STANDARD WASTEWATER CONSTRUCTION SPECIFICATIONS

PREPARED FOR:

Town of Zionsville, Indiana

ZIONSVILLE
FOR ALL THE RIGHT REASONS

TOWN OF ZIONSVILLE
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Table of Contents

1) General Requirements
   a) 01001 General Requirements
   b) 01783 GPS Asset Location
   c) 02539 Temporary Bypass Pumping

2) Earthwork
   a) 02300 Earthwork for Sanitary Sewer
   b) 02530 Gravity Sanitary Sewers
   c) 02545 Sanitary Force Mains

3) Installation Techniques
   a) 02410 Horizontal Directional Drilling
   b) 02530 Gravity Sanitary Sewers

4) Rehabilitation Options
   a) 02535 CIPP Pipeline
   b) 02536 Slip Lining Pipeline
   c) 02537 Pipe Bursting Pipe
   d) 02541 Sanitary Sewer Structure Rehab
   e) 02539 Temporary Bypass Pumping

5) Lift Stations
   a) 11310 Submersible Lift Station
   b) 02545 Sanitary Force Mains
   c) 02539 Temporary Bypass Pumping

6) Generators and Transfer Switches
   a) 16620 Packaged Engine Generators
   b) 16415 Transfer Switches

7) Testing and Other Requirements
   a) 01783 GPS Asset Location Data
   b) 02531 Digital Manhole Inspection
   c) 02532 Sewer Televising

8) Town of Zionsville Design and Construction Specifications Combined

SECTION 01001
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:

1. General limitations of the work
2. Temporary facilities
3. Cutting and patching
4. Substantial completion
5. Record drawings
6. Product requirements
7. Site preparation
8. Dust, noise, and erosion control
9. Maintenance of traffic
10. Execution requirements

1.2 DEFINITIONS

A. When used in these specifications, the following terms have the meanings indicated:

1. Town – the Town of Zionsville, represented by the Town Council, having the authority of approval of plans and specifications and acceptance of final construction
2. Engineer – Town Engineer acting on behalf of the Town
3. Contractor – person, firm, or corporation with whom the Town has entered into an agreement for construction of the project
4. Project – the total construction of the work to be provided
5. Work – the entire completed construction required of the Contractor
6. Product – item purchased for the incorporation into the work, including materials, equipment, systems, and other similar terms.

1.3 SUBMITTALS

A. General

1. Electronic copies of CAD drawings will not be provided for Contractor's use in preparing submittals.
2. Submittals in each specification are listed as a guide and are generally applicable.
   a. Engineer or Wastewater Superintendent may waive the requirement for certain listed submittals.
   b. Engineer or Wastewater Superintendent may require submittals not listed.

3. Contractor shall make resubmittals in the same number and form as the initial submittal.

4. Contractor shall submit to Engineer a certificate of compliance from the manufacturer or supplier of every specified product.

5. All submittals shall be provided in electronic PDF format, except for:

    a. Product samples.

    b. Record Drawings

        1) Provide both hard copy and electronic format.

    c. Operations and Maintenance Data

        1) Provide both hard copy and electronic format.

6. Send electronic submittals as PDF format files directly to Engineer’s email address or Engineer's file sharing site.

7. Physical Submittals

    a. Submit 3 samples. Engineer will return 1 sample.

    b. Submit 2 paper copies of Record Drawings along with digital files.

    c. Submit 2 paper copies of Operations and Maintenance Data along with digital files.

8. Clearly mark each submittal to show:

    a. Applicable products where multiple products or options are described.

    b. Deviations from specified products.

9. Construction Photographs:

    a. Before starting construction, take photos of the project site and surrounding properties, including existing items to remain during construction, from different vantage points.

    b. Take photos at same locations as pre-construction photos after substantial completion. Take additional photographs as directed by Engineer or Wastewater Superintendent.

10. Construction Video:

    a. Provide pre-construction videos for linear utility projects exceeding 800 feet in total length.

    b. Provide post-construction videos for all linear utility projects.

    c. Confirm date and time at beginning and end of recording.

    d. Begin each video with project name and recording location.

    e. Submit 2 copies of all video on a removable USB storage device as MPEG or AVI format files.

    f. With each copy, provide the following information:

        1) Project name.

        2) Date video was recorded.

3) Description of location, direction, and elevation.

4) Weather conditions at time of recording.

11. Contractor shall use only submittals approved in writing by Engineer.

B. Coordination

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of submittals for related parts of the Work so processing will not be delayed because of need to review submittals.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time

1. Allow time for submittal reviews, including time for resubmittals, as follows:

a. Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.

b. Allow 15 days for review of each resubmittal.

2. Time for review shall commence on Engineer's receipt of submittal.

3. No extension of contract time will be granted due to failure to transmit submittals enough in advance of the work to allow review, including resubmittals.

1.4 QUALITY ASSURANCE

A. Work to be Performed

1. Work to be performed shall be in accordance with drawings and specifications approved by the Town and Wastewater Superintendent.

B. Conflicting Requirements

1. If compliance with 2 or more standards is specified and the standards establish conflicting requirements, comply with the more stringent requirement. Refer uncertainties to Engineer or Wastewater Superintendent before proceeding.

2. The quantity or quality level specified shall be the minimum. Actual installation may comply exactly with the minimum or may exceed the minimum within reasonable limits. Refer uncertainties to Engineer or Wastewater Superintendent before proceeding.

C. Qualifications

1. Qualifications in these specifications establish minimum qualification levels required of Contractor. Town may establish additional qualifications.

a. Professional Engineer Qualifications:

1) A professional engineer who is legally qualified to practice in jurisdiction where the project is located and who is experienced in providing engineering services of the kind indicated.

b. Testing Agency Qualifications:

1) An agency with the experience and capability to conduct testing and inspecting indicated, per ASTM E548.

c. Service Representative Qualifications:

1) An authorized representative of a product manufacturer who is trained and approved by the manufacturer to inspect installation of manufacturer's products.

D. Quality Control

1. Tests and inspections not assigned to the Town are Contractor's responsibility. Perform quality control services and submit all reports, whether specified or not.

a. Engage a qualified testing agency to perform quality control services where indicated and where laboratory testing is required.

b. Notify Engineer, Wastewater Superintendent, and testing agencies at least 24 hours in advance of performing work that requires testing or inspecting.

c. Submit a certified written report of each quality control service.

2. Contractor Responsibilities

a. Schedule sampling and testing to allow sufficient time for testing and analyzing results to prevent delaying the Work.

b. Provide contract documents and submittals to testing agency as required.

c. Assist testing agency in obtaining test specimens.

d. When testing is complete, remove test specimens and assemblies.

e. Do not reuse test products.

f. Patch or repair destructive testing locations.

3. If Engineer considers re-inspection or re-testing necessary, Contractor shall uncover, expose, or otherwise make available the portion of the Work in question, furnishing all necessary labor, material, and equipment.

a. Work shall be considered defective if it does not meet any one or more of the testing requirements, performance requirements, or other requirements.

b. If it is found that the work is defective, Contractor shall pay all costs relating to such uncovering, observation, inspection, testing, and satisfactory replacement or reconstruction, and Town shall be entitled to an appropriate decrease in the contract price.

c. If the Work is not found to be defective, Contractor shall be allowed an increase in the contract price or an extension of the contract times, or both, attributable to such uncovering, observation, inspection, testing, replacement, and reconstruction.

4. Testing Agency Responsibilities:

a. Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform tests and inspections.

b. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the work during tests and inspections.

c. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

d. Conduct tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

e. Submit a certified written report of each test, inspection, and similar service through Contractor.

f. Do not release, revoke, modify, or increase the contract requirements or approve or accept any portion of the work.

g. Do not perform any duties of Contractor.

1.5 GENERAL LIMITATIONS OF THE WORK

A. Easements and Adjacent Properties

1. Town will obtain right-of-way easements over and through private land for construction. The width or limits of such easements will be defined by the Town before the Work shall begin.

2. If Contractor's methods of construction require the use of land beyond the limits obtained, Contractor shall make an agreement with the property owners affected for the use of such additional land.

3. Contractor shall be required to carefully remove all obstacles within easements and replace in kind after Work is installed. Backfilling shall be to the grade of the existing ground level.

4. The cost of all property restoration shall be included in the Work.

B. Use of Site

1. Do not disturb portions of the site beyond areas in which work is indicated. Limit use of the site to:

a. Areas within the contract limits indicated. Where not indicated, limit work to site limits.

b. Designated public rights-of-way, permanent and temporary easements, and limits of work indicated on plans.

c. Temporary easements obtained by Contractor for the work.

2. Contractor's use of site is limited by:

a. Town's right to operate and maintain its utility works,

b. Public use of existing rights-of-way,

c. Property rights of utilities occupying the site,

d. Property rights of the site owner, including governmental agencies and landowners.

3. Allow for occupancy of the site and use by the public of any public areas not immediately occupied by Contractor.

4. Keep driveways and entrances serving the site clear and available to property owners, residents, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

C. Town Occupancy

1. Town reserves the right to occupy and to place and install equipment in completed portions of the Work, provided such occupancy does not interfere with completion of the Work. Such partial occupancy shall not constitute acceptance of that portion of the Work.

D. Work Restrictions

1. Work shall be generally performed on site during the hours of 7:00 a.m. to 7:00 p.m., Monday through Saturday, except as indicated:

   a. Sunday: No work without Town's prior written authorization.

   b. Early morning: No work without Town's prior written authorization.

   c. Night hours: No work without Town's prior written authorization.

   d. Utility shutdowns: 8:00 a.m. to 4:00 p.m. Monday through Friday.

   e. Noisy activity: 8:00 a.m. to 5:00 p.m. Monday through Friday.

E. Interruption of Existing Utilities

1. Do not interrupt existing utilities unless the following conditions are met:

   a. Coordinate all utility interruptions with utility owner.

   b. Comply with all utility owner's requirements in conducting utility interruptions.

   c. Do not proceed with interruptions without utility owner's written permission.

   d. Notify Town and utility owner not less than 48 hours in advance of proposed utility interruptions.

2. Relocation of utilities and utility appurtenances shall be performed by utility owner at Contractor's expense, unless the utility owner provides written authorization for the Contractor to relocate the utility.

1.6 TEMPORARY FACILITIES

A. General

1. Contractor shall provide sanitary facilities, drainage facilities, heating and cooling, ventilation and humidity control, electric service, lighting, and telephone service as necessary and in accordance with applicable regulations.

2. All temporary facilities provided shall be Contractor's responsibility and shall be provided at Contractor's expense.

3. Arrange with utility company, Town, and existing users for time when service can be interrupted to make connections for temporary services.

4. Maintain facilities in good operating condition until removal. Remove each facility when need for its service has ended, when it has been replaced by a permanent facility, or no later than substantial completion.

B. Support Facilities

1. Construct and maintain temporary roads and paved areas as necessary for construction operations.

2. Provide temporary parking areas as necessary for construction personnel.

3. Provide temporary installations of existing mailboxes affected by the work in a manner and at a location to be accessible to postal carriers.

   a. Notify postmaster when a mailbox has been temporarily relocated.

   b. Restore mailboxes to original condition as soon as practicable.

4. Maintain project site, excavations, and construction free of water.

5. Provide waste collection containers to handle construction waste.

C. Security and Protection Facilities

1. Conduct construction to comply with environmental regulations.

   a. Protect against possible air, waterway, and soil contamination or pollution and other undesirable effects.

2. Comply with requirements of authorities having jurisdiction for erecting barricades, including warning signs and lighting.

3. Provide temporary enclosures for protection of construction from exposure, weather, construction operations, and similar activities.

4. Install and maintain temporary fire protection facilities to protect against fire losses. Comply with NFPA 241 and other applicable regulations.

5. Provide portable, UL rated fire extinguishers with class and extinguishing agent as required.

1.7 CUTTING AND PATCHING

A. Quality Assurance

1. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

2. Do not cut and patch components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Do not cut and patch construction in a manner that results in visual evidence of cutting and patching.

4. Do not cut and patch construction in a manner that would, in Engineer or Wastewater Superintendent's opinion, reduce the building's aesthetic qualities.

5. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

6. Remove, replace, patch, and repair materials so as not to void existing warranties.

7. Use materials identical to in-place materials where possible. For exposed surfaces, use materials that visually match adjacent surfaces if possible.

1.8 SUBSTANTIAL COMPLETION

A. Before requesting final inspection, complete the following:

1. Prepare and submit a list of items to be completed and corrected.

2. Advise Town of pending insurance changeover requirements.

3. Submit specific warranties, bonds, maintenance agreements, final certifications, and similar documents not previously submitted.

4. Prepare and submit record drawings.

5. Perform startup testing of systems.

6. Top off fuel tanks and other consumable commodities.

7. Remove temporary facilities.

8. Complete final cleaning requirements.

B. Final Inspection

1. Submit a written request for final inspection. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements.

2. Following inspection, Engineer will notify Contractor of construction that must be completed or corrected.

1.9 RECORD DRAWINGS

A. Maintain at all times 1 set of plans and shop drawings for use as record drawings.

1. Mark record drawings to show the actual installation where installation varies from that shown originally on the plans.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure later.

b. Accurately record information in a clear and understandable manner.

c. Record data daily.

2. Mark existing and abandoned utilities whether shown on the plans or not.

3. Mark additional information that was omitted from the original plans.

4. Date each record drawing and identify as record drawings by including the designation "RECORD DRAWING" in a prominent location.

5. Maintain record drawings in good order and in a clean, dry, legible condition, protected from deterioration and loss.

6. Allow access to record drawings by Engineer during normal working hours.

B. Provide 1 set of half-size (11”x17”) record drawings, 1 set of full-size (22”x34”) record drawings, and 1 electronic set of record drawings on a removable USB storage device or through electronic file transmission. Electronic set shall utilize AutoCAD or similar design software and shall be DWG or DXF format.

C. Record drawings shall be certified to accuracy by a Professional Engineer.

D. Record drawings shall be submitted to Town Clerk’s office within 30 days of substantial completion.

E. Prepare and submit final photographic and video records.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. When possible, Contractor and subcontractors shall employ local labor.

B. Contractor shall purchase products from local dealers where local dealer's prices meet competitor's prices, and where such materials meet the specifications.

C. Substitution Requests

1. Engineer will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at Engineer's discretion.

2. Submit 3 copies of each request for substitution.

a. If necessary, Engineer will request additional information or documentation within 7 days of receipt of a request for substitution.

b. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information, whichever is later.

D. Provide products that are new and undamaged at time of installation.

E. Provide products of the latest model or style complete with accessories, trim, finish, fasteners, and other items needed for a complete installation.

F. Provide standard products of types that have been produced and used successfully in similar situations on other projects.

G. Product Delivery, Storage, And Handling

1. Deliver, store, and handle products using methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's instructions.

2. Deliver products to site in undamaged condition in manufacturer's original sealed container or other packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

3. Store products to allow for inspection and measurement of quantity.

4. Store products subject to damage by the elements under cover in a weathertight enclosure above ground, ventilated to prevent condensation.

5. Protect stored products from damage and liquids from freezing.

H. Product Warranties

1. Warranties specified in individual specification sections shall be in addition to, and run concurrent with, other warranties required.

2. Provide manufacturer's standard published warranty for all products unless specified otherwise.

3. Contractor shall provide a warranty for all equipment installed.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. General

1. Take field measurements as required to lay out the work properly. Recheck measurements before installing each product.
2. Before proceeding to lay out the work, verify layout information shown on plans in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
3. Establish benchmarks and control points to set lines and levels at each structure and elsewhere as needed to locate each element of the work.
4. Preserve and protect benchmarks and control points during construction.
    a. Report promptly to Engineer and replace lost or destroyed permanent benchmarks, control points, and property corner pins.
5. If hazardous material is observed on the site, Contractor shall immediately notify Engineer and Town in writing. Contractor shall not perform any work pertinent to the hazardous material prior to receiving instructions from the Town.

B. Existing Utilities

1. Complete the following prior to start of construction:
    a. Notify utility locator service before work at the site.
    b. Furnish information to local utility that is necessary to adjust or relocate existing utility services affected by construction.
    c. Excavate, expose, and confirm the location, size, elevation, material, and other relevant information of all underground utilities related to the work.

C. Tree Protection

1. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
2. Protect tree root systems from damage, flooding, and erosion.
3. Maintain fenced area free of weeds and trash.
4. Do not excavate within tree protection zones.
5. Repair trees and vegetation not indicated to be removed that are damaged by construction operations within 24 hours.
    a. Replace trees and shrubs in kind that cannot be repaired and restored to full-growth status.

3.2 DUST, NOISE, AND EROSION CONTROL

A. Dust Control

1. Prevent wind-borne soil particles that could create health or visibility hazards from leaving the site.

2. Apply an approved dust control product as necessary to prevent health or visibility hazards due to wind-borne particles.

B. Noise Control

1. Minimize noise by use of sound attenuating devices where necessary.

C. Erosion Control

1. Prevent pollutants from entering existing storm and sanitary facilities in the area.
2. Regularly inspect all vehicles and equipment. Any item found to be leaking gas, grease, oil, or other fluids shall be immediately removed from the site and repaired.
3. Keep all construction areas free of trash and debris that could leave the site and enter a storm sewer, drainage swale, or waterway.
4. Before beginning construction in an area:
   a. Install silt fences or other appropriate sheet flow erosion control measures in areas subject to sheet flow.
   b. Install appropriate sediment control measures in areas subject to concentrated flow.
   c. Provide inlet and outlet velocity control devices where necessary to avoid creation of gullies and to prevent damage to receiving waters.
5. Upon completion of work in an excavation, immediately backfill and return the area to rough grade elevation.
6. Do not leave areas unprotected for more than 7 days.
7. Immediately after final grading, remove all temporary erosion control systems and unstable sediment around them.
8. Inspect erosion control measures no less than once per week, and after every 1/2" or greater rainfall event.
9. Immediately remove all mud and sediment tracked onto public roads.

3.3 MAINTENANCE OF TRAFFIC

A. Notify Town at least 7 days prior to work in existing roadway or right-of-way.

B. Receive written authorization from Town before closing lanes or entire roadways.

C. Contractor shall be responsible for maintaining and protecting pedestrian and vehicular traffic at all times on all streets involved in the work.

D. Contractor shall furnish signage and barricades that are in good condition and in accordance with Indiana Manual on Uniform Traffic Control Devices.

E. Contractor shall not unnecessarily restrict or impede normal traffic on streets.

F. Excavated materials and spoil banks shall be located so as not to obstruct traffic.

G. Comply with requirements of Town for work in or near roadways.

1. Provide detour routes where required to maintain traffic. All detour signs and barricades shall be in place prior to the actual street closing.

2. Provide a smooth temporary driving surface where pavement has been disturbed until permanent repair can be completed. Temporary driving surface shall be suitable for travel at the design speed of road.

3. Private driveways shall not be closed, except where necessary, and only upon giving advance notice to the property owner.

H. Do not obstruct sidewalks or gutters or prevent the flow of water in streets.

I. Contractor may be required to erect suitable barriers to prevent inconvenience or injury to the public, trees, sidewalks, fences, and adjacent properties.

J. Contractor shall provide sufficient warning lights and signage near the work and keep them illuminated during periods of reduced visibility.

3.4 EXECUTION REQUIREMENTS

A. Permits

1. Contractor shall obtain all permits which relate to construction procedures, whether specifically stated on the plans and specifications or not.

B. General Installation

1. Locate components of the work accurately, in correct alignment and elevation, as indicated.

   a. Make vertical work plumb and make horizontal work level.

   b. Install elements within tolerances of good construction practice.

2. Comply with manufacturer's written instructions and recommendations for installing products.

3. Provide anchors and fasteners as required to anchor components securely.

   a. Allow for structure movement, including thermal expansion and contraction, as necessary.

