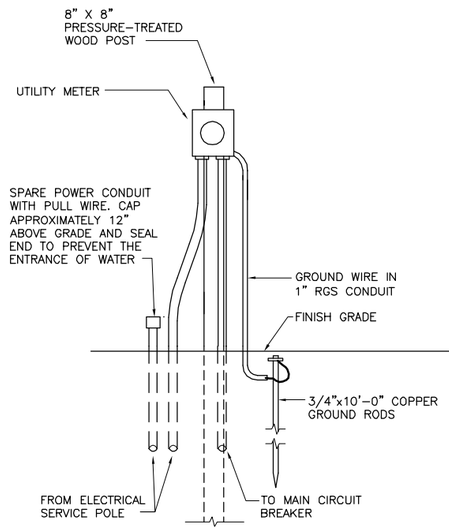
(FLOAT SWITCH INSTALLATION DETAIL)

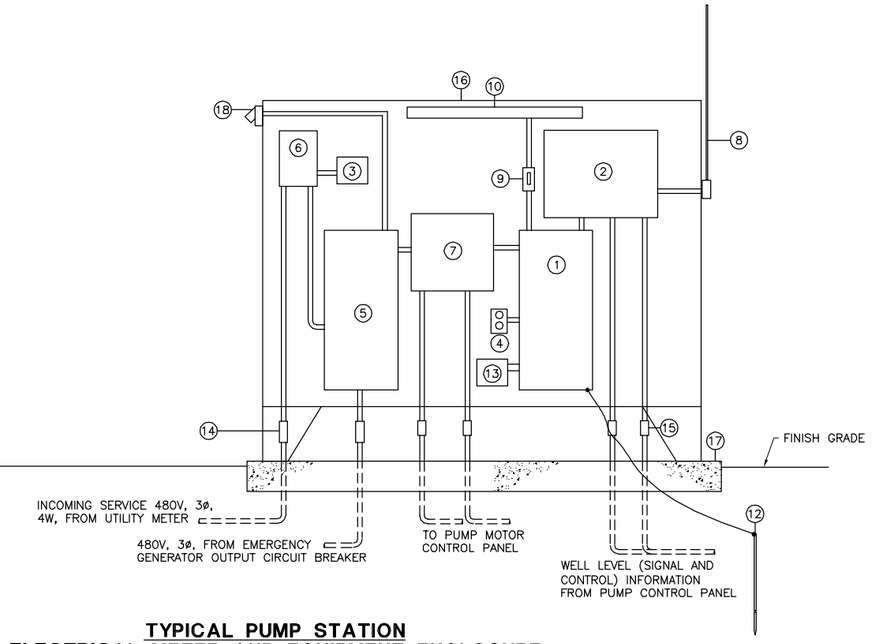
1. ALL EQUIPMENT, MATERIALS, INSTALLATION, ETC.,, SHOWN ON THIS DETAIL, SHALL BE FURNISHED AND INSTALLED BY DIVISION 16 – ELECTRICAL.

2. ALL MATERIAL AND MOUNTING HARDWARE SHALL BE 316 STAINLESS STEEL UNLESS OTHERWISE NOTED.

TYPICAL FLOAT SWITCH SUPPORT AND INSTALLATION DETAIL

NTS





TYPICAL PUMP STATION ELECTRICAL METER AND EQUIPMENT ENCLOSURE

NTS

EQUIPMENT LIST

1. MINIPOWER ZONE WITH 5KVA, 480:120/240V TRANSFORMER AND 10, 1P-20A CIRCUIT BREAKERS
2. TELEMETRY UNIT (BY DISTRICT)
3. LIGHTNING PROTECTION AND SURGE ARRESTER PACKAGE
4. DUPLEX GFI RECEPTACLE, 120V, 20A
5. 100A, 3 POLE, AUTOMATIC TRANSFER SWITCH, SERVICE ENTRANCE RATED WITH SOLID NEUTRAL, IN NEMA 1 ENCLOSURE
6. 100A, 3-POLE, ENCLOSED CIRCUIT BREAKER, SERVICE ENTRANCE-DUTY RATED
7. NEMA 1 480V JUNCTION BOX
8. TELEMETRY ANTENNA (BY DISTRICT)
9. 120V, 20A LIGHT SWITCH
10. 2' LONG FLUORESCENT STRIP LIGHT
11. NOT USED
12. 3/4"x10' GROUND ROD AND #2 GROUND WIRE
13. 500W STRIP HEATER, 120V
14. EXPANSION FREEZE FITTING (TYP) (PROVIDE WHERE REQUIRED BY NEC)
15. CONDUIT SEAL FITTING (TYP)
16. NEMA 4X SS, 2 DOOR, PAD-MOUNTED ENCLOSURE
17. CONCRETE SLAB (SEE DIVISION 03 SPECIFICATIONS)
18. 4-PIN WEATHERPROOF RECEPTACLE, 100A FOR PORTABLE GENERATOR CONNECTION (AS REQUIRED)

ELECTRICAL NOTES:

1. COORDINATE ALL WORK WITH THE REQUIREMENTS OF THE UTILITY COMPANY.

2. GROUND NEUTRAL CONDUCTOR AND ALL EQUIPMENT ENCLOSURES IN ACCORDANCE WITH NEC ARTICLE 250.

3. ALL EQUIPMENT SHALL BE MOUNTED AT ACCESSIBLE HEIGHTS IN ACCORDANCE WITH NEC ARTICLE 110.

4. COORDINATE SIZE OF DOUBLE DOOR ENCLOSURE TO ACCOMMODATE ALL EQUIPMENT AS INDICATED.

5. UNLESS OTHERWISE NOTED, ALL POWER AND TELEMETRY CONDUITS PROVIDED UNDER THIS CONTRACT SHALL BE RIGID GALVANIZED STEEL (RGS) ABOVE AND BELOW GRADE. THE TELEMETRY SYSTEM SHALL BE FURNISHED BY OTHERS; CONNECTIONS SHALL BE MADE BY THE ELECTRICAL CONTRACTOR.

6. THE OWNER/CONTRACTOR SHALL PROVIDE AND INSTALL POWER, CONTROL AND SIGNAL CONDUITS TO THE TELEMETRY ENCLOSURE. THE CONTRACTOR SHALL MOUNT THE TELEMETRY ENCLOSURE AND EQUIPMENT PROVIDED BY THE WELLS SANITARY DISTRICT.

7. CONTRACTOR TO COORDINATE ADEQUATE SPACE WITH THE DISTRICT TO ACCOMMODATE THE TELEMETRY EQUIPMENT.

8. THE ENCLOSURE MOUNTING PAD SHALL BE 12 INCHES THICK AND EXTEND A MINIMUM IF 8 INCHES BEYOND THE ENCLOSURE FOOTPRINT. REINFORCE THE PAD WITH #4 REBAR, SPACE 12 INCHES ON CENTER TOP AND BOTTOM FACE, EACH DIRECTION WITH 2 INCH CONCRETE EMBEDMENT.

9. PLACE ENCLOSURE MOUNTING PAD ON A MINIMUM OF 12 INCHES OF COMPACTED SELECT FILL.

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2009
SCALE:	NONE

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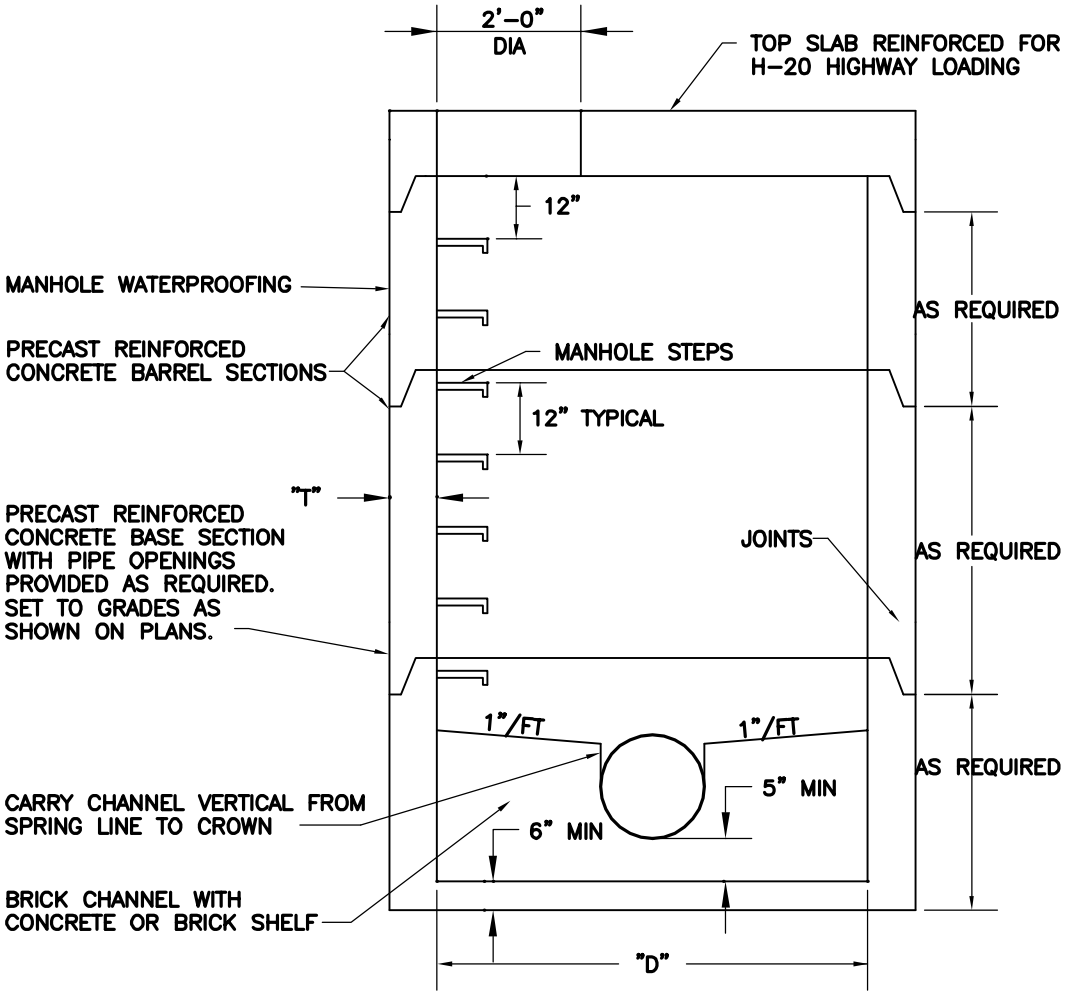

NOTE: MANHOLE CHANNELS REQUIRING CHANGE IN ALIGNMENT ARE TO BE BUILT ON A SMOOTH RADIUS. IF SIDE PIPES ENTER CHANNEL, SHAPE TO RECEIVE ADDED SIDE FLOW.

DIAMETER ("D")	MAX PIPE DIAMETER STRAIGHT THRU TO 45° DEFLECTION	MINIMUM WALL THICKNESS ("T")
48"	UP TO 30" O.D.	5"
60"	UP TO 44" O.D.	6"
72"	UP TO 51" O.D.	7"
96"	UP TO 72" O.D.	9"