4. Use products, cleaners, and installation materials that are not considered hazardous by regulatory agencies.

C. Progress Cleaning

1. Clean site and work areas daily and dispose of materials lawfully.

2. Maintain site free of waste materials and debris.

3. Clean areas as necessary for proper execution of the work.

4. Burying or burning waste materials on site will not be permitted.

5. Washing waste materials into sewers or waterways is not permitted.

D. Correction of the Work

1. Repair or replace defective construction. Restore damaged substrates and finishes.

2. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

3. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Final Cleaning

1. Employ experienced workers or professional cleaners for final cleaning.
2. Clean each surface to the condition expected of a new facility. Comply with manufacturer's written instructions.
3. Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property.
4. Complete the following cleaning operations before requesting inspection for substantial completion:
    a. Clean site of waste material, litter, and other foreign substances.
    b. Sweep paved areas clean. Remove chemical spills, stains, and other deposits.
    c. Remove tools, construction equipment, machinery, and surplus material from site.
    d. Remove snow and ice to provide safe access where applicable.
    e. Remove labels that are not permanent.
    f. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication, paint and mortar drippings, and other foreign substances.
    g. Leave site clean and ready for occupancy.

END OF SECTION 01001

SECTION 01783
GPS ASSET LOCATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes GPS location of existing sanitary sewer system assets.

1.2 DEFINITIONS

A. GPS – global positioning system

B. GIS – geographic information system

1.3 SUBMITTALS

A. Action Submittals

1. Schedule of Activities.

B. Informational Submittals

1. Product data for GPS equipment.

C. Project Record Documents

1. GPS unit data file capable of being uploaded to a GIS program.
2. Written report.

1.4 QUALITY ASSURANCE

A. Qualifications

1. GPS operator shall be knowledgeable in the use of the equipment.

B. Regulatory Requirements

1. Comply with all requirements of Wastewater Superintendent.

1.5 PROJECT CONDITIONS

A. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existed prior to the work.

B. Coordinate activities with weather conditions such that GPS data acquisition is possible.

C. Do not enter manholes or sewers without prior authorization of the Wastewater Superintendent.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT

A. GPS Equipment

1. Shall be capable of providing sub-meter horizontal accuracy.

2. Shall be able to provide Indiana State Plane coordinate values based on NAD 83 datum (East or West zones) for each asset.

3. Smart phones and/or recreational grade units may not be used.

4. A data dictionary shall be provided by the Wastewater Superintendent. The data elements required for the data dictionary include:

	DATA ELEMENT	DATA OPTIONS
a.	Manhole Type:	Precast; Brick; Block; Mixed Materials
b.	Manhole Type:	Sanitary; Other
c.	Lid Condition:	Good; Poor; Not Located
d.	Manhole Condition:	Good; Bad
e.	Manhole Debris:	None; Visible Grit; Evidence of Surcharge; Debris in Channel; Rocks or Sticks; Rags; Grease; Concrete; Other
f.	Flow Depth:	In Channel; 25%; 33%; 50%; 67%; 75%; 100%; Surcharged
g.	Inflow Pipe 1:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
h.	Inflow Pipe 2:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
i.	Inflow Pipe 3:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
j.	Inflow Pipe 4:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
k.	Outflow Pipe 1:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
l.	Outflow Pipe 2:	6”; 8”;10”; 12”; 15”; 18”; 24”; 30”; 36”; 42”; 48”; 54”; 60”; 72”; 90”; 96”
m.	Weir:	V Notch; Concrete; Wood Planks; Steel Plate; Bricks
n.	Remarks	
o.	Manhole Lid Photo	
p.	Manhole Interior Photo	

3.2 PROCEDURE

A. Sequence of Work

1. GPS Locate Asset

   a. Create data point for each asset.

   b. Input data dictionary elements for the asset.

c. Acquire the asset's GPS location. To ensure sub-meter accuracy, allow a minimum of 30 seconds for satellite acquisition.

d. Create 1 data file per day.

e. Process and transmit the data in a format that can be imported to GIS.

3.3 GPS DATA REPORT

A. Supply 1 digital copy of the processed data file(s) in a format that can be imported to GIS.

B. Photographs

1. Digital prints shall be provided for each individual asset.
2. Acceptable photo formats include JPEG, TIFF, BMP, GIF, and PNG.
3. The photographic prints shall be supplied on a removable USB storage device of suitable size to cover the project.
4. Each storage device supplied shall be clearly labeled with date of photos and asset name(s).

END OF SECTION 01783

SECTION 02300
EARTHWORK FOR SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Preparation of subgrades for surface restoration.
2. Excavation and backfill of sanitary sewer trenches, including structure backfill.

1.2 DEFINITIONS

A. Authorized Additional Excavation – excavation below subgrade elevations or beyond indicated lines and dimensions as authorized by Engineer

B. Backfill – material used to fill an excavation

C. Borrow Soil – soil imported from off site for use as fill or backfill

D. Excavation – removal of material encountered above subgrade elevations and to lines and dimensions indicated

E. Fill – soil materials used to raise existing grades

F. Final Backfill – backfill placed over initial backfill to fill a trench

G. Flexible Pipe – pipe manufactured of polyvinyl chloride, polyethylene, high-density polyethylene, or other plastic materials

H. INDOT SS – Indiana Department of Transportation Standard Specifications

I. Initial Backfill – backfill placed beside and over pipe in a trench, including haunches to support sides of pipe

J. Pipe Bedding – material placed over excavated subgrade in a trench before laying pipe

K. Rigid Pipe – pipe manufactured of ductile iron, cast iron, concrete, steel or other metals

L. Rock – rock which cannot be excavated without the use of a power shovel greater than 1 cubic yard capacity, or other equivalent powered equipment. Also includes all stones having a volume of 0.50 cubic yards or more

M. Subgrade – surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below topsoil materials

N. Unauthorized Excavation – excavation below subgrade elevations or beyond indicated lines and dimensions without authorization by Engineer or Wastewater Superintendent

O. Utilities – underground pipes, conduits, ducts, and cables

1.3 SUBMITTALS

A. Action Submittals

1. Product data for geotextiles and flowable fill, including design mixture.
2. Material Test Reports

a. Sieve analysis in accordance with AASHTO T27 and materials certifications in accordance with INDOT SS of each aggregate proposed for fill or backfill.

b. Classification according to ASTM D2487 of each borrow soil material proposed for fill and backfill.

c. Laboratory compaction curve according to ASTM D1557 for each on-site and borrow soil material proposed for fill and backfill.

3. Samples

a. 8”x10” sample of geotextile.

b. 1 pound to 2 pound sample of aggregates in clear plastic bag.

B. Informational Submittals

1. Qualification data for geotechnical testing agency

2. Product and material certificates

3. Schedule of tests and inspections

4. Field test reports

C. Project Record Documents

1. Field test reports

2. Record drawings

1.4 QUALITY ASSURANCE

A. Qualifications of geotechnical testing agency:

1. Independent testing agency qualified per ASTM E329 to conduct soil materials and rock-definition testing, per ASTM D3740 and ASTM E548.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils

1. AASHTO M145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these groups.

2. Satisfactory soils shall be free of rocks larger than 2” in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

3. Provide B borrow soil materials in compliance with INDOT SS when sufficient satisfactory soil materials are not available from excavations.

B. Unsatisfactory Soils

1. Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M145, or a combination of these groups.

2. Unsatisfactory soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction.

C. Impervious Fill

1. Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 OTHER BACKFILL AND FILL MATERIALS

A. Structure Backfill

1. No. 53 coarse aggregate per Section 904.03 of the INDOT SS.

B. Flowable Backfill

1. Flowable backfill per Section 213 of the INDOT SS.

C. Engineered Fill

1. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand per ASTM D2940, with at least 90% passing a 1-1/2" sieve and 12% maximum passing a No. 200 sieve.

D. Filter Material

1. Coarse aggregate with 100% passing a 1" sieve and 0-5% passing a No. 4 sieve.

E. Sand

1. Fine aggregate, natural, or manufactured sand per ASTM C33.

F. Concrete Backfill

1. Class B concrete per Section 702 of the INDOT SS.

2.3 FILL FOR OVER-EXCAVATION

A. Fill for over-excavation, whether inadvertent or to obtain a stable bottom soil condition, shall be INDOT No. 8 crushed aggregate.

2.4 GEOTEXTILES

A. Geotextiles shall comply with Section 918 of the INDOT SS.

2.5 SOIL TREATMENT MATERIALS

A. Soil treatment materials to achieve necessary compaction shall comply with Section 913 of the INDOT SS.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection

1. Protect structures, utilities, pavements, poles, fences, mailboxes, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

2. Movable items such as mailboxes may be temporarily relocated during construction. Place movable items back at their original location immediately after backfilling is complete unless otherwise indicated. Replace items that are damaged during construction.

3. Prior to excavation work, pothole or otherwise physically confirm location and depth of existing utilities to be exposed by excavation. Notify Engineer and Wastewater Superintendent immediately of any potential conflicts with existing utilities.

4. Hand-dig at all locations within 2 feet of utilities.

5. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 EXPLOSIVES

A. Do not use explosives.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated without exceeding the following dimensions:

a. 24” outside of concrete forms

b. 6” beneath bottom of concrete slabs on grade.

c. 6” beneath pipe in trenches

d. 24” wider than pipe diameter or 42” wide, whichever is greater.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated shall be classified as earth and rock. Do not excavate rock until it has been classified by Engineer.

1. Earth excavation includes excavating pavements and obstructions visible on the surface, underground structures, utilities, and other items indicated to be removed, and soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated without exceeding the following dimensions:

a. 24” outside of concrete forms.

b. 6” beneath bottom of concrete slabs on grade.

c. 6” beneath pipe in trenches

d. 24” wider than pipe diameter or 42” wide, whichever is greater.

3.4 EXCAVATION FOR SANITARY STRUCTURES, VAULTS, AND TANKS

A. Excavate to indicated elevations and dimensions indicated within a tolerance of plus or minus 1”. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services, and inspection.

B. Do not disturb bottom of excavations intended as bearing surfaces.

3.5 EXCAVATION FOR SANITARY SEWER TRENCHES

A. Excavate trenches to indicated lines, depths, and elevations.

1. Trench curves for flexible pipe shall not be less than the minimum radius of curvature recommended by pipe manufacturer.

B. Excavate trench walls vertically from trench bottom to 12” above top of pipe elevation, unless otherwise indicated.

1. Horizontal clearance of trench shall be 12” plus pipe diameter or 24” wide, whichever is less.

C. Excavate trench bottoms to provide uniform support of bedding course and pipe. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes less than 6” in diameter, hand-excavate trench bottoms and support pipe on an undisturbed subgrade.

2. For pipes 6” or larger in diameter, excavate trenches 6” deeper than elevation required to allow for bedding course.

D. Fill over-excavations to the indicated lines and grades.

3.6 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed. Notify Engineer immediately if unsatisfactory subgrade soil is encountered during trench excavation.

C. Proof-roll subgrade below sanitary structures larger than 20 feet in any horizontal dimension to identify pockets of soft soil. Do not proof-roll wet subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted fill.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavations under sanitary sewer pipe as directed by Engineer.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Stockpile soil materials away from edge of excavations. Do not store within drip line of trees.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Survey locations of underground utilities for record documents.
2. Test and inspect underground utilities where indicated prior to backfill.
3. Remove concrete formwork.
4. Remove trash and debris.
5. Remove temporary shoring and bracing and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice. Use topsoil removed during site clearing as final layer of backfill.

3.10 TRENCH BEDDING AND BACKFILL

A. Over-excavation

1. Place material in over-excavation on soils free of mud, frost, snow, or ice to indicated lines and grades. Notify Engineer upon restoration of trench bottom and obtain acceptance before proceeding with pipe installation.

B. Pipe Bedding

1. Place pipe bedding in trenches on firm subgrades free of standing water, mud, frost, snow, or ice.
2. Place and compact pipe bedding on trench bottoms. Shape pipe bedding to provide continuous support for bells, joints, and barrels of pipes.

C. Initial Backfill

1. Place and compact initial backfill to a height of 12” over the pipe.
   a. Carefully hand place and compact initial backfill in lifts no greater than 6” in depth under pipe haunches to springline. Compact each lift evenly on both sides and along the full length of pipe by shovel slicing, hand tamping, and walking the backfill in.
   b. Place and compact remaining initial backfill in lifts to avoid damage or displacement of pipe.
2. Where indicated, place flowable backfill to a height of 12” over the pipe.

D. Final Backfill

1. Place and compact final backfill to final subgrade elevation.
2. Place backfill so that it flows into the trench without freefalling.
3. Backfilling with satisfactory soil:
   a. Mechanically tamp each lift until no further settlement is observed before placement of the next lift.
   b. Heavy equipment shall not be used until there is at least 3 feet of cover depth over the pipe.
   c. Leave trench surface in slightly rounded condition.

d. Maintain slightly rounded condition until surface restoration activities are initiated, but not less than 30 days.

4. Backfilling with structure backfill:

a. Mechanically tamp each lift until no further settlement is observed before placement of the next lift.

5. Unstable trench walls

a. With Engineer's prior approval, where trench walls become unstable during compaction, Contractor may push final backfill from the back of the trench into the trench and compact with vibratory compactor in 2 foot diagonal lifts.

6. Do not jet backfill.

E. Special Conditions

1. For trenches excavated under footings, place utilities in Schedule 40 PVC casing pipe and fill to 18" beyond either side of footings with Class B concrete to elevation of bottom of footings.

2. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

3.11 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate backfill soil lift and each subsequent fill or subgrade lift before compaction to within 2% of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2%.

3.13 COMPACTION OF SOIL BACKFILL AND FILL

A. Place backfill and fill soil materials in lifts not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly and uniformly on all sides of structures to required elevations.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D1557:

1. Under structures, scarify and recompact top 12" of existing subgrade and each lift of backfill or fill soil material at 95%.

2. Under walkways, scarify and recompact top 6" below subgrade and compact each lift of backfill or fill soil material at 92%.

3. Under unpaved areas, scarify and recompact top 6” below subgrade and compact each lift of backfill or fill soil material at 85%.

4. For trenches with structure backfill, compact each lift of initial and final backfill material at 95%.

3.14 GRADING

A. Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to lines and elevations indicated.

1. Provide a smooth transition between existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Slope grades to direct water away from structures and to prevent ponding.

3.15 SUBSURFACE DRAINAGE

A. Place geotextile around perimeter of subsurface drainage trenches.

B. Place a 6” course of filter material on geotextile to support subsurface drainage pipe.

C. Encase pipe in 12” minimum of filter material, placed in 6” compacted lifts, and wrap in geotextile, overlapping sides and ends at least 6”.

1. Compact each filter material lift with a minimum of 2 passes of a plate-type vibratory compactor.

D. Place and compact filter material over subsurface drain to within 12” of final subgrade, in compacted lifts 6” thick.

1. Compact each filter material lift with a minimum of 2 passes of a plate-type vibratory compactor.

E. Overlay drainage backfill with 1 layer of geotextile. Overlap sides and ends at least 6”.

F. Place and compact impervious fill over drainage backfill in 6” thick compacted lifts to final subgrade.

3.16 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. Place and compact drainage course under concrete slabs as follows:

1. Install geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Place drainage course in a single compacted 6” lift.

3. Place drainage course exceeding 6” in compacted lifts of equal thickness, with no compacted lift more than 6” or less than 3”.

4. Compact each lift of drainage course to not less than 95% of maximum dry unit weight according to ASTM D698.

3.17 FIELD QUALITY CONTROL

A. Engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill lift. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D6938, and ASTM D2937, as applicable. Tests shall be performed at the following locations and frequencies:

1. Trench Structure Backfill

a. For final backfill, conduct 1 test for each manhole run or every 400 feet, whichever is shorter.

D. When testing agency reports that subgrades, fills, or backfills have not achieved the compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required. Recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protect newly graded areas from freezing and erosion and keep free of debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, or settled.

1. Scarify or remove and replace soil material to depth as directed by Engineer. Reshape and recompact.

C. Repair and re-establish grades where compaction is lost due to construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer. Reshape and recompact.

D. Where settling occurs, remove finished surface, backfill with additional soil material, compact, and reconstruct surface.

1. Restore appearance, quality, and condition of finished surface to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site.

END OF SECTION 02300

SECTION 02410
HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes requirements for pipe installation using the horizontal directional drilling method.

1.2 DEFINITIONS

A. HDD – Horizontal Directional Drilling.

1.3 SUBMITTALS

A. Action Submittals

1. Product data for drilling fluid and admixtures, MSDS sheets, and manufacturer's literature.
2. Shop Drawings
   a. Scaled and dimensioned plan and profile layouts of pipe.
      1) Drawing submittal shall show finished grades, deflection and radius of the pilot bore, and all existing utilities with minimum vertical and horizontal clearances. Proposed clearances shall exceed the guidance system accuracy tolerance by a minimum of 100% for flexible pipe and 150% for rigid pipe.
   b. Locations of proposed pits and equipment set-up areas.

B. Informational Submittals

1. Qualification Data
   a. Provide within 10 days after Notice of Award:
      1) Name, address, and phone number of any subcontractor proposed for the HDD work.
      2) Name and phone number of 5 references to contact to verify similar projects.
      3) List of completed projects.
   b. Names and work history of all supervisory field personnel to be present during HDD work.
2. Installer Certificates
   a. Qualification records certifying that bonders and bonding operators employed to complete fusion bonding are qualified to install flexible pipe.
3. Field Test Reports
   a. Calibration records for guidance equipment.
4. Manufacturers' Instructions

a. Bonding Procedure Specification for installing flexible pipe. Shall include cutting and facing requirements.

C. Project Record Documents

1. Record drawings

2. Drilling logs

1.4 QUALITY ASSURANCE

A. Qualifications

1. Contractor Experience

a. Contractor or subcontractor shall have the following minimum requirements in horizontal directional drilling:

1) 5 horizontal directional drilling projects of a similar nature.

2) Successful completion of at least 50,000 linear feet of directional drilling. Conventional open cut trenching shall not be considered applicable experience.

2. Supervisory personnel shall be adequately trained and shall have at least 4 years of experience in directional drilling.

3. Fusion bonders and bonding operators shall be qualified in the use of the Bonding Procedure Specification.

PART 2 - PRODUCTS

2.1 DRILLING FLUID

A. Drilling fluid shall be composed of clean water and appropriate additives such as bentonite clay and polymer admixtures specifically blended for use in drilling.

B. Water shall be from a clean source with a pH of 8.5 – 10 or in accordance with mixing requirements of the additive manufacturer. Water of a lower pH or with excessive calcium shall be treated with sodium carbonate or equal.

C. The drilling fluid shall have a minimum viscosity based on soil type as measured by a Marsh funnel as follows:

1. Rocky Clay – 60 seconds

2. Hard Clay – 40 seconds

3. Soft Clay – 45 seconds

4. Sandy Clay – 90 seconds

5. Stable Sand – 80 seconds

6. Loose Sand – 110 seconds

7. Wet Sand – 110 seconds

D. No hazardous additives may be used. Drilling fluid shall be totally inert and contain no risk to the environment.

E. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall.

2.2 TRACER WIRE

A. Shall be as described in Section 02545 – Sanitary Force Mains.

2.3 TRACER WIRE BOXES

A. Shall be as described in Section 02545 – Sanitary Force Mains.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Directional drilling equipment shall consist of:

1. A directional drilling rig of sufficient capacity to perform the bore and pull back the pipe.
2. A drilling fluid mixing and delivery system of sufficient capacity to successfully complete the drilling and pulling.
3. A guidance system to accurately guide boring operations.

B. Drilling Rig

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.
2. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing.
3. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks.
4. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
5. A magnetic or walk-over guidance system shall be able to control the depth and direction of the pipe and must be accurate to within 6”.

C. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets for effective use in the soils being bored.

D. Drilling fluid motors shall be of adequate power to turn the required drilling tools.

E. Guidance System

1. Electronic walk-over guidance system, magnetic guidance system probe, or proven gyroscopic probe and interface.
2. Provide a continuous and accurate determination of the location of the drilling head during the drilling operation, including all depths up to 50 feet and in any soil condition, including hard rock.
3. Enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction).

4. Accurate and calibrated to manufacturer's specifications for the vertical depth of the bore hole at sensing position at depths up to 50 feet and accurate to at least 2 feet horizontally.

5. The operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system.

F. Pipe Rollers

1. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations.

2. Provide enough rollers to prevent sagging of pipe.

G. Pipe Rammers

1. Hydraulic pipe rammers, pneumatic pipe rammers, and other devices providing horizontal thrust other than those defined in the preceding sections shall not be used unless approved by the Engineer and Wastewater Superintendent prior to commencement of pipe boring.

H. Other Equipment

1. Drilling fluid mixing system shall be a self-contained, closed system of sufficient size to mix and deliver drilling fluid.

2. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing.

3. Drilling fluid reservoir tank shall be sized for adequate storage of the drilling fluid, but no less than 1,000 gallons.

4. Mixing system shall continually agitate the drilling fluid during drilling operations.

5. Drilling fluid pumping system shall have a minimum capacity to supply fluid in accordance with the drilling equipment pull-back rating at a constant required pressure of no less than 1,200 psi.

6. Drilling fluid delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be leak-free.

7. Drilling rig shall be fitted with a permanent alarm system capable of detecting an electrical current. This system shall have an audible alarm to warn the operator when the drill head is nearing electrified cables but is still at a safe distance.

8. Pipe bonding equipment shall be in proper operating condition. Equipment heater shall be tested and certified prior to use for fusion bonding.

3.2 DIRECTIONAL DRILLING PROCEDURE

A. Notify Engineer and Wastewater Superintendent 48 hours before initiating HDD operations.

B. Site Preparation

1. Grade or fill site to provide level work area. No alteration beyond what is required for operations shall be made. Limit activities to designated work area.

C. Drill Path Survey and Layout

1. Accurately survey entire drill path.
2. If a magnetic guidance system is used, survey drill path for any surface geomagnetic variations or anomalies.
3. Contact all property owners regarding the location of all existing service lines, water wells, septic tanks, etc.
4. Contact all utilities to determine the location of all existing underground lines, cables, pipes, valves, vaults, etc.
5. Excavate and confirm location and elevation of existing utilities in or near path of HDD work.
6. Maintain a continuous positive grade of the pipe toward air relief valve locations and a continuous negative grade of the pipe away from air relief valve locations, with only one low point between air relief valve locations. Avoid high spots in the line between air relief valve locations.
7. Where conflicts occur with existing utility lines, the pipe layout may be shifted to avoid interference with the existing utility lines. All location changes shall be limited to existing easements and rights-of-way. Note on layout plan all proposed changes in pipe location.
8. Drilling depths below 96" shall not be allowed without permission from the Engineer and Wastewater Superintendent.
9. Drilling above a depth of 54" shall not be allowed without permission from Engineer and Wastewater Superintendent.
10. Prepare a dimensioned, scaled plan for submittal to Engineer.

D. Environmental Protection

1. Place silt fence between all drilling operations and any drainage areas, wetlands, waterways, or other areas designated for such protection by state, federal, and local regulations. Additional protection necessary to contain drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Adhere to all applicable environmental regulations.
2. Used or spilled drilling fluid shall be contained and properly disposed of. A spill sock, hay bales, or sandbags shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits, and drilling fluid recycling system to prevent spills into the surrounding environment. Provide pumps or vacuum trucks to remove excess drilling fluid from containment areas.
3. Spoils shall be promptly recovered by use of a vehicle-mounted vacuum system. Spoils are not to be discharged into sewers or storm drains. Dispose of all spoil and excess excavated material in accordance with applicable regulations.

E. Pilot Hole

1. Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event the pilot hole deviates from the bore path more than 5% of depth in any 100 feet, notify Engineer. Unless directed otherwise, pull-back and re-drill from a location along the bore path before the deviation.

2. If a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, cease drilling, wait at least 30 minutes, inject drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel, and then wait another 30 minutes. If drilling fluid fracture or returns loss continues, cease operations and notify Engineer.

F. Reaming

1. Upon successful completion of pilot hole, ream bore hole to a minimum of 25% greater and a maximum of 50% greater than outside diameter of pipe using the appropriate tools. Do not attempt to ream more than the drilling equipment and drilling fluid system are designed to safely handle.

2. The type of hole opener or back reamer used shall be based on the types of subsurface soil conditions encountered.

3. Drilling fluid shall remain in the tunnel to increase stability of the tunnel and to provide a lubricant to reduce drag when the pipe is pulled.

G. Setup

1. Pipe will be placed on pipe rollers before pulling into bore hole. Rollers shall be spaced close enough to prevent sagging of pipe.

2. Contractor may pre-test pipe prior to pulling. However, pre-testing is not a substitute for the acceptance testing otherwise required.

3. The interior of every pipe, fitting, and valve shall be cleaned of all debris, dirt, and other foreign material before being bonded and shall be kept clean until work is completed.

4. Install polyethylene encasement on ductile iron pipe during pipe setup or when pulling pipe according to installation Method A in accordance with AWWA C105 for installations below the water table.

H. Tracer Wire

1. Shall be installed as described in Section 02545 – Sanitary Force Mains.

I. Pull-back

1. After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole.

2. Pipe will be elevated to the approximate angle of entry and supported to allow a straight, smooth pull.

3. Once pull-back operations have begun, operations must continue without interruption until pipe is completely pulled into the bore hole. During pull-back, do not apply more than the maximum safe pipe pull pressure at any time.

4. If pipe becomes stuck, cease pulling operations to allow any potential hydro-lock to subside. If pipe remains stuck, notify Engineer and Wastewater Superintendent.

J. Valves, Fittings, and Appurtenances

1. Install services, pipe connections, fittings, valves, and other appurtenances where indicated in accordance with applicable specifications.

K. Recordkeeping

1. As the pilot hole is drilled, measure location and depth of the pilot hole. Record readings after advancement of each successive drill pipe (no more than 10 feet).
    a. Plot on a scaled drawing of 1” = 2’, both vertical and horizontal.
    b. Tabulate and record coordinates on the record drawings daily.
    c. Access to all records and plan and profile information shall be made available to Engineer and Wastewater Superintendent at any time.
2. Do not allow the deflection radius of the drill pipe to exceed the deflection limits of the carrier pipe as specified by the pipe manufacturer.
3. Maintain a daily log of drilling operations and a guidance system log.

END OF SECTION 02410

SECTION 02530
GRAVITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes gravity flow, non-pressure sanitary sewers, including:

1. Sanitary sewer mains.
2. Sanitary sewer laterals.
3. Sanitary manholes.

B. Related regulations include the following:

1. 327 IAC 3-6-9 for separation requirements with water mains and wells.

1.2 DEFINITIONS

A. AWWA – American Water Works Association

B. HDD – horizontal directional drilling

C. INDOT SS – Indiana Department of Transportation Standard Specifications

D. PVC – polyvinyl chloride plastic

E. HDPE – high-density polyethylene

F. DI – ductile iron

G. HDPE – high density polyethylene

H. MJ – mechanical joint

I. SS – stainless steel

1.3 SUBMITTALS

A. Action Submittals

1. Product data for:
   a. Pipe, joints, and fittings.
   b. Tracer wire and warning tape.
   c. Manhole castings.
   d. Manhole products including boots and gaskets, sealants, joint sealing products, and infiltration control products.
2. Shop Drawings
   a. Precast manhole structures.

B. Informational Submittals

1. Coordination Drawings
   a. Show clearances from water lines and storm sewer system pipe and structures.

1) Indicate interface and spatial relationship between manholes, pipe, and nearby structures.

2) Draw profiles at horizontal scale of not less than 1” equals 50 feet and vertical scale of not less than 1” equals 5 feet. Indicate manholes and pipe.

b. Show type, size, material, and elevation of utilities crossing system pipe.

2. Design calculations and detail drawings

a. Manhole flat top slabs (if designed per ASTM C478 or located in a right-of-way).

3. Factory Test Reports

a. Manhole flat top slabs

4. Product Certificates

5. Material Certificates

6. Schedule of Tests and Inspections

7. Field Test Reports

8. Design Data

a. Precast manhole concrete design

9. Manufacturers’ Instructions

a. Pipe installation

b. Manhole boot installation

c. Products used with manholes

10. Product Warranties

C. Project Record Documents

1. Product data

2. Field Test Reports

3. Record drawings, including:

a. Vertical Information

1) Invert elevation(s) of all pipes connecting to manholes.

2) Casting elevations

3) Top and bottom elevations of all utilities encountered, including utility size, material, and type descriptions.

a) Include utility relocations or changes required.

b. Horizontal Information

1) Northing and easting of all manholes and other structures, centered on casting or hatch.

2) Distance of all lateral connections from downstream manhole.

3) Northing and easting of all lateral terminations.

c. Calculated Information

1) Sewer segment length

2) Sewer segment grade

d. General

1) Vertical and horizontal information shall be based on control provided.

2) Accuracy shall match that in the project drawings.

D. Cast-in-place Manholes

1. Action Submittals

a. Plans and details of proposed manhole construction with dimensions.

b. Design concrete mix.

c. Steel reinforcement.

d. Pipe penetration and manhole boot details.

1.4 QUALITY ASSURANCE

A. Pipe and fitting manufacturer's quality control system shall be ISO 9001 registered.

B. Manholes

1. Allowable Tolerances

a. Length and width of precast units measured at face adjacent to mold shall meet the following tolerances:

1) Units 10 feet or under: ± 1/8".

2) Units 10 to 20 feet: + 1/8", - 3/16".

3) Units over 20 feet: + 1/8", - 1/4".

b. Thickness of units shall be + 1/4", - 1/8".

c. Units shall not be out of square more than 1/8" per 6 feet or 1/4" total.

C. Regulatory Requirements

1. Comply with requirements of Wastewater Superintendent.

2. Comply with standards of authorities having jurisdiction for sewer-service pipe, including materials, installation, and testing.

3. Comply with requirements of IDEM and EPA regarding wastewater facilities.

D. Qualifications

1. Concrete Testing Agency

a. Minimum 3 years experience performing concrete tests of the type specified.

b. Capable of performing testing in accordance with ASTM E329.

1.5 SYSTEM REQUIREMENTS

A. Design Requirements

1. Provide the services of a registered Professional Engineer to design flat top slabs for manholes per ASTM C478, or for flat top slabs located in the right-of-way.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manhole components, pipe, gaskets, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle pipe and manholes according to manufacturer's written rigging instructions.

D. Do not skid or roll products on or against other products.

E. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.

F. Do not allow gaskets to come in contact with petroleum products.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe and fitting sizes and references to pipe diameters are intended to be nominal.

B. Special Applications and Limitations

1. PVC and HDPE sewer pipe shall be used in buried locations only.
2. Horizontal Directional Drilling of Laterals
   a. Shall be as described in Section 02410 – Horizontal Directional Drilling.
3. Boring and Jacking Pipe Installations
   a. Water Quality Pipe
4. Pipe Bursting
   a. Shall be as described in Section 02537 – Pipe Bursting Pipe Installation.

2.2 PVC GRAVITY SEWER PIPE

A. General

1. Pipe and fittings shall have an integral bell and smooth inner walls.
2. Solvent cement joints shall not be allowed.
3. Pipe and fittings shall be colored green for identification as wastewater pipe.
4. No saddles or clamps will be allowed.

B. PVC Pipe and Fittings

1. Pipe 15” or less shall meet ASTM D3034.
   a. Pipe installed at a depth of 16 feet or shallower shall be SDR 35.
   b. Pipe installed at depths greater than 16 feet shall be SDR 26.
2. Pipe in sizes larger than 15” through 48” shall meet ASTM F679.
   a. Pipe installed at a depth of 16 feet or shallower shall be PS46.
   b. Pipe installed at depths greater than 16 feet shall be PS115.
3. Minimum tensile strength of 34.50 MPa per ASTM D1784.

4. Minimum pipe stiffness of 46 psi for SDR 35 and 115 psi for SDR 26 when measured at 5% vertical ring deflection tested per ASTM D2412.

C. Joints

1. Joints shall be flexible gasket compression-type conforming to ASTM F477.
2. Joint performance shall be in accordance with ASTM D3212 under both pressure and 22" Hg vacuum.
3. Joints and couplings connecting to dissimilar pipe or fitting types shall be in accordance with both manufacturers' recommendations.

D. Fittings

1. Fittings shall conform to ASTM D3034.
   a. Fittings installed at a depth of 16 feet or less shall be SDR 35.
   b. Fittings installed at depths greater than 16 feet shall be SDR 26.

2.3 WATER QUALITY PIPE

A. General

1. Pipe and fittings shall have an integral bell without solvent cement joints.
2. No saddles or clamps will be allowed.

B. Water Quality PVC Pipe

1. Pipe and fittings shall be colored green for identification as wastewater pipe.
2. SDR Series Pipe and Fittings
   a. SDR series pipe shall conform to ASTM D2241, SDR 21, or SDR 17.
   b. Fittings shall meet the same standards as the pipe.
3. AWWA Series Pipe
   a. Pipe sizes through 12" shall conform to AWWA C900, DR 18.
   b. Pipe sizes greater than 12" shall conform to AWWA C905, DR 32.5.

C. Water Quality DI Pipe

1. Pipe shall conform to AWWA C151.
2. Pressure class in conformance with AWWA C150:
   a. Pipe sizes through 12" shall be 350 psi pressure class.
   b. Pipe sizes greater than 12" shall be 250 psi pressure class.
3. Joints
   a. Buried Service
      1) Mechanical joints per AWWA C110 and AWWA C111.
      2) Push-on type joints shall conform to AWWA C111.
      3) Gaskets meeting AWWA C111.
4. Coatings

a. Cement mortar lining and bituminous seal coat meeting AWWA C104.

b. Outside coating shall meet the requirements of AWWA C151.

c. Interior and exterior coatings shall be provided for all pipe and fittings.

5. Encasement

a. Polyethylene encasement colored green and conforming to AWWA C105.

D. Fittings for AWWA Series Pipe and DI Pipe

1. Fittings shall be DI meeting the requirements of AWWA C110.

E. Joints

1. Joints shall be flexible gasket compression type conforming to ASTM F477.

2. Joint performance per ASTM D3139 under pressure and 22” Hg vacuum.

3. Joints connecting to dissimilar pipe or fitting types shall be in accordance with manufacturer’s recommendations.

4. No solvent cement joints shall be allowed.

2.4 HDPE GRAVITY SEWER PIPE

A. General

1. Pipe

a. HDPE pipe (PE 3408) shall meet ASTM D3350 and ASTM F714.

b. Pipe shall be green-striped or have a green color.

B. HDPE Sewer Lateral Pipe

1. SDR 13.5 and pressure class 130 psi.

C. HDPE Gravity Sewer Pipe

1. Pipe installed at a depth of 16 feet or less shall be SDR 17.

2. Pipe installed at depths greater than 16 feet shall be SDR 13.5.

D. Pipe joints shall be fusion butt-welded.

E. Fittings

1. Manufactured in accordance with the same standards, design pressure classes, dimensions, and temperature ranges specified as for HDPE pipe.

2. Same manufacturer and material as the pipe.

3. Do not use tapping sleeves for connections.

4. Fittings shall not be field fabricated.

F. Service Saddles

1. Service saddles shall be designed for use with HDPE pipe.

2. Saddles shall utilize wide double stainless steel straps or be of full-circumference stainless steel sleeve design. Strap saddles shall have a ductile iron body coated with a fusion epoxy or nylon coating.

3. Gasket shall be a broad pressure activated design bonded into a cavity in the saddle body or have spring-tensioning to accommodate pipe thermal expansion.

4. Straps, bolts, nuts and washers shall be Type 304 stainless steel with all welds passivated for corrosion resistance.

2.5 WARNING TAPE

A. General

1. Warning tape shall be made of inert materials, resistant to alkalis, acids, and other destructive agents found in soil.

2. Warning tape shall have a minimum thickness of 4 mils.

3. Warning tape width shall be a minimum of 3” and a maximum of 6”.

4. Imprint shall repeat a minimum of once every 2 feet of tape length.

5. Warning tape shall be aluminum-backed or have a foil core detectable by a cable locator.

B. Material

1. Warning tape shall be imprinted with “CAUTION – SANITARY SEWER BURIED BELOW” or similar wording.

2. Tape shall be green in color or green striped with black printed lettering.

C. Warning tape shall be Terra Tape Sentry Line by Reef Industries, Inc., or approved equal.

2.6 TRACER WIRE

A. Tracer wire shall be 21% conductivity annealed copper-clad high carbon steel high strength tracer wire.

B. Insulation shall be HDPE complying with ASTM D1248, 30 volt rating.

C. Composite conductivity shall be 21% IACS (International Annealed Copper Standard).

D. Minimum physical characteristics:

1. AWG: 10

2. Insulation thickness: 0.030”

3. Breaking load: 1,000 lb

E. Connectors shall be from manufacturer’s packaged kit, consisting of insulating spring-type connector or crimped joint and epoxy resin moisture seal, suitable for burial.

2.7 TRACER WIRE BOXES

A. General

1. Cylindrical construction with removal round lid.

2. Support flange at the base at least 1/2” wide.

a. If box is designed for use with integral valve support, flange may be omitted.

3. Telescoping design with upper and lower tubes overlapping 3” when the box is extended to its maximum length.

4. Magnetized to amplify tracer signal.

a. A magnet shall be securely attached on the upper inside of the box or encapsulated within the lid.

B. Material

1. Box material shall be high grade ABS or equivalent rigid plastic that meets ASTM D1788, Type 1.

2. Lid material shall be cast iron or ductile iron, with tensile strength or ductility meeting ASTM A126-B.

C. Box Lid

1. Colored green for wastewater per APWA standards.

2. Lock with a tamper-resistant pentagon locking nut.

3. Internal corrosion-resistant brass wire lug for tracer wire connection, and a wax pad to block out moisture at the wire connection.

D. Manufacturer

1. Tracer wire boxes shall be Snakepit Lite Duty Access Point by Copperhead Industries in unpaved areas, Snakepit Roadway Access Point by Copperhead Industries in paved areas, or approved equal.

2.8 PRECAST MANHOLES

A. General

1. Precast reinforced concrete manhole sections shall be manufactured in accordance with ASTM C478. Concrete shall be minimum 28-day compressive strength of 4,000 psi.

2. Thickness and Design

a. Manhole sections less than 6 feet in diameter shall have a minimum wall thickness of 5”.

b. Continuous steel hoop reinforcement shall not be used except with Engineer’s prior approval.

c. Flat slab tops shall be designed according to:

1) ASTM C478 if located outside of the right-of-way.

2) AASHTO M 199M/M 199 if located within the right-of-way.

d. Where depth exceeds 12 feet, provide 2 cages of reinforcement per ASTM C76 (assume structure as a Class III reinforced concrete pipe of the same diameter).

3. Hoisting lugs or hooks shall be cast in place for handling and setting. No through-the-wall lift holes are allowed.

4. Openings of proper sizes and suitable design shall be cast in place or factory cored for receiving drop pipes and connections.

5. Manhole diameter indicated is minimum. Provide larger diameter manholes where a minimum distance between penetrations cannot meet the following requirements:

a. 12” for non-cored openings.

b. 8” for factory-cored openings.