FLAT SLAB TOP MANHOLE

NTS

WELLS SANITARY DISTRICT
WELLS, MAINE
STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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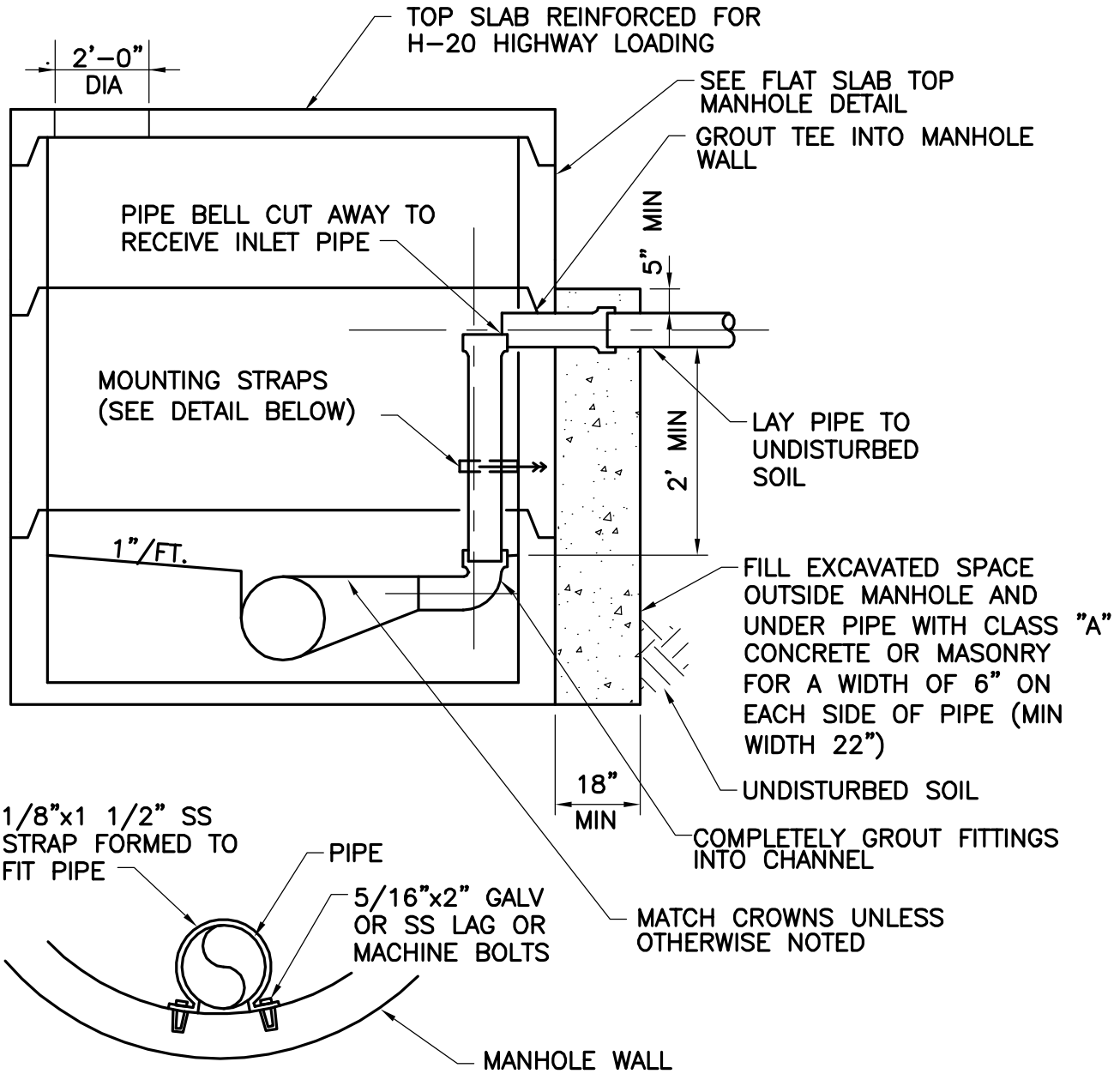
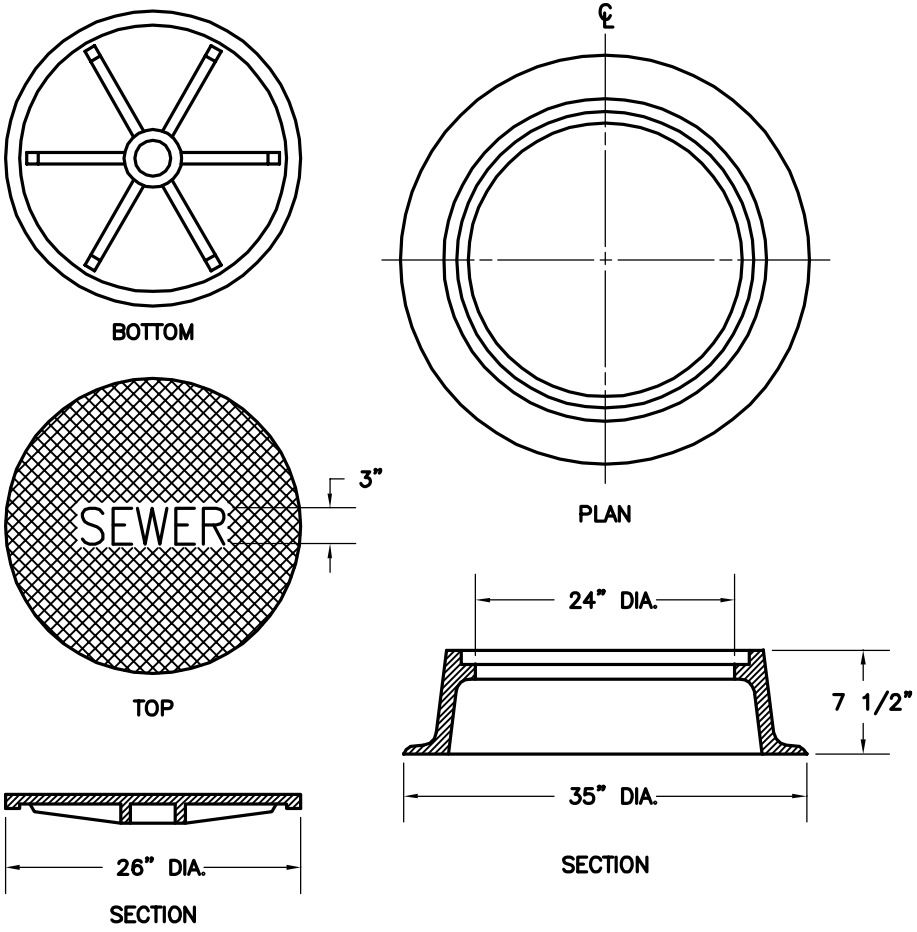


NOTE: INSIDE DROP MANHOLES SHALL BE 6' DIAMETER.

INSIDE DROP MANHOLE WITH PVC PIPE

NTS

WELLS SANITARY DISTRICT WELLS, MAINE STANDARD SPECIFICATIONS AND DETAILS	
PROJ NO: 10885F	WRIGHT-PIERCE Engineering a Better Environment Offices Throughout New England 888.621.8156 | www.wright-pierce.com
DATE: OCT 2008	
SCALE: NONE	