6. Provide supplemental reinforcing to the primary reinforcing cage at all penetrations 12” or larger in diameter.

7. Precast concrete items shall not exhibit cracks, voids, or other visible imperfections, evidence of imperfect proportioning, mixing, or molding, or visible reinforcing steel.

8. All precast manhole items, including adjusting rings, used on any particular manhole, shall be provided by the same manufacturer.

B. Manhole Joints

1. Precast Manhole Sections

a. Joints shall be tongue and groove with rubber gaskets per ASTM C443.

b. Supplementary joint sealer shall conform to Federal Specification SS-S-210.

c. Exterior joint collars shall conform to ASTM C877, Type II.

2. To seal adjusting rings and casting frame, provide butyl mastic or trowelable joint sealer in extrudable 1/2” preformed cords, per Federal Specification SS-S-210.

C. Base Sections

1. Base sections for 48” and 60” diameter manholes shall be constructed with the base and first riser section as one complete integral precast unit. Base sections for larger diameter manholes shall use a gasketed joint between the base section and first riser.

2. Base sections shall be a minimum of 8” thick and reinforced with 2 layers of steel.

3. Benches

a. Benches may be precast or cast-in-place into base section.

b. Use 3,500 psi minimum 28-day compressive strength concrete for cast-in-place benches.

c. Brushed finish to prevent slipping.

d. Slope toward the channel not less than 1” per foot.

4. Flow Channels

a. Channels shall be smooth, continuous, u-shaped in cross section, with constant width and invert grade from inlet to discharge.

b. Changes of flow direction shall be made with a smooth curve with the maximum possible radius.

c. For cast-in-place flow channels, provide a minimum of 3” from the top of the base slab to the invert out.

5. Bedding

a. Manhole base bedding shall be INDOT No. 8 crushed aggregate.

b. Over-excavation, whether inadvertent or to obtain a stable soil condition, shall be filled as specified in Section 02300 – Earthwork for Sanitary Sewers.

D. Pipe Connections

1. Pipe connectors shall comply with ASTM C923.

2. Rubber sleeve with stainless steel banding installed in factory. Stainless steel elements of the connector shall be totally non-magnetic Series 305 SS.

3. Rubber compression gasket cast into section.

4. For pipes less than 18” in diameter, pipe connector shall be Kor-N-Seal 106/406 Series flexible boot connector as manufactured by Trelleborg Pipe Seals, Z-Lok boot connector as manufactured by A-Lok Products, Inc., or approved equal.

5. For pipes 18” and greater in diameter, pipe connector shall be Kor-N-Seal 206 Series flexible boot connector as manufactured by Trelleborg Pipe Seals, Z-Lok STM boot connector as manufactured by A-Lok Products, Inc., or approved equal.

E. Cone Sections

1. Eccentric cone type.

2. Provide uniform circumference internally on top 4” for internal chimney seal.

F. Flat Tops

1. Precast flat tops shall be 8” thick minimum and reinforced with 2 layers of steel.

G. Outside Drops

1. Outside drops can be:

a. Precast with manhole sections.

b. Field constructed with Engineer and Wastewater Superintendent’s prior approval.

2. Precast outside drops shall comply with requirements for manhole sections.

3. Field Constructed Outside Drops

a. Comply with sewer pipe requirements for drop pipe.

b. Use only rubber compression gasket cast-in-place for pipe connections.

c. Encase in concrete, minimum 28-day compressive strength of 4,000 psi.

H. Adjusting Rings

1. Adjusting rings shall be precast concrete conforming to ASTM C478.

2. Nominal thickness shall be between 3” and 6”.

3. Total height of all adjusting rings used on each manhole shall not exceed 12”.

I. Castings

1. General

a. Castings shall be manufactured in accordance with ASTM A48, Class 35B with a minimum tensile strength of 35,000 psi.

b. Castings shall be of uniform quality and free of all defects.

c. Casting shall be manufactured true to pattern. Component parts shall exhibit a good fit and be interchangeable. Horizontal bearing surfaces shall be machined and not experience rocking or rattling under traffic or other loads.

d. Castings shall be well cleaned by shot blasting or other methods.

2. Standard frames and lids.

a. 1022 by East Jordan Iron Works,

b. Or approved equal.

3. Bolt-down gasketed frames and lids.

a. 1022 by East Jordan Iron Works,

b. Or approved equal.

J. External Joint Wrap

1. External joint wrap shall comply with ASTM C877.

2. Shall be External Joint Wrap by Cretex Specialty Products, or approved equal.

K. External Chimney Seal

1. External chimney seal shall be a single continuous rubber band meeting the material requirements of ASTM C923.

2. Seal shall be able to extend as one piece from cone section to casting frame.

3. Attachment shall be with a minimum of 2 16-gauge type 304 stainless steel bands with type 304 SS accessories.

4. Shall be External Manhole Chimney Seal by Cretex Specialty Products or approved equal.

L. External Chimney Backplaster

1. External chimney backplaster shall be trowelable grade butyl rubber.

2. Wrap shall meet ASTM E1745.

M. Internal Chimney Seal

1. Internal chimney seals shall consist of flexible internal rubber sleeve, interlocking extensions, and stainless steel compression bands.

2. The seal shall remain flexible throughout a 25-year design life, allowing repeated vertical movement of the frame of not less than 2” and repeated horizontal movement of the frame of not less than 1/2”.

3. Sleeve

a. The sleeve portion of the seal shall be a minimum double pleated with a minimum unexpanded vertical height of 8”, 10”, or 13”.

b. The sleeve and extension shall have a minimum thickness of 3/16” and shall be made from a high quality rubber compound conforming to ASTM C923, with a minimum 1,500 psi tensile strength.

4. The area of the seal that compresses against the manhole shall provide a watertight seal.

5. Hardware

a. The bands shall be fabricated from Type 304 stainless steel with no welded attachments and shall have a minimum adjustment range of 2”.

b. Screws, bolts, or nuts used to lock the band in place shall be Type 304 stainless steel.

6. Shall be LSS Internal Chimney Seal by Cretex Specialty Products, FlexRib Manhole Chimney Seal by Trelleborg Pipe Seals, or approved equal.

N. Inflow Dish

1. Inflow dish shall be made of ultra high density polyethylene copolymer material that meets ASTM D1248, Class A, Category 5, Type 111.

   a. Dish shall have a minimum impact brittleness temperature of –100°F.

   b. Thickness shall be uniform 1/8” or greater.

   c. Material shall be corrosion proof from all gases associated with wastewater collection systems.

2. Lift strap shall be a corrosion resistant nylon strap or polypropylene web.

3. All cut edges of the dish shall be seared to prevent raveling.

4. Ventilation shall be provided by two 3/16” holes located 1” from the top of the dish.

5. Ventilation system shall not allow water to completely fill the dish and shall not contain any parts subject to corrosion.

6. Dish measurement shall be as required for the frame and casting.

7. Shall be Inflow Dish by Cretex Specialty Products or approved equal.

2.9 CAST-IN-PLACE MANHOLES

A. Cast-in-place manholes may only be used with prior approval of Engineer and Wastewater Superintendent.

2.10 CONNECTIONS TO EXISTING MANHOLES

A. Manhole wall penetration seals shall be rubber sleeves complying with ASTM C923.

B. Internal Drops

1. Drop pipe size, material, and fittings to match main line for gravity sewers.

2. Use force main pipe material with restrained joints or flange joints for force mains.

3. Use Type 304 SS braces and anchor fixtures.

4. Shall utilize Inside Drop Bowl by Reliner/Duran Inc. or approved equal.

C. Structural Repair Grout

1. Shall be designed to fill large voids in structure walls.

2. Shall consist of rapid setting cements, aggregates, and various accelerating agents.

3. Shall not contain chlorides, gypsum, or metallic particles.

4. Shall have a minimum compressive strength of 1,400 psi at 6 hours per ASTM C109.

5. Shall be Quadex Hyperform by Vortex Co., Strong-Seal QSR by The Strong Company, or approved equal.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of pipe systems used to estimate wastewater flows, size pipe and calculate friction loss, pump sizing, and other design considerations. Install pipe as indicated unless deviations to layout are approved by Engineer and Wastewater Superintendent.

B. Utilize ductile iron sewer mains and fittings within pumping and treatment facilities.

C. Install pipe beginning downstream, true to grade and alignment indicated with unbroken continuity of invert. Place bell ends of pipe facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturers. Comply with ASTM D3212 for joint tightness.

D. Sanitary sewers shall be laid at least 10 feet horizontally from any existing or proposed water main, measured edge to edge. Notify Engineer if this separation cannot be met.

E. Sanitary sewers crossing water mains shall be laid so that 18” of vertical clear space remain between the sewer and water main. Notify Engineer if this separation cannot be met.

F. As sanitary sewers are installed, lines shall be marked with a 2”x4” or other acceptable stake, with a minimum height of 6 feet above grade. Stake shall have the uppermost section painted green to indicate sewer line placement.

G. Install manholes at all changes in pipe direction or pipe grade.

H. Lateral Connections

1. Material and construction requirements for mainline sewers shall apply to sewer laterals.

2. Use fittings for lateral connections to sanitary sewers.

3. Use saddle taps only to connect laterals to existing sewers.

   a. Connect laterals to existing sewers only with Engineer and Wastewater Superintendent’s prior written approval.

4. Laterals shall be installed from a wye or tee fitting in the main sewer line to the property line or easement line unless otherwise indicated.

5. Contractor shall contact property owner for the preferred location of the lateral.

6. Intrusion of service connections into the main line sewer shall not be permitted.

7. Laterals shall connect to main sewer line at a maximum angle of 45 degrees from the spring line and shall include any bends necessary to reach the property line at the elevation specified.

I. Install proper size couplings according to manufacturer’s instructions where different sizes or materials of pipes and fittings are connected.

J. Reducing size of pipe in direction of flow is prohibited.

K. Install gravity sewer pipe according to the following:

1. Meet or exceed minimum slope required by regulatory authorities.

2. Install ductile iron gravity sewer pipe and fittings per AWWA C600, ASTM A746, and AWWA M41.

3. Install PVC sewer pipe per ASTM D2321, ASTM F1668, and AWWA M23.

4. Blocking pipe up to grade and then bedding under it is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.

5. Provide a waterproof bulkhead at points of connection to the existing sewer system from the time of the connection until the new sewers have been completed and cleaned of all debris.

6. Use a laser beam for horizontal and vertical control of the sewer.

   a. Set up laser unit so that the alignment of the beam is through the centerline of the pipe or outside the pipe directly above and parallel to the centerline of the pipe. Confirm elevation at regular intervals along pipe segment using survey equipment.

   b. If set up on the centerline:

      1) Provide a blower for continuous air circulation within the pipe.

      2) Establish a target on line and grade to provide a method of checking the setting of the laser beam as construction progresses.

   c. If set up above the pipe:

      1) Provide means to ensure the grade pole is plumb when checking pipe grade.

      2) Set grade pole on the invert of the pipe when checking alignment and grade.

L. Install pipe encasement over DI pipe and fittings per ASTM A674 or AWWA C105.

M. Clear interior of pipe and manholes of dirt, water, and superfluous material as work progresses. Place plug in end of incomplete pipe when work stops.

N. Field Cut Pipe

1. Per manufacturer's recommendations except when joining pipes.

2. Bevel end by grinding or filing as close to the original taper provided by the manufacturer as possible.

3.2 PIPE JOINT CONSTRUCTION

A. Join PVC sewer pipe per ASTM D2321 and ASTM D3034 for elastomeric-seal joints or elastomeric-gasket joints.

B. Join PVC sewer pipe per ASTM F794 for gasketed joints.

C. Join DI gravity sewer pipe per AWWA C600 for push-on joints, and per AWWA C600 or AWWA M41 for special fittings or DI fittings.

D. Join flanged joints of DI pipe and fittings per AWWA C115.

E. Join dissimilar pipe materials with non-pressure type, flexible couplings according to both pipe manufacturer's directions.

3.3 INSTALLATION OF WARNING TAPE

A. Warning tape shall be installed over all buried non-metallic pipe in accordance with manufacturer's installation instructions.

B. Warning tape shall be installed 12" above the pipe centerline unless noted otherwise on plans.

3.4 INSTALLATION OF TRACER WIRE

A. Provide two tracer wires on the crown of all pipes and tubing.

B. Wires shall be installed along the pipe and securely fastened by two full wraps of duct tape at no more than 20 foot intervals.

C. Terminate tracer wires above ground at each at-grade or above-ground structure and at intervals of no more than 400 feet.

1. Bring tracer wires to grade through a tracer wire box where no structures exist.

2. Do not terminate tracer wires within limits of waterways.

D. Individually test each tracer wire strand after installation. At least one of the two tracer wires shall provide continuous transmission of tracing signal along the full pipe length.

3.5 MANHOLE INSTALLATION

A. Manholes shall be installed straight and plumb. Completed manholes shall be rigid, true to dimensions, and watertight.

B. Bottom of excavation shall be flat, level and dry, with stable soils, prior to manhole installation. Place and level stone base prior to manhole installation. Fill over-excavation with INDOT No. 8 crushed aggregate prior to bedding.

C. Install and compact pipe bedding from bottom of manhole to pipe bottom elevation prior to making pipe connection to manhole.

D. Place backfill evenly around manhole to prevent lateral movement.

E. Where manhole is within a legal drain or FEMA designated floodway, or where shown on the plans, manhole frames and lids shall be bolt-down type.

1. Frames shall be bolted through the anchor base flange to the cone section with 3/8" stainless steel anchor bolts, washers, and concrete anchors.

F. Install adjusting rings according to manufacturer’s recommendations and the following:

1. Clean the concrete cone or top slab to assure a flat seating surface free of debris.

2. Install adjusting rings of thickness necessary to come within 1/4" of grade with the cover frame in place, considering the space between the adjusting rings created by the compressed joint sealer.

3. Apply two strips of joint sealant to each joint from the top of the cone or slab to the casting frame. Install joint sealant around the entire circumference, overlapping the ends.

4. Install adjusting rings centered over eccentric cone top, straight and plumb. Reset when knocked offline.

5. Set the casting frame in place, centered on the top adjusting ring.

G. Chimney Seals

1. Chimney seals shall be installed according to manufacturer’s directions.

H. Manhole Backplaster

1. Apply backplaster evenly at a minimum thickness of 1/4” from the frame to 2” below the last adjusting ring.

2. Install wrap over backplaster, covering the backplaster completely.

I. Inflow Dish

1. Clean manhole frame of all dirt and debris before placing the inflow dish on the rim.

2. Inflow dish shall be fully seated around the manhole frame rim to prevent water from infiltrating between the cover and the manhole frame rim.

J. Manholes Receiving Force Main Discharge

1. Coat inside to prevent deterioration by sewer gases.

2. Clean casting and concrete surface to remove dirt, loose concrete, and cement.

3. Apply one coat of Tnemec 46H-413 or approved equal to interior concrete surfaces and all casting surfaces to 16 mils to 20 mils thickness.

K. In general, top of casting elevations given are approximate. Unless a top of casting elevation is specifically indicated to differ from this requirement, field adjust all castings to the following elevations:

1. Set tops of frames and covers +0" to -1/4" with finished surface for manholes located in paved surfaces.

2. Set tops of frames and covers 3" above finished surface elsewhere.

3.6 CONCRETE PLACEMENT

A. Place concrete external to manhole according to ACI 318/318R.

B. Place cast-in-place concrete manholes and cast-in-place bases in precast manholes according to ACI 350/350R.

3.7 ABANDONING SANITARY SEWER SYSTEMS

A. Where new sewers replace existing sewers, abandon existing sewers only after completion of construction, testing, and acceptance of new sewers. Connect existing customers to new sewers prior to abandoning existing sewer.

B. Abandoned Pipe

1. Abandonment by Removal

a. Remove and dispose of all pipe to be abandoned.

b. Fill excavation with final backfill as defined in Section 02300 – Earthwork for Sanitary Sewers.

2. Abandonment by Capping

a. Clean pipe to be abandoned using high pressure jetting.

b. Close open ends of underground pipe to be abandoned with plastic plugs, concrete, or other acceptable methods. Do not use wood plugs.

3. Abandonment by Filling

a. Clean pipe to be abandoned using high pressure jetting.

b. Pump flowable fill into the sewer pipe from one manhole to the next. Flowable fill shall be as defined in Section 02300 – Earthwork for Sanitary Sewers.

c. Fill until visually apparent at the opposite end that all space within the pipe has been filled.

C. Abandoned Manholes

1. Abandonment by Filling

a. Break 2 holes in manhole barrel at bench elevation.

b. Remove top of manhole down to at least 36” below final grade.

c. Fill manhole to within 12” of top of remaining manhole structure with stone, rubble, or gravel.

d. Fill top 12” of manhole with flowable fill as defined in Section 02300 – Earthwork for Sanitary Sewers.

e. Fill excavation with final backfill per Section 02300 – Earthwork for Sanitary Sewers.

2. Abandonment by Removal

a. Excavate and remove manhole.

b. Fill excavation with final backfill per Section 02300 – Earthwork for Sanitary Sewers.

3.8 CONNECTIONS TO EXISTING MANHOLES

A. Make connections from sewers to existing manholes by coring an opening into existing manhole of the size required for the pipe connector. Saw cutting and hammer taps are prohibited without Engineer and Wastewater Superintendent’s prior written approval. Install pipe connector into manhole, and install pipe through connector according to manufacturer’s instructions.

B. Cut end of connection pipe passing through pipe or structure wall to conform to be flush with inside wall, unless otherwise indicated.

C. Prevent concrete or debris from entering existing pipe and manholes while making connections. Remove debris or other material that may accumulate.

D. Chip out new channel as required. Provide smooth transition into existing channel and bench. Use structural repair grout to form new channel and bench.

E. Where manhole conditions prohibit coring and with Engineer and Wastewater Superintendent’s prior approval, a hole 3” larger in diameter than the pipe may be cut or chipped out of the manhole and structural repair grout packed around connection.

3.9 FIELD QUALITY CONTROL

A. Testing, General

1. Test new pipe systems and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

a. Inspect and test completed pipe systems.

b. Schedule inspections and tests with Engineer and Wastewater Superintendent with at least 48 hours advance notice.

c. Submit separate report for each test.

2. Failure of inspections or tests indicate defects that must be repaired or replaced.

3. Replace failed work using new materials, and repeat testing until test results are within allowances specified.

B. Visually inspect interior of main line pipe by lamping to determine whether line displacement or other damage has occurred. Inspect after approximately 24” of backfill is in place, and again at project completion.

C. Cleaning

1. Conduct standard cleaning prior to acceptance testing.

D. Mandrel Deflection Test

1. Conduct deflection tests on PVC or other flexible pipe sewers 48” and less in diameter using a mandrel.

2. Mandrel Characteristics

a. Mandrel manufactured for the purpose of determining flexible pipe deflection shall have a diameter of at least 95% of the base pipe ID indicated in the applicable pipe standard.

b. Minimum mandrel length shall be as follows:

1) 8” long for 8” diameter pipe.

2) 10” long for 10” diameter pipe.

3) 10” long for 12” diameter pipe.

4) 12” long for 15” diameter pipe.

5) As approved by Engineer for pipe larger than 15”.

c. Mandrel shall be made of steel or aluminum and have 9 or more arms.

d. Provide proving ring clearly marked with diameter and ASTM standard.

3. Procedure

a. Conduct test a minimum of 30 days after the backfill has been placed to final grade.

b. Pull the mandrel through all main line sewers.

c. The pipe shall pass the deflection test if one person can pull the mandrel through the pipe by hand.

4. Any pipe that does not pass the deflection test shall be replaced and retested at no additional expense to the Town.

E. In-Situ Deflection Test

1. Conduct in-situ deflection tests on PVC or other flexible pipe sewers larger than 48” in diameter.

2. Equipment

a. Provide a rigid small-diameter rod of a length equal to the manufactured inside diameter of the pipe less the acceptable deflection limits of the pipe.

1) Acceptable deflection shall be the lesser of the manufacturers’ published deflection standards, the applicable regulatory standards, or the applicable certification agency standards.

b. Device shall include a level capable of determining level and plumb conditions.

3. Procedure

a. Conduct test a minimum of 30 days after the backfill has been placed to final grade.

b. With Engineer present, conduct in-situ deflection test per the following:

1) Spot checks shall occur at the following locations.

a) One location in each section of pipe.

b) At locations indicated by Engineer.

2) Circumferentially mark an equal distance at the following locations measured from the spigot end of the pipe.

a) At the springline of the pipe on both sides.

b) At the crown of the pipe.

c) At the bottom center of the pipe.

3) Place the rod at the locations of the marks at the top and bottom of the pipe and at the spring line of the pipe using the level to confirm level or plumb, as applicable.

4. Any pipe that will not allow the rod-type device to be placed level or plumb at the marks in the pipe shall be replaced and retested at no additional cost to the Town.

F. Closed-Circuit Television Inspection

1. Visually inspect mainline sewers by closed circuit television as described in Section 02532 – Sewer Televising.

G. Low Pressure Air Test

1. All main line sewers 24” and smaller, including attached laterals, shall be subjected to an air test.

2. Test shall comply with ASTM F1417.

3. Procedure:

a. The air test may be done after final backfill is placed in the trench.

b. At a minimum, the following equipment shall be provided:

1) Mechanical or pneumatic plugs.

2) Air control panel.

3) Shut-off valve, pressure regulative valve, pressure relief valve, and input pressure gauge. The pressure regulator or relief valve shall be set no higher than 9 psig to avoid over pressurization;

4) Continuous monitoring pressure gauge having a range of 0 to at least 10 psi. The gauge shall be no less than 4” in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi;

5) To reduce the potential for sewer line over-pressurization, 2 separate hoses shall be used to:

a) Connect the control panel to the sealed line for introducing low pressure air; and

b) Constantly monitor air pressure buildup in the line.

6) If pneumatic plugs are utilized, a separate hose shall be required for inflation.

c. The procedures for the low pressure air test are as follows:

1) After a manhole to manhole segment of pipe has been backfilled to final grade and all laterals and appurtenances installed, securely place and brace suitable test plugs in the ends of the sewer segment and in all lateral stubs included in the test. All plugs shall be securely restrained and braced prior to and during the test.

2) Add air slowly to the test section until the pressure inside the pipe reaches 4.0 psig plus the necessary adjustment for groundwater (Initial Pressure). The air pressure adjustment for groundwater is:

a) 2.0 psig unless groundwater monitoring wells have been installed.

b) If groundwater wells or manhole groundwater monitoring taps have been installed, the adjustment shall be determined by the following:

Adjustment = Depth of Groundwater x 0.43

where:

Adjustment = Adjustment added to the starting pressure of the low-pressure air test, psig. The maximum adjustment shall be 2.0 psig.

Depth of Groundwater = As measured above the top of pipe, feet.

0.43 = Conversion factor

If more than one well was installed, take the average depth of the nearest downstream and nearest upstream monitoring locations.

3) Do not exceed 6.0 psig at any time during the low-pressure air test.

4) After the initial pressure is reached, the air supply shall be throttled to maintain that initial pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

5) Testing

a) When temperatures have equalized and the pressure stabilized at the initial pressure, the air hose from the control panel to the air supply shall be shut off or disconnected.

b) The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 0.5 psig below the initial pressure. At this reading, or any convenient observed pressure reading between the initial pressure and 0.5 psig below the initial pressure, timing shall begin.

c) A timed pressure drop of 0.5 psig shall be used. The allowable time shall be predetermined using the following table.

TABLE 02530-1
SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED

Pipe Dia. (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.472L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

6) No time adjustment will be made for lateral lengths.

7) If the time shown for the designated pipe size and length elapses before the 0.5 psig pressure drop, the section of pipe being tested shall have passed the test. The test may be discontinued once the prescribed time has elapsed even though the pressure drop has not occurred.

8) If the pressure drops 0.5 psig or more before the appropriate time has elapsed, the air loss rate shall be considered excessive and the section of pipe being tested shall have failed the test.

9) Uncover, replace, or repair and completely retest any section of sewer or laterals not passing the test. The method of repair shall be subject to acceptance by Engineer. Grouting is not an acceptable method of repair.

H. Joint Test

1. All main line sewers larger than 24" shall be subjected to a joint test using air or water under low pressure. All joints shall be tested.

2. Testing procedures shall be per ASTM C1103 and as follows:

a. The joint test may be done at any time after final backfill is placed.

b. Equipment used shall be made specifically for joint testing of pipelines.

c. Joint Test Apparatus Installation

1) Clean the joint and interior joint surfaces.

2) Move the joint test apparatus into the sewer to the joint to be tested and position it over the joint. Make sure the end element sealing tubes straddle both sides of the joint and the hoses are attached.

3) Inflate end element sealing tubes with air in accordance with equipment and manufacturer's instructions.

d. Joint Air Test

1) Pressurize the void volume with air to 3.5 psig plus the necessary adjustment for groundwater (Initial Pressure). The air pressure adjustment for groundwater is:

a) 2.0 psig unless groundwater monitoring wells have been installed.

b) If groundwater wells have been installed, the air pressure adjustment for groundwater will be done in the same manner as for a low pressure air test.

2) Allow the air pressure and temperature to stabilize before shutting off the air supply. Start the timing of the test.

3) Measure the pressure drop after 5 seconds.

4) After the joint test is completed, exhaust void volume, then exhaust end element tubes prior to removal of the testing apparatus.

e. Joint Water Test

1) Introduce water into the void volume until water flows evenly from open petcock. Close the petcock and pressurize with water to 3.5 psi plus the

necessary adjustment for groundwater (Initial Pressure). The water pressure adjustment for groundwater is:

a) 2.0 psig unless groundwater monitoring wells have been installed.

b) If groundwater wells have been installed, the water pressure adjustment for groundwater will be done in the same manner as for a low pressure air test.

2) Shut off the water supply and start test timing.

3) Measure the pressure drop after five 5 seconds.

4) After the joint test is completed, exhaust end element tubes which will automatically release the water from the void volume, prior to removal of the testing apparatus.

f. If the pressure holds or drops less than 1 psig for the 5 second test time, the joint shall have passed the test.

g. If the pressure drops 1 psig or more during the 5 second test time, the joint shall have failed the test.

h. If the joint fails, repair and retest as necessary. The method of repair shall be subject to acceptance by Engineer. Grouting is not an acceptable method of repair.

I. Vacuum Test

1. All manholes shall be subjected to a vacuum test. The vacuum test shall include the sewer-to-manhole connection boot and all joints between the casting and the bottom of the base. Internal chimney seals shall be tested separately.

2. Testing shall be done per ASTM C1244.

3. If possible, each manhole shall be tested immediately after assembly and prior to backfilling. If the test is done after backfilling, Contractor shall be responsible for re-excavation to locate and correct any leaks that have been identified. The vacuum test shall be done before an internal chimney seal is installed and tested.

4. Equipment used shall be made specifically for vacuum testing of manholes.

5. Testing Procedures

a. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

b. The test head shall be placed at the top of the manhole casting in accordance with the manufacturer's recommendations.

c. A vacuum of 4.9 psig shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.

d. The time for the vacuum reading to drop from 4.9 psig to 4.2 psig shall be measured. The allowable time shall be determined by using the following table.

TABLE 02530-2

MINIMUM TIME REQUIRED FOR A PRESSURE RISE OF 1" Hg

FOR MANHOLES OF VARIOUS DEPTHS AND DIAMETERS

Manhole Depth to (ft.)	Diameter (in)		
	48	60	72
	Time (sec)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
Add for each addn'l 2'	5	7	8

a)

6. If the time shown for the designated manhole depth and diameter elapses before the vacuum reading drops by 0.7 psig, the manhole shall have passed the test.
7. If the vacuum reading drops more than 0.7 psig before the appropriate time has elapsed, the manhole shall have failed the test.
8. Uncover, replace, or repair the manhole and retest until a successful test is accomplished.

J. Internal Chimney Seal Leakage Test

1. All internal chimney seals shall be tested using a leakage test.
2. The leakage test shall be conducted as follows:
   a. Shall be performed after the manhole has passed the vacuum test.
   b. Install the chimney seal and only the bottom expansion band per manufacturer's recommendation. Fully tighten the bottom band. Do not install top expansion band.
   c. Pulling the top of the seal away from the manhole frame, pour 1 gallon of water behind the seal.
   d. Observe the bottom seal for a minimum of 1 minute for leakage.
   e. Drain the water by folding the top of the chimney seal down.

f. If the chimney seal passes the test, install the top expansion band per manufacturer's recommendation.

3. If the bottom expansion band holds water without visible leaking, the chimney seal will have passed the test.

4. If the bottom expansion band has any leakage during the test time, the chimney seal will have failed the test.

5. Replace or reposition the bottom expansion band and retest until a successful test is accomplished.

END OF SECTION 02530

SECTION 02531
DIGITAL MANHOLE INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes inspection of sanitary manholes and other structures.

1.2 DEFINITIONS

A. CCTV – Closed-circuit television system designed for use in sewers.

B. MACP – Manhole Assessment Certification Program.

C. NASSCO – National Association of Sanitary Sewer Companies.

1.3 SUBMITTALS

A. Action Submittals

1. Schedule of Activities
2. 3 photographic examples representative of video product to be provided.

B. Informational Submittals

1. Product data for televising equipment.
2. Contractor qualifications.

C. Project Record Documents

1. Videos and Inspection Reports.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Operator shall be certified by equipment manufacturer in the use of the equipment.
2. Operator shall be MACP certified.

B. Regulatory Requirements

1. Comply with all requirements of Wastewater Superintendent.

1.5 PROJECT CONDITIONS

A. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existed prior to the work.

B. Coordinate activities with weather conditions and sewer flows. Where a temporary rise in flow due to wet weather makes work impossible, provide bypass pumping, move to a different location where work is possible, or delay work until high flows have subsided.

C. Do not enter manholes or sewers without the prior authorization of the Wastewater Superintendent.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Televising Equipment

1. The camera system and illumination shall be capable of providing a clear and accurate color record of the manhole's internal condition.
2. The inspection camera system shall be 100% digital.
3. The inspection camera system must have 2 independently or simultaneously controlled digital cameras, 1 facing in the downward direction and 1 facing in the upward direction. Each camera must have a minimum 185 degree field of view.
4. The illumination shall be xenon strobe light. The light shall be positioned 360 degrees around the camera lenses to distribute the light evenly onto the structure walls. The lighting must be able to illuminate manholes up to 120” in diameter without the need of any auxiliary lighting.
5. The inspection system shall produce individual images or frames with no more than 0.001” of movement during image or frame exposure to produce crisp, clear images.
6. The inspection camera must provide a minimum of 3,000 lines of vertical resolution in the side view and a minimum of 500 lines in the perspective view.
7. Video Formats
   a. Allowable video file formats are MPEG and AVI.
   b. Digital video/audio files shall be minimum 480x360 pixel, 24 frame per second, 24-bit color depth.
8. Winches and reels used shall be stable under loaded conditions.
9. Hose and cable lengths shall be sufficient to cover the depth of the manhole to be inspected.

3.2 PROCEDURE

A. Sequence of Work

1. Commence manhole televising at the most convenient location.
2. Field confirm location and access to manholes prior to televising.
   a. Coordinate with sewer utility owner where necessary to locate manholes or gain access to manhole locations.
   b. Report damaged or unusable manholes immediately to sewer utility owner. Revise schedule as required due to unusable manholes.
3. Transport televising camera through manhole.
   a. A test pattern shall be used at the start of each video to ensure accurate focus, geometry, toning and contrast of the picture.

b. Stop travel of camera when steam builds up and impairs the quality of the inspection recording.

4. Retrieval of Jammed Equipment

a. Immediately notify sewer utility owner of jammed equipment.

b. Coordinate with sewer utility owner for retrieval of jammed equipment and flow bypassing to prevent sewer backups.

3.3 INSPECTION REPORT

A. Contractor is responsible for reviewing collected data, coding observations, and completing a full MACP evaluation of each inspected manhole.

B. Supply 2 printed copies and 1 digital copy of a report on the condition of the sewers inspected within 3 weeks of the televising work being complete.

C. Digital report shall be in one of the following formats:

1. PDF format.

2. Microsoft Word (2010 or later).

3. Microsoft Excel (2010 or later) with photographs in JPEG format.

D. The report shall include:

1. An unfolded view of the manhole with 3,000 lines minimum of vertical resolution.

2. A three dimensional representation of the structure. This file shall be exportable to common CAD programs for further analysis.

3. A virtual pan and tilt allowing review of the manhole structure from any angle and any depth.

a. Must be able to view 360 degrees in any direction.

b. Must consist of views from the top and bottom camera; any virtual pan and tilts that artificially create this view from a single camera will be rejected due to distorted images.

4. The virtual pan and tilt and up/down direction of the view must be able to be controlled from a computer mouse.

5. The virtual pan and tilt and unfolded views must be viewable without the need of any third party data logging software.

E. Contractor must supply a removable USB storage device containing the data and reports. Reports shall be prepared by a certified MACP user.

3.4 RE-TELEVISING

A. Engineer or Wastewater Superintendent shall notify Contractor within 14 days of receipt of videos and reports if the quality of the video record is unacceptable.

B. Contractor shall, within 7 days, re-televise any manhole as necessary to produce an acceptable video record.

C. Re-televise manhole as required until satisfactory results are obtained.

END OF SECTION 02531

SECTION 02532
SEWER TELEVISING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes closed-circuit televising of sanitary sewers.

1.2 DEFINITIONS

A. CCTV – Closed-circuit television system designed for use in sewers.

B. NASSCO – National Association of Sanitary Sewer Companies

1.3 SUBMITTALS

A. Action Submittals

1. Schedule of Activities

B. Informational Submittals

1. Product data for CCTV sewer televising equipment.
2. Contractor qualifications.
3. Videos and written report.

1.4 QUALITY ASSURANCE

A. Qualifications

1. CCTV operator shall be certified by equipment manufacturer in the use of the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal

1. Do not store material removed from sewers on site.
2. Dispose of material removed from sewers in compliance with applicable regulations.

1.6 PROJECT CONDITIONS

A. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existing conditions.

B. Coordinate activities with weather conditions and sewer flows. Where a temporary rise in the flow in the sewer due to wet weather makes work impossible, provide bypass pumping, move to a different location where televising is possible, or delay work until high flows have subsided.

C. Do not enter manholes or sewers without the prior authorization of the Wastewater Superintendent.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Televising Equipment

1. The camera system and illumination shall be capable of providing an accurate and clear color record of the sewer's internal condition. The illumination shall be capable of allowing the camera to operate in all sewers at an iris setting providing a minimum depth of field of 3 feet. The depth of field shall commence no more than 1 foot from the camera lens.
2. The camera lens shall be positioned near the center of the pipeline to reduce picture distortion. Lens shall be capable of panning 90 degrees in all directions from the horizontal front position.
3. A means of accurately locating the camera’s horizontal location at the ground surface.
4. A means of accurately locating the camera's distance and any recorded defect, along the sewer shall be provided, to an accuracy of 0.1 ft.
5. Camera shall be capable of panning and tilting to view laterals and other connections.
6. Video Formats
   a. Provide MPEG or AVI format video. Video files shall be minimum 480x360 pixel, 24 frame per second, 24-bit color.
   b. Video files shall be provided on a USB storage device.
7. Photographic Formats
   a. Photographs shall be digital JPEG, TIF, or PDF format, minimum 1 megapixel in size, 24-bit color.

3.2 PROCEDURE

A. Sequence of Work

1. Commence televising sequence at the most upstream sewer segment and proceed downstream.
   a. Clean manholes and sewers thoroughly prior to televising.
2. Field confirm location and access to manholes prior to initiation of cleaning and televising.
   a. Coordinate with Wastewater Superintendent where necessary to locate manholes or gain access to manhole locations.
   b. Report damaged or unusable manholes immediately to Engineer and Wastewater Superintendent. Revise schedule as required due to unusable manholes.
3. Transport sewer televising camera through sewer.
   a. Video record of the work shall include the following:

1) Date, time and location, manhole number, sewer size and material, and direction (upstream or downstream and cardinal direction (i.e., N, S, E, or W)) of televising activity at start of run.

2) Describe each defect by location and type.

a) Defects shall be defined in accordance with NASSCO's Pipeline Assessment and Certification Program.

3) Describe each connection to the sewer by distance from the start of the run, type of connection, and direction in the pipe (clock-hour angle from top)

4) Record length of run at end and any unusual problems or activities required.

b. A test pattern shall be used at the start of each video and at the start of each new day, to ensure accurate focus, geometry, toning and contrast of the picture.

c. Pan the camera within the starting manhole to the extent of the camera limits in all directions prior to transporting the camera through the sewer to show features of the starting manhole.

d. The camera shall travel at a maximum speed of 1/2 foot per second. Where each specific fault exists, the camera shall be stopped for a minimum of 5 seconds.

e. Pan up every connection to the sewer.

f. Pan the camera throughout the limits of the lens travel up-down and left-right immediately upon entering the terminal manhole to provide a video record of the manhole.

g. Stop travel of camera when steam builds up in the sewer or when the quality of the inspection records is impaired.

h. Photographic record

1) Defects shall occupy the central part of the photograph and be clearly in focus and accurately reflect the feature. If necessary, a second photograph shall be taken to put the feature depicted in the specific photographs into perspective in the overall context of the sewer.

4. Retrieval of Jammed Equipment

a. Immediately notify Engineer and Wastewater Superintendent if equipment becomes jammed in sewers.

b. Coordinate with Wastewater Superintendent for the retrieval of jammed equipment and the temporary bypassing of flows, as necessary, to prevent sewer backups.

3.3 INSPECTION REPORT

A. Supply 2 printed copies and 1 digital copy of a report on the condition of the sewers inspected within 3 weeks of the televising work being complete.

B. Digital report shall be in either

1. PDF format.

2. Microsoft Word (2010 or later).

3. Microsoft Excel (2010 or later) format with photographs in JPEG format.

C. Where a length of sewer between manholes cannot be surveyed, attempted, or is abandoned for practical reasons, define the reason for abandonment in writing.

D. The report shall note in appropriate tables:

1. Sewer segment identification, date of televising, starting manhole number, ending manhole number, manhole northings and eastings (except for new construction), pipe size, pipe material, segment length, cardinal (i.e., N, S, E, W) viewing direction, and operator name.

2. The distance from the starting manhole and description of each identified defect.

a. Defects shall be coded in accordance with NASSCO's Pipeline Assessment and Certification Program.

3. The distance from the starting manhole and direction (in clock-hour type angles) of each lateral connecting to the sewer.

E. Photographs

1. Printed photographs shall be supplied in suitable plastic containers to prevent damage during transportation. Each photograph container shall be clearly labeled with photo numbers, date photographed, and street name.

2. Each photograph shall clearly identify running distance of camera and starting manhole number, direction of travel, and type of defect. Labeling shall not detract from the detail of any defect or the condition of the pipe.

F. Videos

1. Each video label shall clearly identify running distance of camera, manhole numbers, when a manhole length commences, and when a manhole length ends.

3.4 RE-CLEANING AND RE-TELEVISING

A. Engineer shall notify Contractor within 14 days of receipt of videos and reports if a length of sewer or any part thereof has not been effectively cleaned for the televising or the quality of the video record is less than required.