MANHOLE
STANDARD COVER AND FRAME

NTS

WELLS SANITARY DISTRICT	
WELLS, MAINE	
STANDARD SPECIFICATIONS AND DETAILS	
PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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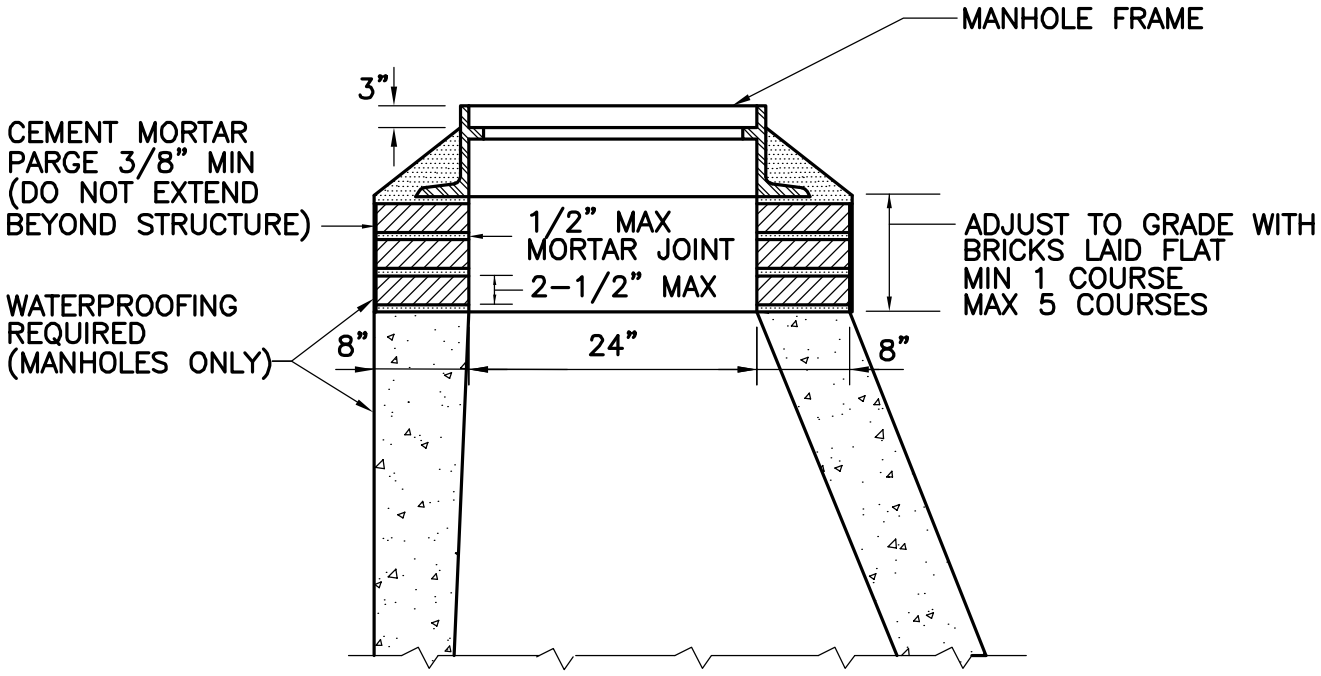

MANHOLE
FRAME INSTALLATION

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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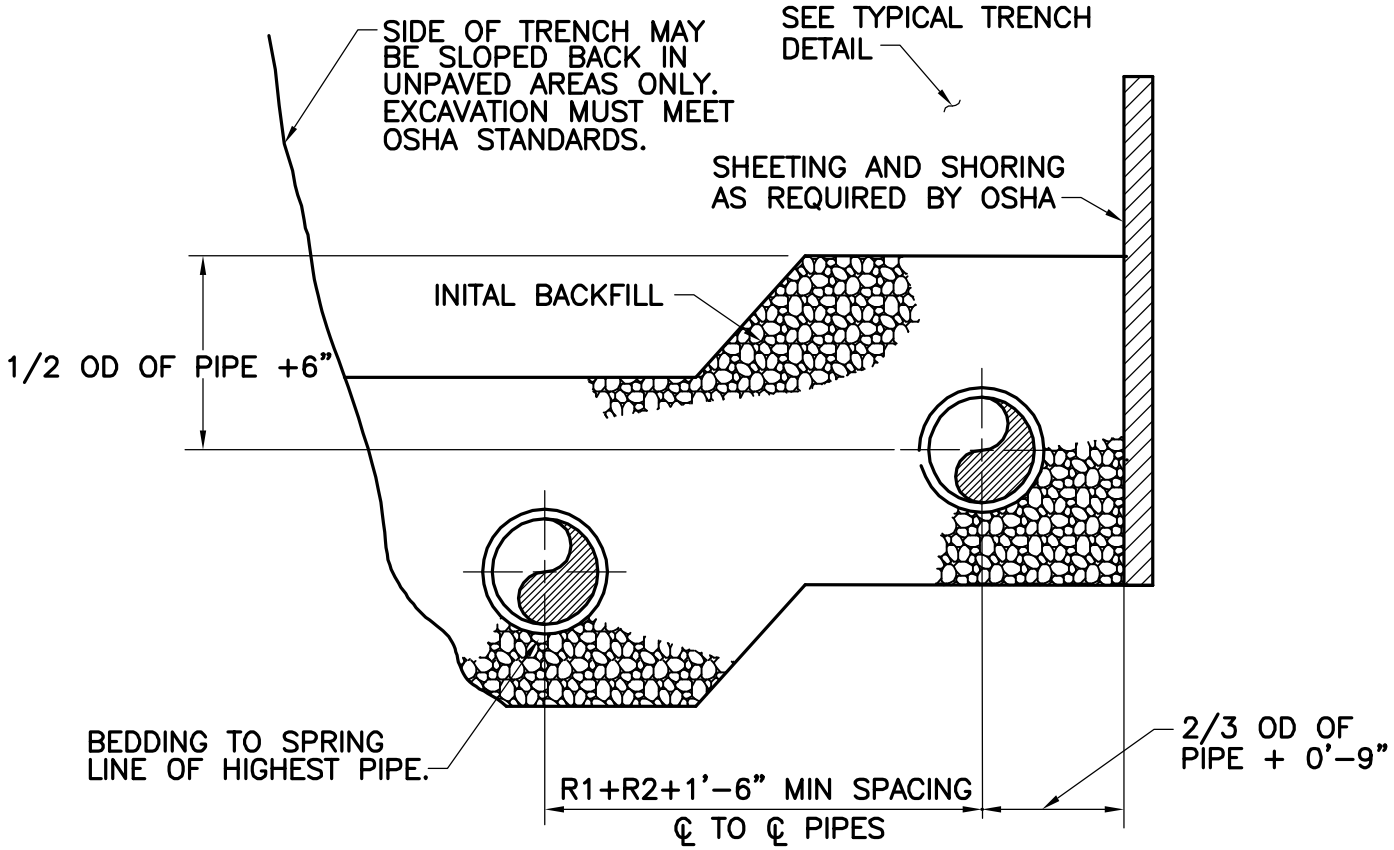

NOTES:
1. THIS SECTION IS SHOWN FOR TWO PIPES. IT IS TO BE USED FOR ANY NUMBER OF PIPES.
2. SEE SPECIFICATIONS FOR BEDDING AND BACKFILL MATERIALS AND COMPACTED BACKFILL REQUIREMENTS.
3. PIPE SPACING SHOWN IS TYPICAL UNLESS OTHERWISE INDICATED.

MULTIPLE PIPE TRENCH SECTION

NTS

WELLS SANITARY DISTRICT
WELLS, MAINE
STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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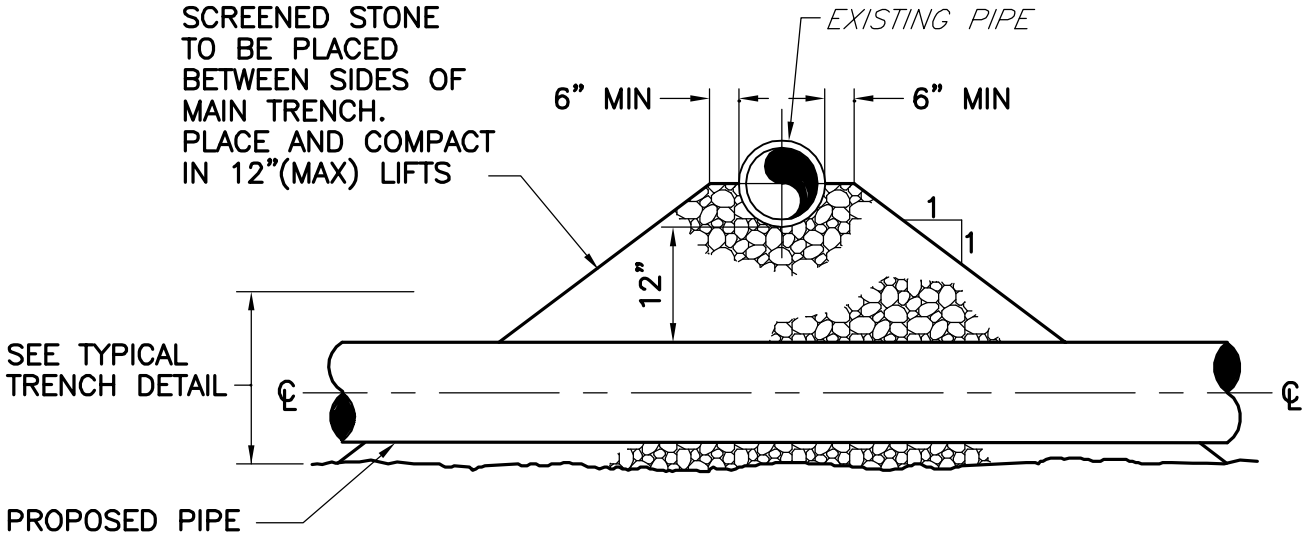

NOTE:
JOINTS ON EACH PIPE TO BE AS FAR FROM INTERSECTION AS POSSIBLE

PIPE CROSSING DETAIL

NTS

WELLS SANITARY DISTRICT WELLS, MAINE STANDARD SPECIFICATIONS AND DETAILS	
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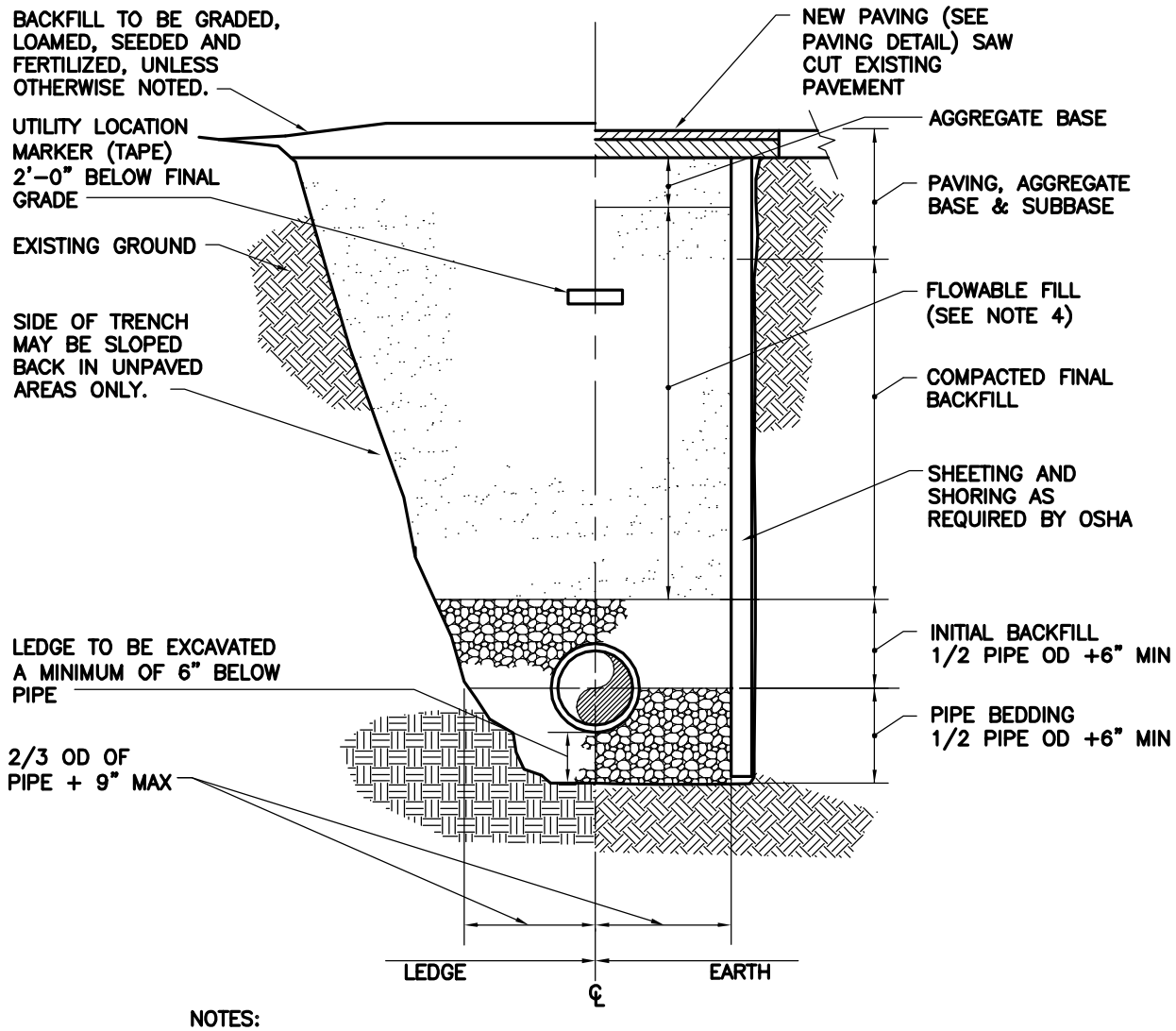
DATE: FEB 2008	
SCALE: NONE	