B. Contractor shall, within 7 days, re-clean and re-televise that part of the sewer not effectively cleaned or video recorded.

C. Re-clean and re-televise sewers as required until satisfactory results are obtained.

END OF SECTION 02532

SECTION 02535
CIPP PIPELINE REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes rehabilitation of existing sewers by the cured-in-place pipe (CIPP) method.

1.2 DEFINITIONS

A. CIPP – Cured-in-Place Pipe

B. CCTV – Closed Circuit Television

1.3 SUBMITTALS

A. Action Submittals

1. Product Data

a. Liner design per ASTM F1216, Appendix X1

b. Resin materials

c. Catalysts and additives

d. Liner end seals

2. Shop Drawings

a. Liner Insertion Plan

1) Description of the proposed CIPP lining procedure, including:

a) Detailed plan for identifying all service laterals.

b) Maintaining service during mainline installation to each home connected to the section of pipe being lined, including temporary service if required.

c) Procedure for reconnection of service laterals.

b. Public Notification Plan

1) A detailed public notification plan including detailed staged notification to residences affected by the CIPP installation. The public notification plan shall include the following:

a) Written notice to be delivered to each home or business the day prior to the beginning of the work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any potential problems.

b) Personal contact with any home or business, which cannot be reconnected within the time stated in the written notice.

B. Informational Submittals

1. Installer Certificates

2. Manufacturer Certificates, including
    a. Certifications required by applicable standards.
    b. Nominal void volume in the felt fabric that will be filled with resin.
3. Design Calculations, including
    a. Data on the maximum allowable stresses and elongation of the tube.
    b. Curing schedule(s).
4. Manufacturer Test Reports
5. Manufacturer Data Sheets
6. Independent Lab Test Reports
7. Schedule of Tests and Inspections
    a. Preliminary sewer televising.
    b. Field liner coupons.
    c. Post liner sewer televising.
    d. Warranty sewer televising.
8. Product Warranties

1.4 QUALITY ASSURANCE

A. Qualifications
1. Installer's qualification
    a. Certified by liner manufacturer in the products and technologies to be used.
    b. Minimum of 5 years of continuous experience installing CIPP liners in pipe of similar size, length, and configuration.
    c. Minimum of 150,000 linear feet of shop wet-out liner installation and minimum of 6 onsite wet-out installations.
2. Lab qualifications – NRTL laboratory.

B. Regulatory Requirements
1. Product and installation shall not result in discharges of wastewater or impact the performance of the sewer utility's wastewater treatment plant.

1.5 SYSTEM REQUIREMENTS

A. Design Requirements
1. The required structural CIPP wall thickness shall be in accordance with the design equations in Appendix X1 of ASTM F1216.
2. Design Safety Factory shall be 2.
3. All pipes shall have a minimum of 2% ovality in the circumference.
4. The Enhancement Factor to be used in partially deteriorated design conditions shall be assigned a value of 7.

5. The soil depth shall be determined by field conditions.

6. The live load shall be H-20 Highway.

7. The thickness of the CIPP lining shall be rounded to the next higher multiple of 1.5 mm after adding 5% to the design thickness for resin migration.

1.6 PROJECT CONDITIONS

A. Maintain sewer service to properties along sewer segment to be CIPP lined except under conditions approved in writing by Wastewater Superintendent.

B. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existed prior to the work.

C. Coordinate activities with weather conditions and sewer flows. Where a temporary rise in flow due to wet weather makes work impossible, provide bypass pumping, move to a different location where work is possible, or delay work until high flows have subsided.

D. Do not enter manholes or sewers without prior authorization of the Wastewater Superintendent.

1.7 DELIVERY, STORAGE AND HANDLING

A. Damaged liner products shall be immediately removed from the site.

B. Damage includes gouging, abrasion, flattening, cutting, puncturing, or UV degradation.

1.8 WARRANTIES

A. Manufacturer's warranty.

PART 2 - PRODUCTS

2.1 FLEXIBLE FABRIC TUBE LINER

A. One or more layers of absorbent non-woven felt fabric, felt/fiberglass or fiberglass meeting the requirements of ASTM F1216, ASTM F1743, ASTM D5813, and ASTM F2019, as applicable.

B. Capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures, of sufficient strength to bridge missing pipe segments, able to stretch to fit irregular pipe sections, and able to negotiate bends in the existing pipe.

C. Wall color of the pipe's interior surface after installation shall be a light reflective color so that a clear detailed examination with CCTV equipment may be made.

D. Fabricated from materials which, when cured, will be chemically resistant to hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, saturation with moisture, diluted sulfuric acid, and other chemical reagents commonly found in sanitary sewers.

E. Manufactured to a size and length that, when installed, will tightly fit the internal circumference of the original pipe. Allow for circumferential stretching during installation. Tube shall be properly sized to the existing pipe diameter and the length to be rehabilitated.

F. The exterior of the manufactured tube shall be marked along its length at regular intervals not to exceed 5 feet. Use these marks as a gauge to measure elongation during insertion. Markings shall also include the manufacturer's name or identifying symbol.

G. The outside and/or inside layer of the fabric tube (before inversion/pull-in, as applicable) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate, if applicable, vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

2.2 RESIN

A. Corrosion resistant, thermosetting polyester, vinyl ester, or epoxy resin and catalyst system that, when properly cured within the tube composite, meeting ASTM F1216, ASTM F1743, or ASTM F2019, as applicable.

1. Do not use recycled polyethylene terephthalic (PET) resins.

B. Will properly saturate the tube without draining out and will produce a properly cured pipe which is resistant to abrasion and the wastewater passing through the CIPP.

C. Catalysts and additives shall be per manufacturer's recommendations and shall not reduce the resin's ability to withstand the minimum chemical resistance criteria.

2.3 LINER END SEALS

A. Shall provide a watertight seal at the ends of CIPP sections between the CIPP liner and the sewer pipe.

B. Shall utilize 300 series stainless steel expansion bands to provide permanent sealing force meeting ASTM C923.

C. Shall be manufactured from natural or synthetic rubber and shall conform to the material requirements of ASTM C923.

D. Shall be compressed against the existing pipe and CIPP liner creating a permanent watertight seal meeting ASTM C923.

2.4 INVERT GROUTING MATERIALS

A. Shall be quick-setting cementitious materials designed to fill large voids and to repair or reconstruct inverts where no hydrostatic pressure exists.

B. Shall consist of rapid setting cements, aggregates, and various accelerating agents.

C. Shall not contain chlorides, gypsum, or metallic particles.

D. Minimum physical properties:

1. Compressive Strength per ASTM C109:

   a. 1 Hour: 4,000 psi

   b. 24 Hours: 7,000 psi

2.5 Flexural Strength per ASTM C348:

   a. 1 Hour: 450 psi

   b. 24 Hours: 600 psi

2.6 Setting Time per ASTM C266:

   a. Initial: 15-18 minutes

b. Final: 22-25 minutes

2.7 EXCAVATED LATERAL RECONNECTIONS

A. Strap-On Service Saddles

1. Saddles shall utilize wide double stainless steel straps or be of full-circumference stainless steel sleeve design. Strap saddles shall have a ductile iron body coated with a fusion epoxy or nylon coating.
2. Gasket shall be a broad pressure activated design bonded into a cavity in the saddle body or have spring-tensioning to accommodate pipe thermal expansion.
3. Straps, bolts, nuts and washers shall be Type 304 stainless steel with all welds passivated for corrosion resistance.
4. Stub-out attached to the inside of the saddle must protrude into the liner a distance equal to the wall thickness of the liner.

B. PVC Lateral Reconnection Pipe

1. Shall be PVC sewer pipe with fittings meeting ASTM D3034.
2. Pipe installed at 16’ depth or less shall be SDR 35.
3. Pipe installed at depths greater than 16’ shall be SDR 26.
4. Joints shall be flexible gasket compression-type meeting ASTM F477.

C. Lateral Pipe Connectors

1. Shall be flexible transition couplings meeting ASTM C1173.
2. Shall have elastomeric sleeves with ends the same size as the pipe to be joined.
3. Shall have corrosion-resistant metal band on each end.

PART 3 - EXECUTION

3.1 PREPARATION

A. Bypass Pumping

1. Conduct bypass pumping as required during:
   a. Cleaning and inspection of existing sewers.
   b. Liner installation and curing.
   c. Lateral reinstatement.
   d. Final inspection and warranty televising.

B. Cleaning and Inspection of Existing Sewers

1. Provide standard cleaning of all sewer segments to be CIPP lined prior to:
   a. Preliminary sewer televising.
   b. Installation of the CIPP lining.
   c. Post-lining sewer televising.
2. Provide heavy cleaning as required to clean sewers prior to initial televising.

3. Televise sewers before and after CIPP lining and 11 months after substantial completion. Televising for the purpose of lateral cut-ins is not acceptable as post-lining sewer televising.

C. Unsatisfactory Conditions

1. Cut protruding laterals flush with sewer pipe prior to installing the CIPP lining.

2. Notify Wastewater Superintendent immediately when unsatisfactory conditions are identified in a sewer segment to be CIPP lined.

D. Confirming Dimensions for Liner

1. Verify lengths in the field prior to impregnation of the tube with resin to ensure that the tube will extend the entire length of the run.

2. Measure the inside diameter of the existing pipe in the field prior to ordering liner so that the liner can be installed in a tight-fitted condition.

E. Manholes

1. Protect or support manholes to withstand forces generated by equipment.

2. Protect manholes from damage due to water or air pressure used while inserting the tube.

3.2 INSTALLATION

A. Resin Impregnation

1. Liner shall be impregnated with resin using distribution rollers and vacuum to thoroughly saturate the felt tube prior to installation.

a. A catalyst system or additives compatible with the resin and tube may be used per manufacturer's recommendation.

b. Resin shall not be subjected to ultraviolet light and shall form no excessive bubbling or wrinkling during lining.

2. Transport impregnated liner in bag and store at the site in such a manner that it will not be damaged, exposed to direct sunlight, or result in any safety hazard. Keep in a refrigerated truck until it is installed.

3. Impregnated tube shall have a uniform thickness and resin distribution that when compressed at installation pressures will meet the design thickness after cure.

B. Liner Installation

1. Install remote temperature gauges or sensors inside the host pipe to monitor temperatures during the cure cycle. Liner and existing pipe interface temperature shall be monitored and logged during curing of the liner.

2. The resin-impregnated tube shall be inserted through an existing manhole or other access during installation and shall fully extend to the next designated manhole or termination point.

3. The wet-out tube shall be positioned in the existing pipe per manufacturer's recommendations. Care shall be taken not to damage the tube during installation.

4. Application of hydrostatic head, compressed air, or other means shall fully extend and inflate the liner and firmly adhere the liner to the existing pipe wall.

3.3 CURING

A. Curing Cycle

1. Curing shall be in accordance with the manufacturer's recommended cure schedule for the resin/catalyst system used.

2. Liner wall thickness, existing ground temperature, moisture level, and thermal conductivity shall be considered in the curing cycle.

3. Temperature during the cure shall not be less than 130°F at the boundary between the pipe wall and the liner unless otherwise directed by manufacturer.

B. Curing Equipment

1. Shall be capable of circulating hot water, air, and/or steam throughout the sewer segment per manufacturer's recommendations to raise the temperature uniformly above the temperature required to cure.
2. The heat source pipe shall be fitted with continuous monitoring thermocouples to gauge the temperature of the water, air, and/or steam.

3. Additional continuous monitoring thermocouples shall be placed between the impregnated tube and the pipe invert at the terminal manhole and midway between the entry and terminal manholes to measure temperature during the cure.

C. Curing Procedure

1. Continuously cycle hot water, steam, or air meeting manufacturer's cure cycle recommendations throughout the liner.

2. Water, steam, or air temperature during the cure period shall meet the requirements of the resin manufacturer.

3. Monitor and record temperatures and curing data throughout the installation process to ensure that each phase of the process is in accordance with the manufacturer's recommendations.

4. The initial cure shall be considered complete after the heated cure cycle is complete, the exposed portions of the liner appear hard and sound, and the remote temperature sensors indicate that an exotherm has occurred.

3.4 COOL DOWN

A. Cool hardened liner to a temperature below 100°F before relieving the pressure in the lined pipe and returning normal flow to the sewer. Cool down process may vary depending on manufacturer's recommendations.

B. Care shall be taken during the release of pressure so that a vacuum does not develop which could damage the newly installed liner.

C. Samples shall be obtained for testing at this time.

3.5 MANHOLE CONNECTION

A. Install a liner end seal at the ends of each CIPP liner section.

1. Comply with manufacturer's instructions for installation of the liner end seals.

2. Comply with ASTM C923 in the installation of the liner end seals.

B. Pipe invert shall be streamlined for smooth flow from the liner system through the manhole channel.

3.6 LATERAL RECONNECTIONS

A. General

1. Reconnect all service laterals to the lined pipe as soon as feasible after the CIPP liner has been installed, fully cured, and cooled down.

B. Service Reconnection by Remote Controlled Cutting Device

1. The remote cut shall be made by experienced operators so that no blind attempts or holes are made in the liner.
2. Location shall be verified carefully for accuracy.
    a. Video record of remote cuts shall be submitted to Engineer within 72 hours of the cutting activity.
3. A minimum of 2 complete functional cutters plus spare components shall be on the job site before each installation.
4. The remote cut shall be smooth and circular, and shall be a maximum of 100% and a minimum of 90% of the service pipe diameter.
5. The remote cut shall be properly aligned and concentric with the existing connection.
6. The edges of the opening shall not have pipe or liner fragments.
7. The invert of the service connection shall match the bottom of the reinstated service opening.
8. Repair unsatisfactory cuts in accordance with CIPP liner manufacturer's recommendations. Damage to CIPP liner from unsatisfactory cuts may require the liner to be significantly repaired or replaced, at Engineer's discretion.
9. If service lateral reinstatements result in openings that are greater than 100% of the service connection opening, install a CIPP repair of sufficient size to completely cover the over-cut service connection.
10. Pipe material cut from service lateral reinstatement shall be collected at the next manhole downstream prior to placing the sewer in service. Pipe material shall not be allowed to pass through the sewer system.

C. Service Reconnection by Excavation

1. Shall be utilized where reconnection by remote-controlled cutting device is unsuccessful.
2. Lateral shall be disconnected at the joints near the connection and carefully removed to expose the liner.
3. A smooth, circular hole the size of the connection shall be drilled in the liner.
4. The edges of the opening shall not have pipe or liner fragments.
5. The invert of the service connection shall match the bottom of the hole.
6. Pipe material cut from service lateral reinstatement shall be collected at the next manhole downstream prior to placing the sewer in service. Pipe material shall not be allowed to pass through the sewer system.

7. Install strap-on service saddle over the hole and use a flexible coupling to secure the existing lateral to the service saddle stub.

8. Remove and replace any cracked, offset, or leaking service lateral pipe to a distance of 8 feet from the saddle, measured horizontally.

9. Encase the entire service lateral connection in sand a minimum of 12” in all directions.

3.7 FIELD QUALITY CONTROL

A. Material Testing

1. Testing Program

   a. The cured liner shall be sampled and tested for flexural strength and flexural modulus (short term). A certificate of compliance shall be provided for long term flexural modulus.

2. Sampling

   a. Obtain 1 sample from each 1,000 linear feet of pipe installed for each pipe diameter, minimum of 1 sample from each pipe size.

3. Testing

   a. Flexural strength and modulus shall be tested in accordance with the requirements of ASTM D790. The CIPP system shall meet or exceed the following minimum initial requirements:

	Test Method	Polyester Resin (std)	Polyester Resin (enhanced)	Vinyl Ester and Epoxy Resins
Flexural Strength	ASTM D790	4,500 psi	4,500 psi	5,000 psi
Flexural Modulus (short term)	ASTM D790	250,000 psi	400,000 psi	300,000 psi
Flexural Modulus (long term)		125,000 psi	200,000 psi	150,000 psi

   b. The laboratory results shall identify the test sample location referenced to the nearest manhole and station.

   c. If minimum requirements are not met, the CIPP shall be repaired or replaced and retested until the minimum requirements are met.

B. Video Inspection

1. Perform a CCTV inspection for quality control:

   a. After installation of CIPP liner and reconnection of sewer services.

   b. 11 months after substantial completion.

2. Pan camera 360 degrees around the circumference of the pipe and along the wall of the finished pipe at 10 foot intervals. The finished liner shall be continuous over the entire length of installation and free of significant visual defects, damage, deflection, holes, and leaks.

3. A televising report shall be provided within 10 working days of the liner installation. The report shall note any debris or defects in the liner, including gouges, cracks, bumps, bulges, foreign inclusions, dry spots, pinholes, and wrinkles.

4. Where leakage is observed, institute additional testing including air testing, localized testing, and any other testing that will verify the leak-proof integrity of the installed CIPP to satisfaction of the Engineer.

5. Should the overall elongation of a reach exceed 5%, the liner tube shall be rejected and replaced.

6. If the post-installation inspection report is not submitted within the required time after the liner installation, further installation of CIPP may be suspended by the Wastewater Superintendent until the documentation is submitted. No additional working days will be added to the contract and no increase will be made for costs as a result of this suspension.

END OF SECTION 02535

SECTION 02536
SLIP LINING PIPELINE REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Rehabilitation of existing sanitary sewers with one of the following types of pipe within an existing host pipe:

   a. Solid-wall HDPE.

   b. FRP slip lining pipe.

2. Filling the annular space between a slip lined pipe and a host pipe with cementitious grout.

1.2 DEFINITIONS

A. FRP – glass fiber reinforced plastic

B. HDPE – high density polyethylene

C. ID – inside diameter

D. Liner pipe – pipe installed within a host pipe by the slip lining method

E. OD – outside diameter

F. PE – polyethylene

G. DR – dimension ratio

H. SDR – standard dimension ratio

I. UV – ultra-violet

J. CCTV – closed-circuit television

1.3 SYSTEM REQUIREMENTS

A. Conveyance Capacity

1. Liner pipe shall provide the maximum conveyance capacity possible while maintaining a 1” minimum average annular space between the host pipe and liner pipe for grouting.

2. The ID of the liner pipe shall not be less than 80% of the nominal ID of the host pipe.

1.4 SUBMITTALS

A. Action Submittals

1. Product data for pipe, fittings, joints, grouting material, and admixtures.

2. Detailed work plan for slip lining, outlining the following items:

   a. Proposed construction sequencing and scheduling, including:

      1) Detailed plan for identifying all service laterals.

2) Maintenance of service during mainline installation to each home connected to the section of pipe being lined, including temporary service if required.

3) Procedure for reconnection of service laterals.

b. Areas requiring special construction techniques.

c. Pushing and receiving pit locations.

1) Indicate manholes to be replaced.

2) Indicate manholes to be rehabilitated.

d. Proposed access and staging areas.

e. Method of field joint creation.

3. Qualifications data and experience of grout mix applicator.

4. Grout mix design and trial mix tests.

a. Initial set time of the grout.

b. The 24-hour and 28-day minimum grout compressive strengths.

c. The grout working time before a 15% change in density or viscosity occurs.

5. Grout installation methods and procedures.

a. Method for waste grout recovery.

b. Estimated grout volume for each pipe.

c. Maximum injection pressures proposed and maximum allowable grout injection pressures as provided by the pipe manufacturer.

d. Bulkhead designs and locations including vent and injection port location and materials for bulkhead construction.

e. Method of flow control during grouting.

6. Public notification plan

a. A detailed public notification plan for notifying residences affected by the liner pipe installation.

B. Informational Submittals

1. Installer Certificates

2. Manufacturer Certificates, including

a. Certifications required by applicable standards.