NOTES:

1. ALL EXCAVATIONS MUST MEET OSHA STANDARDS

2. INSTALL 3 FOOT LONG IMPERVIOUS MATERIAL DAM IN BEDDING/INITIAL BACKFILL MATERIAL EVERY 100' TO PREVENT TRENCH GROUND WATER FROM BEING CHANNELED ALONG BEDDING/INITIAL BACKFILL.

3. SEE SPECIFICATIONS FOR BEDDING AND BACKFILL REQUIREMENTS.

4. CONTRACTOR SHALL BACKFILL PIPE TRENCH IN ROUTE 1, AND AS DIRECTED BY THE WELLS SANITARY DISTRICT, WITH FLOWABLE FILL.

PIPE TRENCH DETAIL

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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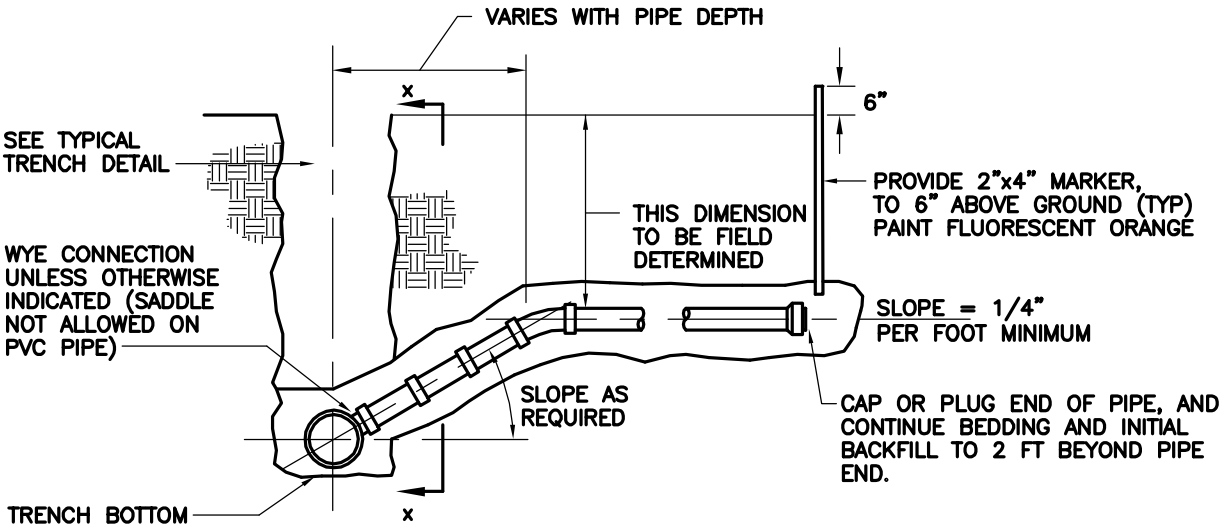

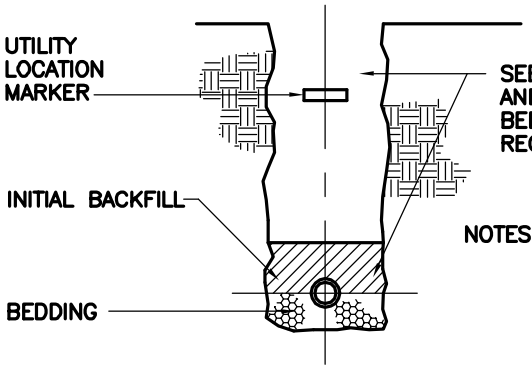

SECTION X-X

NOTES:
1. ALL SERVICE CONNECTIONS TO BE 6" DIAMETER UNLESS OTHERWISE SHOWN ON THE DRAWINGS.
2. USE CHIMNEY DETAIL WHERE SERVICE CONNECTION ENTERS SEWER AT GREATER THAN 60° TO THE HORIZONTAL.
3. EXTEND SERVICE 4' BEYOND LIMIT OF SIDEWALK (MIN.)

SEWER SERVICE CONNECTION DETAIL

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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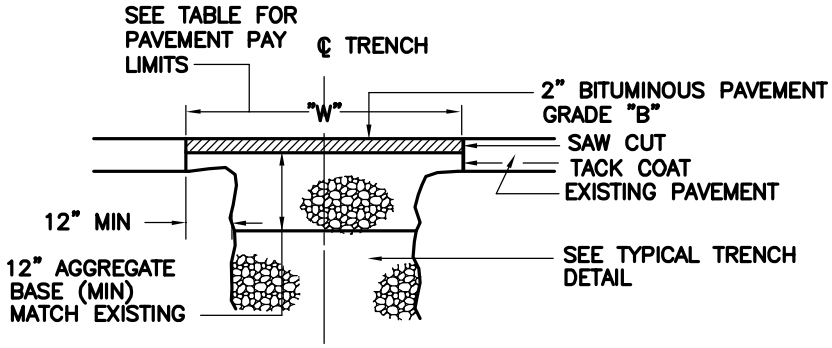
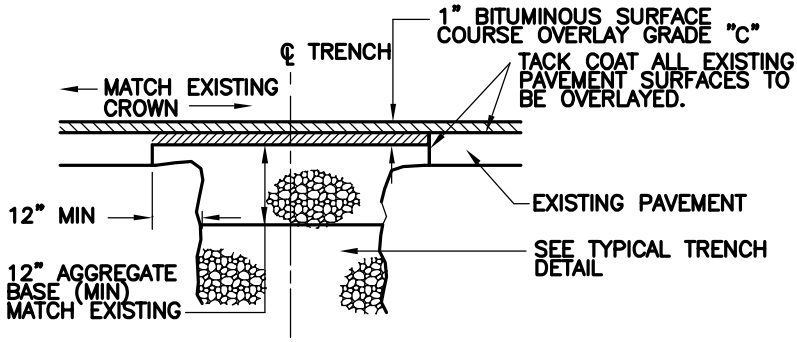


INITIAL TRENCH PAVING (WITH OVERLAY)

NTS

NOTE: INITIAL TRENCH PAVING MAY BE USED AS THE BASE COURSE FOR FINAL PAVING IF IN GOOD REPAIR.



FINAL OVERLAY PAVING

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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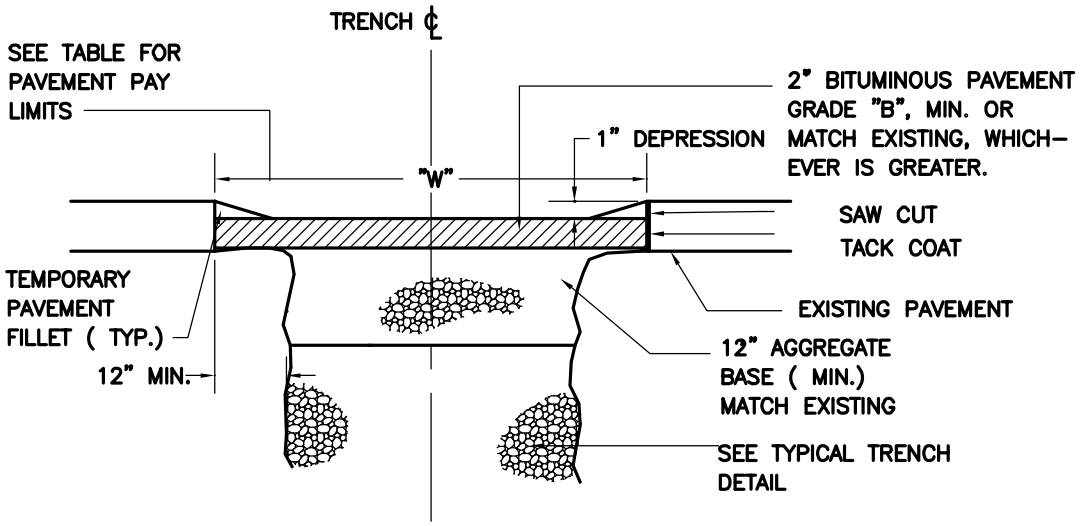
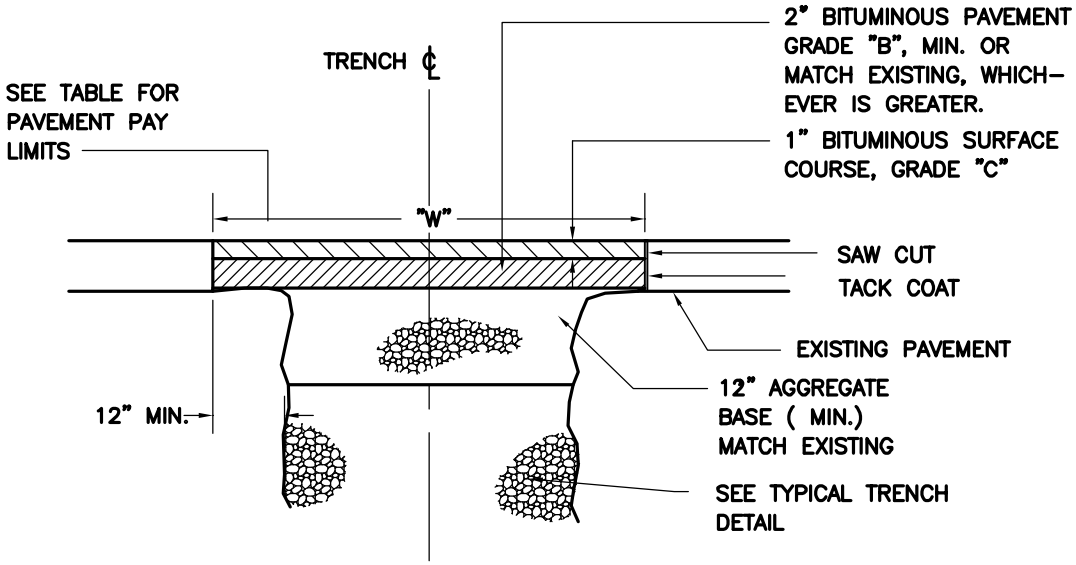


INITIAL TRENCH PAVING (WITHOUT OVERLAY)



NOTE:
INITIAL TRENCH PAVING MAY BE USED AS THE BASE COURSE FOR FINAL PAVING IF IN GOOD REPAIR.

FINAL TRENCH PAVING (WITHOUT OVERLAY)

WELLS SANITARY DISTRICT	
WELLS, MAINE	
STANDARD SPECIFICATIONS AND DETAILS	
PROJ NO:	10885F
DATE:	FEB 2008
SCALE:	NONE

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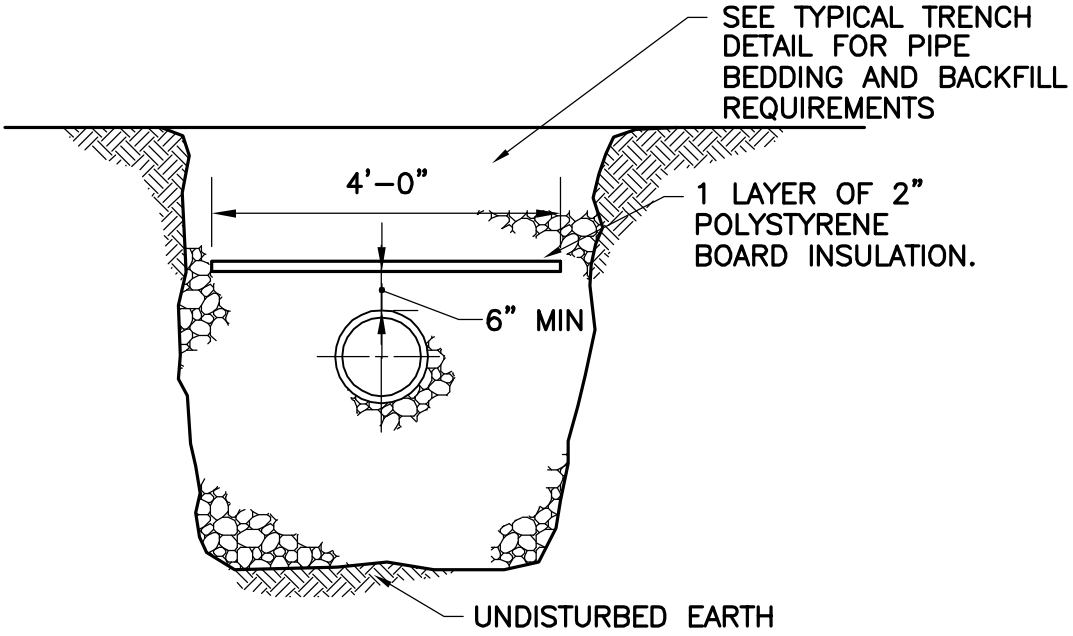