3. Manufacturer's Instructions

4. Manufacturer Test Reports

5. Laboratory Test Results

a. Grout

6. Manufacturer Data Sheets

7. Schedule of Tests and Inspections

   a. Preliminary sewer televising.

   b. Post slip lining sewer televising.

   c. Warranty sewer televising.

8. Product Warranties

1.5 QUALITY ASSURANCE

A. Qualifications

1. Installer's qualification

   a. Certified by liner manufacturer in the products and technologies to be used.

   b. Minimum of 3 years of continuous experience installing liner pipes of similar size, length and configuration by the slip lining method.

2. Independent Laboratory

   a. Engage the services of an independent, ASTM/AASHTO accredited testing laboratory to collect and test grout specimens.

B. Regulatory Requirements

1. Product and installation shall not impact the performance of the sewer utility's wastewater treatment plant or discharge any compound to a waterway that would not be in compliance with all applicable regulations.

1.6 PROJECT CONDITIONS

A. Pipe and fittings shall be suitable for use in existing sanitary sewers.

B. Maintain sewer service to properties along sewer segment to be slip lined, except when otherwise approved in writing by Wastewater Superintendent.

C. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existed prior to the work.

D. Coordinate activities with weather conditions and flows. Where a temporary rise in flow due to wet weather makes work impossible, provide bypass pumping, move to a different location where work is possible, or delay the work until the high flows have subsided.

E. Enter existing manholes or sewers only under approved conditions and with the prior authorization of the Wastewater Superintendent.

1.7 DELIVERY, STORAGE AND HANDLING

A. Damaged slip lining products shall be immediately removed from the site.

B. Damage includes gouging, abrasion, flattening, puncturing, or UV degradation.

PART 2 - PRODUCTS

2.1 HDPE PIPE

a. Shall be as described in Section 02530 – Gravity Sanitary Sewers.

B. Joints for HDPE pipe shall be fusion butt-welded where approved by manufacturer.

2.2 FRP PIPE

A. Centrifugally cast fiberglass reinforcement plastic mortar pipe per ASTM D3262.

1. Cell classification Type 1, Liner 2, Grade 3.

2. Minimum pipe stiffness per ASTM D2412 shall be 36.

B. Glass shall be a commercial grade of E-type glass fibers with the amount, location, and orientation of the chopped glass-fiber reinforcement specifically designed for each application.

C. Sand shall be minimum 98% silica kiln-dried and graded.

D. Polyester wall resin shall be an isophthalic, orthophthalic, or other approved resin.

1. Minimum tensile elongation: 2%.

E. Shall be marked at not less than 5 foot intervals with manufacturer name, size, stiffness, ASTM designation number, and manufacturer's lot number.

F. UV End Treatment

1. All liner pipe ends that may be exposed to sunlight shall receive an interior coating to resist deterioration from UV radiation.

2. Apply 2 coats of Induron Perma-Clean II semi-gloss epoxy (or approved equal) at 4-6 mils per coat to each open end of the interior of the liner pipe for a distance of 2 times the ID of the liner pipe.

a. Finish color shall be white or similar shade.

b. Application of both coats shall be performed by the pipe manufacturer in a climate-controlled environment prior to pipe delivery to the site.

c. Surface preparation shall be per the recommendations of the coating supplier and the pipe manufacturer.

G. Joints for FRP pipe shall be flexible gasket compression type conforming to ASTM F477 and ASTM D4161.

1. Pipe OD shall not be increased and pipe ID shall not be decreased at the joint.

2. Joints shall meet ASTM D3139 under pressure and 22" Hg vacuum.

3. Joints shall be sufficiently watertight so that no grout is visible on the inside of the pipe following annular space grouting.

2.3 NON-STRUCTURAL GROUT

A. Cement shall comply with ASTM C150.

B. Fly ash shall comply with ASTM C618, Type C or Type F only.

C. Compressive Strength

1. Minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C403.

2. Minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C495.

2.4 STRUCTURAL GROUT

A. General

1. Cementitious grout containing a mixture of cement, water, fly ash or lime and admixtures designed to meet performance requirements.

2. Minimum compressive strength of 3,000 psi in 28 days per ASTM C942.

B. Water used shall be potable water obtained from a municipal water distribution system and transported in a clean container used only for that purpose.

2.5 ADMIXTURES

A. Admixtures shall be selected by the grout manufacturer to meet performance requirements, improve pumpability, control set time, and reduce segregation.

B. Admixtures shall not be biodegradable.

2.6 MIX DESIGN

A. Provide a flowable fill with density range of 70-120 pcf for segments less than 125 feet in length.

B. Provide cellular grout with density range of 40-80 pcf for segments greater than 50 feet.

C. Either flowable fill or cellular grout can be used for segments between 50 feet and 125 feet in length.

2.7 EXCAVATED LATERAL RECONNECTIONS

A. Strap-On Service Saddles

1. Saddles shall utilize wide double stainless steel straps or be of full-circumference stainless steel sleeve design. Strap saddles shall have a ductile iron body coated with a fusion epoxy or nylon coating.

2. Gasket shall be a broad pressure activated design bonded into a cavity in the saddle body or have spring-tensioning to accommodate pipe thermal expansion.

3. Straps, bolts, nuts and washers shall be Type 304 stainless steel with all welds passivated for corrosion resistance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning

1. Prior to installing the liner pipe, the host pipe shall be thoroughly cleaned by standard cleaning or heavy cleaning methods.

2. Cleaning shall remove all debris, solids, roots, deposits, pipe protrusions, and other matter which would prevent proper installation of the liner pipe and grout.

B. Control of Flows

1. Provide for bypass pumping or control of water as necessary for satisfactory installation of the liner pipe and grout.

C. Proof Testing

1. A mandrel shall be pulled through all host pipes less than 36” in diameter.

2. Host pipes 36” in diameter and larger may be verified by entry, mandrel, or both.

3. Mandrel

   a. Shall have an OD not less than the liner pipe OD plus 1”.

   b. The mandrel length of liner pipe shall be equal to the liner pipe joint length.

   c. Shall have a stiffness equal to or greater than that of the liner pipe.

   d. A segment of liner pipe may be used as a mandrel, but this test segment shall not be used as a permanent liner pipe.

3.2 INSTALLATION

A. Excavation

1. Excavation along the length of the host pipe, except at lateral connections, is strictly prohibited without written authorization from Engineer or Wastewater Superintendent.

B. Liner Pipe

1. Installation shall be per manufacturer's recommendations and the provisions of this section.

2. Installation shall comply with ASTM D2331 and ASTM F585.

3. Bypass flows past host pipe during liner pipe installation.

4. Prevent water from entering annular space during and after installation.

5. Joints for PE pipe shall be per ASTM D2774 and ASTM F645.

6. Sections of liner pipe shall be joined and pushed into the host pipe until a continuous liner pipe is created along the entire length of the host pipe from structure to structure.

7. Insertion may proceed from either upstream or downstream.

8. A push ring that distributes forces around the perimeter of the liner pipe end shall be used to prevent damage to the liner pipe.

9. An environmentally safe lubricant, compatible with all pipe and grout materials, may be permitted with approval from Engineer or Wastewater Superintendent.

10. Block pipe in place as necessary to prevent flotation during grouting operations.

11. Care shall be taken to prevent jagged edges of the host pipe from damaging the liner pipe during insertion.

    a. If host pipe has a jagged invert, a guide rail method may be prepared and submitted to the Engineer for review and approval.

12. Thermal expansion/contraction effects shall be considered to ensure the ends of the liner pipe are flush with the existing manhole to within 1/2”.

13. Reasonable attempts shall be made to achieve a flush surface between the liner pipe and the host pipe.

C. Grout

1. Provide non-structural grout except in the following conditions where structural grout will be required:
    a. Where required by Engineer.
    b. Under buildings, tanks, and footings.

3.3 GROUT INJECTION

A. Notify Engineer and Wastewater Superintendent at least 24 hours in advance of grouting operations.
    1. Maintain bypass operations and prevent water from entering the annular space during grouting.

B. Grouting system shall have sufficient monitoring devices and tests to determine the effectiveness of the grouting and to ensure compliance with the liner pipe specifications and design parameters.

C. Mixers and Pumps
    1. The materials shall be mixed in equipment of sufficient size and capacity to provide the desired amount of grout material for the grouting operation.
    2. The system shall mix the grout to a homogeneous consistency and deliver grout to the injection point under a normal range of operating conditions.
    3. The equipment shall be capable of mixing the grout at densities required and shall also be capable of changing mixing parameters as dictated by field conditions at any time during the grouting operation.

D. Pressure Gauges
    1. Pressure gauges shall be suitable for use in the grouting environment.
        a. Working pressure shall be 1.5 to 2.0 times the design grout pressure.
        b. Accuracy shall be to within 0.5% of full range.
    2. Provide, at a minimum, 1 pressure gauge at the point of injection and 1 pressure gauge at the grout pump.

E. Install PVC grout injection and venting ports

F. After liner pipe installation, bulkheads shall be constructed in sequence from upstream to downstream at the end of each pipe segment.
    1. Construct bulkheads:
        a. A minimum of 24 hours after the completion of the slip lining process to allow for thermal equilibrium between the liner pipe and host pipe.
        b. At most 72 hours after completion of the slip lining process to minimize exposure to debris from a rainfall event.
    2. After bulkhead construction, fill the entire length of annular space between the liner pipe and host pipe with cementitious grout by injecting grout from one end of the pipe and allowing it to flow to the other end.

G. Remove and prevent standing or running water in annular spaces to maintain the correct water ratio of the grout mixture.

H. Limit pressure on the annular space to prevent damage to the liner pipe.

1. The gauged grout pressure shall not exceed the pipe manufacturer's recommendation or 5 psi, whichever is less.

2. Contractor shall be solely responsible for any damage or distortion to liner pipe due to grouting, regardless of pressure.

I. Drilling additional injection holes to facilitate grouting is prohibited.

J. Continue to inject grout until all the following conditions have been achieved:

1. The annular space is completely filled with grout, and

2. Grout installer recommends ceasing grouting operations.

K. No hardened grout is permitted in the liner pipe following grouting operations.

L. At completion of slip lining, the exposed ends of all pipes shall have a clean, finished look with no visible signs of grout vents, injection tubes, etc.

M. The bulkheads shall be hand-finished with a Portland cement based grout to an appearance that matches a Class "A" concrete surface.

N. UV End Treatment

1. Upon completion of installation, repair all damaged areas of the liner pipe's UV coating per manufacturer's recommendations.

3.4 TESTING AND ACCEPTANCE

A. General

1. Employ an independent testing agency to conduct and report compressive strength testing of the grout utilized in the construction.

2. Prepare and submit for testing 4 cellular concrete cylinders from each day's grouting activities.

a. Testing shall occur at 1 and 28 days.

B. Density

1. Measure grout density not less than 2 times per hour in the field during grout placement in accordance with ASTM C138.

C. Viscosity

1. Measure viscosity of the grout not less than 2 times per hour in the field during grout placement in accordance with ASTM C939.

2. The apparent viscosity shall not exceed 35 seconds unless otherwise approved by the Engineer and Wastewater Superintendent.

D. Compressive Strength

1. Collect, cure, test, and report samples in accordance with ASTM C942.

a. Contrary to ASTM C942, collect and test specimens based on the more restrictive of the following criteria:

1) 1 specimen for each grouting event for each pipe collected at approximately the mid-point of the grouting operation.

2) 1 specimen for each 500 cubic feet of grout placed for each pipe.

2. Test all specimens for compressive strength at 28 days.

E. Television Inspection

1. Provide the Wastewater Superintendent with video files on a USB storage device showing both pre- and post-installation conditions, including restored connections.

2. Correct all defects discovered during post-installation CCTV inspection.

3. Re-televise installation after identified defects are corrected.

4. The post-installation CCTV inspection video shall be submitted to the Engineer with sufficient time for review prior to substantial completion.

END OF SECTION 02536

SECTION 02537
PIPE BURSTING PIPE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following pipe bursting techniques or processes:

1. Pneumatic and Static Pipe Bursting
2. Pipe Splitting
3. Pipe Reaming

1.2 DEFINITIONS

A. Pipe Bursting – technique that fractures existing pipe into fragments so it can be replaced with a similar or larger sized pipe

B. Pipe Splitting – technique used on ductile iron pipe that splits the pipe so it can be replaced with a similar or larger sized pipe

C. Pipe Reaming – technique that uses the reaming process from horizontal directional drilling to remove pipe fragments so that the existing pipe can be replaced with a similar or larger sized pipe

D. CCTV – closed-circuit television

1.3 SUBMITTALS

A. Action Submittals

1. Product List
2. Product Data
   a. Manufacturer's data including statement that the material is suitable for use in a pipe bursting project, which may include scratching or gouging of the pipe a minimum 10% of the wall thickness.
3. Work plan, including:
   a. Detailed construction procedures and layout plans.
   b. Location, size, and construction method for service reconnections.
   c. Pipe installation and bedding details.
   d. Sewer bypass plans, methods, and equipment that will be utilized.
   e. Maintenance of traffic plan.
   f. Project schedule and sequence of construction.
   g. Contingency plan for unforeseen obstructions, surface heave or settlement, damage to adjacent utilities, and deviations from existing line or grade.

B. Informational Submittals

1. Qualification Data
   a. Similar projects list.

b. Certification of pipe bursting system training.

c. Certification of pipe fusion training.

2. Installer Certificates

C. Project Record Documents

1. Product data.

2. Field test reports.

3. CCTV pre-bursting and post-bursting videos and CCTV Inspection Reports.

4. Record Drawings

a. Include GPS coordinates of all manholes, accurate to within 3 feet.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Minimum 50,000 linear feet of successful installations with the same or higher project classification as defined by the International Pipe Bursting Association.

2. Certified by the pipe bursting system manufacturer. Pipe bursting system operator shall be fully trained in the use of the equipment.

3. HDPE pipe joining shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections.

B. Regulatory Requirements

1. Comply with all requirements of sewer utility owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products per manufacturer's recommendations.

1.6 PROJECT CONDITIONS

A. Limit activities on private property to existing easements. Restore surfaces and improvements to a condition equal to or better than existed prior to the work.

B. Coordinate activities with weather conditions and sewer flows. Where a temporary rise in flow due to wet weather makes work impossible, provide bypass pumping, move to a different location where work is possible, or delay work until high flows have subsided.

C. Do not enter manholes or sewers without the prior authorization of the Wastewater Superintendent.

PART 2 - PRODUCTS

2.1 MANHOLE REPAIR

A. Structural Repair Grout

1. Shall be designed to fill large voids in structure walls.

2. Shall consist of rapid setting cements, aggregates, and various accelerating agents.

3. Shall not contain chlorides, gypsum, or metallic particles.

4. Shall have a minimum compressive strength of 1,400 psi at 6 hours per ASTM C109.

5. Shall be Quadex Hyperform by Vortex Co., Strong-Seal QSR by The Strong Company, or approved equal.

B. Invert Repair Grout

1. Shall be quick-setting material designed to fill large voids and to repair or reconstruct inverts where no hydrostatic pressure exists.

2. Shall consist of rapid setting cements, aggregates, and various accelerating agents.

3. Shall not contain chlorides, gypsum, or metallic particles.

4. Shall have the following minimum physical properties:

a. Compressive strength per ASTM C109:

1) 1 hour: 4,000 psi

2) 24 hours: 7,000 psi

b. Flexural strength per ASTM C348:

1) 1 hour: 450 psi

2) 24 hours: 600 psi

c. Setting time per Gilmore ASTM C266:

1) Initial: 15-18 minutes

2) Final: 22-25 minutes

C. Pipe Penetration and Ring Sealer

1. Shall be a flexible, tough, rubbery hydrophilic foam gasket material that seals using a combination of mechanical and chemical bonds and compression. Sealer shall be NSF approved under Standard 61 for drinking water systems components.

2. Shall be AV-333 Injectaflex by Avanti, Hydro Active Sealfoam by De Neef Construction Chemicals Inc., Elastogel GT1100 by Specton Construction Products Ltd., or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All existing pipes shall be pre-cleaned and CCTV inspected prior to bursting. The location of all existing lateral connections shall be noted.

3.2 INSTALLATION

A. Notify customers with service connections to existing pipe prior to bursting operation.

B. Expose all interfering and crossing utilities by spot excavating at the intersection of the pipes and removing the soil from around the utility.

C. Locate and expose all service connections prior to pipe insertion to expedite reconnection.

D. Isolate flow so that pipe to be burst is not active.

E. Bursting unit shall generate sufficient force to burst and compact existing pipe.

F. Bursting unit shall have a shield to prevent collapse of the hole ahead of the new pipe.

G. Bursting unit shall be approved in writing by manufacturer for the application.

H. No heaving and/or settlement of adjacent ground shall be permitted upon completion. Repair any surface heaving.

I. Installation shall not impact adjacent utility lines near the replacement pipe. No bursting may be conducted within 30” of existing buried pipes or 8 feet of surface structures.

J. Use of bentonite is acceptable to reduce friction from soil or for long pipe runs.

K. Pipe insertion shall be continuous from insertion point to the receiving pit or structure. Allow 2” to 4” of new pipe to protrude into manholes or other structures for shortening.

L. Bed pipe at insertion and receiving pits and at service lateral reconnection pits. Backfill in accordance with open trench pipe installation requirements. Restore surface to condition equal to or better than existed prior to the excavation.

M. Allow the pipe to relax before reconnection of laterals. Relaxation period shall be no less than 4 hours.

N. Test pressure pipes according to applicable specifications.

O. Reinstate service through the pipe and re-establish service connections immediately after pipe relaxation and testing are complete.

P. Arrange for temporary bypass pumping or other method of flow control from beginning of pipe bursting operation until laterals are reinstated.

Q. Repair damage to connecting manholes.

1. Provide a ring sealer around each pipe insertion prior to grouting.
2. Utilize structural repair grout for manhole wall damage. Extend grout repair a minimum of 8” into manhole wall.
3. Utilize invert repair grout to repair damage to benches and channels.
4. Complete additional repairs as directed by Wastewater Superintendent.
5. Repair manholes to condition equal to or better than existed prior to work.

R. Complete post-bursting CCTV inspection of the replacement pipe and verify reconnection of all active service taps.

S. Repair any condition which negatively impacts the function of sewer mains or connected laterals, including groundwater infiltration, flat or reverse grade conditions, or out-of-roundness exceeding 10% of the pipe ID.

END OF SECTION 02537

SECTION 02539
TEMPORARY BYPASS PUMPING

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes the use of temporary pumping systems to divert existing sanitary flow around a work area, including:

1. Bypass Pumps.
2. Suction and Discharge Pipe.
3. Backup Power Generation.

1.2 DEFINITIONS (NOT USED)

1.3 SUBMITTALS

A. Action Submittals:

1. Submit at least 7 days in advance:
   a. Bypass Pumping Plan.
   b. Emergency Response Plan.

B. Informational Submittals

1. Product data for bypass pump equipment, back-up power source, and suction and discharge pipe.

1.4 QUALITY ASSURANCE (NOT USED)

1.5 SYSTEM REQUIREMENTS

A. Design Requirements

1. Provide calculations demonstrating that the selected bypass pumping system is capable of performing within the indicated requirements. Provide the following parameters:
   a. Peak flows to the bypass pumping system suction location.
   b. Capacity of the upstream sewer pipe and actual pipe slopes.
   c. Actual suction and discharge locations and elevations.
   d. Flow capacity of the system receiving discharges if different from the suction location.

B. Performance Requirements

1. Bypass pumping systems shall have sufficient capacity to pump the peak flows through the influent sewer.

1.6 PROJECT CONDITIONS

A. It is essential to the operation of the existing system being bypassed that no flow interruptions, no sewage backups, and no releases of waste to the environment occur throughout the duration of the work.