NOTE: TRENCH PIPE INSULATION TO BE USED WHERE DEPTH OF COVER IS LESS THAN 5 FEET OR AS DIRECTED BY THE DISTRICT.

TRENCH PIPE INSULATION DETAIL

NTS

WELLS SANITARY DISTRICT WELLS, MAINE STANDARD SPECIFICATIONS AND DETAILS	
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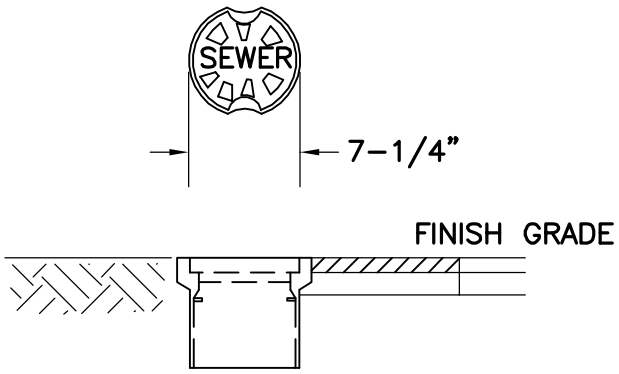
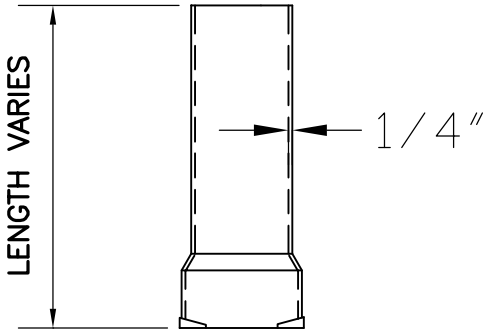
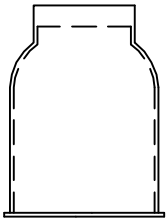
DATE: FEB 2008	
SCALE: NONE	



TOP SECTION



MID-SECTION



BOTTOM SECTION

VALVE BOX DETAIL

NTS

WELLS SANITARY DISTRICT	
WELLS, MAINE	
STANDARD SPECIFICATIONS AND DETAILS	
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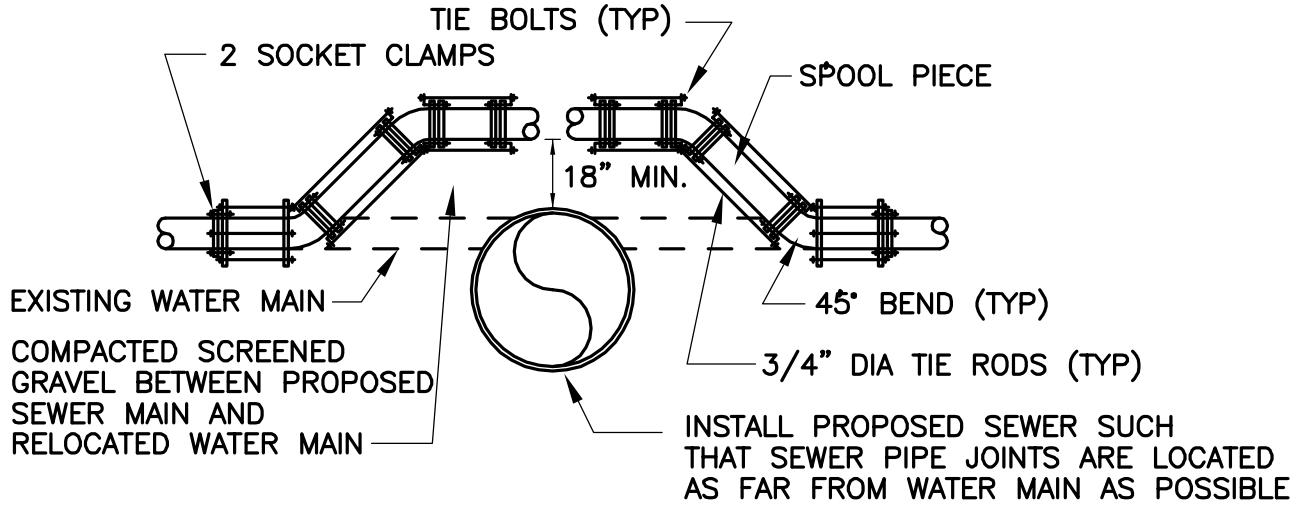

NOTES:
1. WATER MAIN MATERIALS TO BE CLASS 52 DUCTILE IRON. JOINT RESTRAINT TO BE BY MECHANICAL JOINT WITH RETAINER GLANDS, OR WITH TIE BOLTS AS SHOWN.
2. TIE RODS, TIE BOLTS, SOCKET CLAMPS AND BRIDLES SHALL BE COATED WITH A BITUMINOUS PAINT AFTER ASSEMBLY OR IF NECESSARY PROIR TO ASSEMBLY.
3. TIE RODS: 10" DIA WATER MAIN OR LARGER – 4 REQUIRED.
   8" DIA WATER MAIN OR SMALLER – 2 REQUIRED.
4. EXISTING WATER MAINS TO BE RELOCATED OVER NEW SEWERS WHEREVER SUFFICIENT GROUND COVER EXISTS (5' MINIMUM COVER).
5. COORDINATE REQUIREMENTS WITH SANFORD WATER DISTRICT.

WATER MAIN RELOCATION DETAIL

NTS

WELLS SANITARY DISTRICT

WELLS, MAINE

STANDARD SPECIFICATIONS AND DETAILS

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