B. Access to manholes shall be provided by Wastewater Superintendent.

C. Flows may vary depending on time of day, day of the week, and weather. Operation of upstream lift stations may also affect flows. Rainfall, snow melt, and other meteorological events usually increase flows dramatically.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Protect the entire bypass system during setup and operation from vandalism and site conditions that might adversely affect system operation.

1. Protection for the bypass system pipes may include, but is not limited to, burial.
2. Protect pumps and generators with temporary fencing and lighting.

B. Maintain on site a sufficient number of valves, tees, elbows, connections, sewer plugs, pipe, repair bands and other parts to ensure immediate repair or modification of the system as required.

C. Maintain on site all tools needed for repair and maintenance of bypass system.

D. Contact Wastewater Superintendent immediately if a spill does occur.

E. Supervise the bypass pumping system at all times while operating.

1. Provide the services of a qualified bypass pumping company for setup, operation, repair, maintenance, transfer, emergency response, and removal if peak flow capacity of system being bypassed is 3,500 gpm or greater.

F. Maintain sewer flows around the work area in a manner that will not cause surcharging of sewers or damage to public and private property.

G. Lighting

1. Provide temporary lighting at bypass location adequate for the operation, control, and repair of equipment at night.

H. Emergency Alarms

1. Provide a monitoring and emergency alarm system at the bypass system suction location with automated alarm dialing to bypass system emergency response personnel.
2. Monitor and alarm the following conditions:
   a. High suction level.
   b. High pump discharge pressure.
   c. Low pump discharge pressure.
   d. Low fuel (for each diesel pump).
3. Provide automated notification of alarms to Wastewater Superintendent and bypass emergency response personnel.

a. Bypass emergency response personnel shall notify Wastewater Superintendent:

1) Upon arrival at bypass pumping system site.

2) Upon correction of problem that created the alarm condition.

3.2 SMALL SANITARY SEWER FLOWS

A. A registered sewage transport truck may be used to store and transport waste around a work area under the following circumstances:

1. Upstream sewers are dedicated sanitary sewers without storm flows.

2. Upstream sewers serve a small area without large commercial or industrial customers and anticipated peak volumes over a 4 hour period do not exceed truck capacity.

3. Elevation from the invert of the manhole being blocked is substantially lower than the lowest floor elevation of customers, allowing a minimum of 6 hours of peak flow storage capacity in the sewer.

4. Disposal location allows the transport truck to travel from the bypass site to the disposal site, dispose of sewage, and return within 1 hour.

5. Wastewater Superintendent provides written authorization.

B. Vacuum pump in sewage transport truck may be used to withdraw sewage where suction lift is within vacuum system capabilities and upon approval of Wastewater Superintendent.

1. Use bypass pumping system where vacuum pump will not function satisfactorily.

C. Provide standby sewage transport truck available within 1 hour in the event flow exceeds expectations or problems occur with primary sewage transport truck.

D. Continuously supervise storage location to monitor sewage depth.

E. Provide radio communications between storage location, sewage transport truck, and standby sewage transport truck.

3.3 EQUIPMENT

A. Bypass Pumps

1. Pumps shall be solids-handling (3” minimum), centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves, diaphragm pumps, or isolation valves in the priming system. Pumps shall not be submersible or diaphragm type.

a. Pumps may be electric or diesel powered.

b. Pumps must be constructed to allow dry running for extended periods to accommodate the cyclical nature of bypass flows.

c. Pumps shall be capable of providing a static suction lift without water in the volute.

d. Provide the necessary stop/start controls for each pump.

e. Each pump shall have check valves and discharge isolation valves.

f. Pumps connected to a common suction shall have a suction isolation valve.

g. Provide adequate standby equipment at bypass pumping site available and ready for immediate operation and use in the event of an emergency or breakdown.

1) One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

2) Primary and standby pumps shall be isolated by valves.

3) Keep standby pumps fueled and operational at all times.

4) Backup pumps shall be online.

2. Bypass pumping equipment shall have a maximum noise level of 70 dB at a distance of 50 feet.

B. Temporary discharge systems shall be constructed of rigid steel pipe and fittings with gasketed, restrained joints or butt-welded HDPE pipe and fittings. Valves shall be cast iron or ductile iron check and plug valves. All materials shall be suitable for contact with domestic sanitary sewage.

1. Under no circumstances will aluminum pipe or PVC pipe be allowed.

2. Bypass system shall be 100% watertight.

3. Discharge hoses will only be allowed in short sections not subject to traffic and with prior approval of the Engineer or Wastewater Superintendent.

4. Provide pipe, joints, and accessories designed to withstand at least 2 times the maximum system pressure, or 50 psi, whichever is greater.

5. Provide pipe protection capable of withstanding H-20 loading to protect pipe where traffic will drive over pipe system.

6. Provide a redundant discharge pipe of the same diameter as the largest discharge pipe where peak flows exceed 3,500 gpm, discharge pipes exceed 12” in diameter, or where 2 or more discharge pipes are proposed.

7. Provide headers to allow all pumps to discharge through any discharge pipe.

a. Each discharge pipe shall have an isolation valve at its connection with the header.

C. Backup Power Source

1. A backup power source shall be provided on site at all times during the operation of the bypass pump system.

2. In the event of a loss of power supply to the lighting or electric-powered bypass pump system, the backup power source shall be of size and power to continually operate the system at full capacity until power is restored.

3.4 BYPASS PUMPING SYSTEM AND EMERGENCY RESPONSE PLANS

A. Bypass Pumping Plan must include the following details:

1. Product data on pumps, pipe, valves, plugs, temporary lighting, and other equipment and manufactured products.

2. Schedule for installation, operation, and maintenance of bypass pumping system.

3. Calculations of peak bypass pumping flow rate requirements and downstream system capacity.

4. Scaled layout of pumps, suction and discharge pipe and valves, and backup power source.

5. Site layout indicating fencing, lighting, and access for operations, maintenance, and refueling.

6. Bypass pump sizes, capacity, number of each size to be onsite, and power requirements.

7. Bypass pump curves.

8. Graph of system curve plotted over pump curve, including residual and operating pressures of receiving pipe, when connecting to force mains.

9. Road crossing details.

10. Sewer plugging equipment and methods.

11. Where connecting to a force main, indicate connection details.

12. Where buried, provide sections showing suction and discharge pipe depth, embedment, and backfill.

13. Backup power generator capacity.

B. Emergency Response Plan

1. Prepare an Emergency Response Plan to be followed in the event of a flood, spill, or release of sanitary sewage.

2. Where bypass system is located within FEMA designated floodway, ditch, legal drain, or USGS designated stream, include response and alternate plan in event of a flood.

a. Include alternate suction and discharge locations if located within flood-prone area. Where not possible, provide fittings and connections adequate to prevent infiltration of flood waters into suction or discharge location.

b. Provide fittings, pipe, and connections to allow removal of the bypass system from the flood-prone area, relocation, and startup at alternate location with a maximum completion time of 2 hours from time of notification.

c. Provide sequence of transfer and transition from primary bypass pumping location to alternate bypass pumping location and back.

1) Provide maximum pumping capacity during transfer to and from alternate location.

3. Emergency Response Plan shall include lists of equipment, personnel, emergency personnel contact numbers, containment, and cleanup.

3.5 HYDROSTATIC PRESSURE TEST

A. Each bypass pumping system setup shall be hydrostatically tested using clean water prior to use.

B. Test

1. The bypass system shall be equipped with air release valves and filled at a rate which will not cause any surges or exceed the rate at which air can be released through the air valves.
2. Once the system has been filled and all air purged, the bypass system, excluding the pump(s), shall be pressurized and hydrostatically or pneumatically tested for a minimum of 30 minutes.
    a. Test pressure shall be 150% of the calculated working pressure, or 50 psi, whichever is greater.
    b. Pressure shall be measured at the lowest point along the alignment.
3. Visually inspect the entire system for leaks and monitor for pressure drop during the test.
4. Repair any leaks and repeat test until successful.
5. Water used for the test shall be discharged to the sanitary sewer system at a controlled rate to minimize surcharging of the collection system.

3.6 BYPASSING OPERATION

A. The bypass pipe shall be located off streets, sidewalks, and other public ways.
    1. Where bypass pipe crosses active lanes of streets, limit bypass pumping to nights and weekends with the approval of authorities having jurisdiction or bury pipe under roadway surface.
    2. Bypass pipes can cross under roadways and railroads through existing culverts provided the culverts have adequate capacity to pass a 2-year storm and will not create backups from a 50-year 24-hour storm event that could damage public or private property or create a safety hazard.
    3. Where bypass pipe crosses sidewalks, drives, alleys or other public ways, make provisions to permit normal pedestrian and vehicular traffic.

B. Bypass system to be installed longer than 5 working days shall be placed in trenches.
    1. Cover trenches in streets with temporary pavement or metal traffic covers.
    2. Remove pipe when bypass pumping is complete.

C. Check bypass pumping system, including suction level, pumps, discharge pipe, and receiving sewer level at intervals not to exceed 4 hours.
    1. Provide current inspection log at all times at the bypass pumping site for Wastewater Superintendent and Engineer to inspect.

D. When bypass operations are complete:
    1. Drain pipe into sanitary sewer prior to disassembly.
    2. Remove sewer plug in a manner that permits the flow to slowly return to normal without surge to prevent major disturbances downstream.

END OF SECTION 02539

SECTION 02541
SANITARY SEWER STRUCTURE REHABILITATION

PART 1 - GENERAL

1.1 SCOPE

A. This section includes rehabilitation and repair using cementitious materials of existing sanitary sewer manholes and structures.

1.2 DEFINITIONS

A. ANSI – American National Standards Institute

B. ASTM – American Society of Testing and Materials

C. NSF – National Sanitation Foundation

1.3 SUBMITTALS

A. Approval Submittals

1. Product data for each type of product indicated.

B. Informational Submittals

1. Contractor's Certifications.
2. Product and Material Certificates.
3. Laboratory test results.
   a. Compressive strength tests.
4. Material safety data sheets
5. Manufacturer's instructions.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Applicator shall be certified by manufacturer in the handling, mixing and application of products being used where such certifications are provided.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products per manufacturer's recommendations.

1.6 SCHEDULING

A. Coordinate structure rehabilitation with construction of adjacent sanitary sewer work.

1.7 ENVIRONMENTAL CONDITIONS

A. Do not apply materials under the following conditions:

1. Temperatures exceed the manufacturer's recommended maximum or minimum.
2. Dusty or smoke-laden atmosphere.
3. Above flowing water.

4. Other conditions considered unsatisfactory by the product manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall be compatible with substrate and with each other.

B. All materials, including additives, shall be approved by manufacturer for use together and in the application for which it is used.

2.2 HYDRAULIC REPAIR GROUT

A. Hydraulic grout shall be designed to be applied in dry powder form, with no prior mixing of water, directly to leaks under hydrostatic pressure in manholes or structures. Material may also be mixed with water per manufacturer's recommendations.

B. Shall consist of rapid setting cements, silicious aggregates, and various accelerating agents.

C. Shall not contain chlorides, gypsum, or metallic particles.

D. Characteristics:

1. Blend of hydraulic cements and fillers.
2. Compressive Strength per ASTM C109:
   a. 1 Day: 3,500 psi
   b. 7 Days: 4,900 psi
   c. 28 Days: 5,500 psi
3. Tensile Strength per ASTM C190
   a. 7 Days: 290 psi
   b. 28 Days: 575 psi
4. Working Time: 45 to 90 seconds at 77°F.
5. Dark gray in color.
6. Shall be Mainstay ML-10 by Madewell Products Corp. or approved equal.

2.3 STRUCTURAL REPAIR GROUT

1. Shall be designed to fill large voids in structure walls.
2. Shall consist of rapid setting cements, aggregates, and various accelerating agents.
3. Shall not contain chlorides, gypsum, or metallic particles.
4. Shall have a minimum compressive strength of 1,400 psi at 6 hours per ASTM C109.
5. Shall be Quadex Hyperform by Vortex Co., Strong-Seal QSR by The Strong Company, or approved equal.

2.4 INVERT REPAIR GROUT

A. Material

1. Invert repair grouts shall be quick-setting cementitious material designed to fill large voids and to repair or reconstruct inverts where no hydrostatic pressure exists.

2. Shall consist of rapid setting cements, aggregates, and various accelerating agents.

3. Shall not contain chlorides, gypsum, or metallic particles.

B. Minimum physical properties:

1. Compressive Strength per ASTM C109:

   a. 1 Hour: 4,000 psi

   b. 24 Hours: 7,000 psi

2. Flexural Strength per ASTM C348:

   a. 1 Hour: 450 psi

   b. 24 Hours: 600 psi

3. Setting Time per ASTM C266:

   a. Initial: 15-18 minutes

   b. Final: 22-25 minutes

2.5 PIPE PENETRATION AND RING SEALER

A. Shall be a flexible, tough, rubbery hydrophilic foam material that seals using a combination of mechanical and chemical bonds and compression. Sealer shall be NSF approved under Standard 61 for Drinking Water Systems Components.

B. Sealer shall be AV-333 Injectaflex by Avanti, Hydro Active Sealfoam by De Neef Construction Chemicals Inc., Elastogel GT100 by Specton Construction Products Ltd., or equal.

2.6 GROUT LINER

A. Low shrinkage, high strength, polymer modified, sprayable microsilica grout.

1. Composition: Blend of cements, microsilica, thermoplastic fibers, densifiers, polymer admixtures, and modifiers.

   a. Grout shall not contain calcium aluminate cements or aggregates.

2. Compressive Strength per ASTM C109:

   a. 2 Days: 3,875 psi

   b. 7 Days: 4,550 psi

   c. 14 Days: 5,640 psi

   d. 28 Days: 6,190 psi

3. Flexural Strength per ASTM C78:

a. 7 Days: 825 psi

b. 28 Days: 985 psi

4. Tensile Strength per ASTM C190:

a. 7 Days: 290 psi

b. 28 Days: 575 psi

5. Shall be Mainstay ML-72 Sprayable Microsilica Cement Mortar by Madewell Products Corp. or approved equal.

2.7 CORROSION BARRIER COATING

A. Materials for the lining of manholes shall be designed to withstand the effects of hydrogen sulfide in a wastewater environment.

B. Equipment for installing lining materials shall be per manufacturer's recommendations.

C. Lining system shall be a multi-component stress skin panel liner system similar to SpectraShield by Spectrum, Inc. or approved equal as described below:

1. Layering: Liner, moisture displacement barrier, moisture barrier, surfacer, final corrosion barrier.

D. Total thickness of multi-component stress panel liner shall be a minimum of 500 mils.

2.8 MANHOLE FRAME SEAL

A. Composition: 100% solids, flexible epoxy trowel-grade mastic

B. Thickness: Minimum of 1/4"

C. Approved corrosion barrier coating shall be Madewell 806 Flexible Epoxy by Madewell Products Corp. or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Determine condition of existing structure. Any damage not reported prior to the work must be replaced at no additional cost to the Town.

B. Work involves the application of grouts and liners on existing sanitary sewer structures.

C. Use only clean potable water for mixing of grouts. Maintain all mixing equipment in clean condition.

D. Do not apply grouts during freezing weather. Grouts shall not be placed when:

1. The ambient temperature is at or below 37° F and falling

2. When the temperature is anticipated to fall below 32° F during the 24 hours following grout application.

3. Other conditions exist where application is not recommended by manufacturer.

3.2 SURFACE PREPARATION

A. Examine surfaces to receive all grouts. Notify Engineer and Wastewater Superintendent in writing if surfaces are not acceptable. Do not begin surface preparation, repair, or application until unacceptable conditions have been corrected.

B. Surface Preparation

1. Prepare surfaces in accordance with manufacturer's instructions.
2. Cleaning equipment shall be capable of producing a minimum blast pressure of 3,500 psi at 4 gpm. Pressure shall be adjustable to provide for adequate cleaning and removal of unsound substrate without damage to the structure.
3. Remove deteriorated manhole steps prior to cleaning. Cut steps using a handsaw flush with the manhole wall.
4. Clean structure with a minimum of 1,500 psi water spray to remove contaminants, dirt, debris, and other foreign materials.
5. When grease and oil are present, use an approved detergent or muriatic acid integrally with the high pressure cleaning water. Provide hot water blasting where required to adequately clean the surface.
6. Remove roots and loose, unsound, and protruding brick, mortar, and concrete. All materials resulting from the cleaning of the structure shall be removed from the structure and sewers prior to application of the grouts.
7. Before application of each material, surfaces to be sprayed or coated will be inspected by Engineer. Correct defects or deficiencies identified by Engineer before application of subsequent material.

3.3 VOID AND LEAK REPAIR

A. Repair and fill dry voids greater than 2” in depth with structural repair grout. Apply patching material in accordance with manufacturer's instructions.

B. Active Leaks:

1. Stop active leaks with hydraulic repair grout. Apply material in accordance with manufacturer's instructions.
2. Chip out area of active leak to provide solid substrate of shape required for adherence of the hydraulic repair grout.
3. Install weep holes as required to localize infiltration during application of hydraulic grout.
4. Plug weep holes after application of the hydraulic grout material and before application of cementitious grout liner.
5. Severe Infiltration: Drill as required to pressure grout using a cementitious or chemical grout. Apply grout in accordance with manufacturer's instructions.

3.4 PIPE PENETRATION AND RING REPAIR

A. Seal large cracks and voids around pipe penetrations and rings using pipe penetration and ring sealer.

B. Clean void around pipe or between rings thoroughly. Apply pipe penetration and ring sealer in crack or void.

C. Use accelerator as necessary during cold weather or with cold groundwater.

3.5 INVERT REPAIR

A. Temporarily restrict flow in sewer with inflatable or mechanical plugs. Use care to prevent damage to property from backups. Provide bypass pumping as required.

B. Apply invert repair grout to voids in inverts and benches by hand or trowel. Form grout smooth in a manner to facilitate flow.

C. Remove plugs once grout has set.

3.6 GROUT LINER

A. Grout liner shall be installed on existing structures by brushing or low velocity spraying on the entire inside surface. The reconstruction process shall provide a monolithic liner capable of stopping infiltration. The grout liner shall extend from the top of the eccentric cone to the invert, including all penetrating pipe joints.

1. Apply after invert repair and pipe penetration and ring repair.

2. Apply before manhole frame sealer.

B. Give Engineer a minimum of 3 days advance notice of start of grout liner application.

C. Application of Liner Material

1. Apply grout liner material in accordance with manufacturer's instructions.

2. Equipment:

a. Apply grout liner material with equipment recommended by product manufacturer. Remote delivery systems shall not be used to apply grout liner.

b. Provide an air supply system for low velocity spray application.

c. Centrifugal Spin Cast Application: Material hose shall be coupled to a high speed rotating applicator device.

3. Do not apply grout liner to any other surfaces other than structure to be repaired.

4. Remove any excess material from sanitary sewer and dispose of properly.

5. Mixing:

a. Mix liner material with water per manufacturer's instructions.

b. Discharge prepared mix into hopper.

c. Continue mixing as liner material is continuously sprayed.

6. Ensure surface is clean and free of foreign material.

7. Ensure surface is damp and totally saturated with water without water droplets or running water just before application of liner material.

8. Spray apply grout liner material in 2 or more passes from bottom of wall to bottom of frame.

a. The base coat shall be applied to a nominal 1/8” thickness over the substrate. The surface is then rough troweled to fully set base coat. Spray shall fully penetrate joints, cracks or voids.

b. Final coat(s) shall achieve a minimum total thickness of 1/2”.

9. Finishing:

a. Trowel surface of sprayed liner material to relatively smooth finish. Initial troweling shall be in an upward motion to compress the material into voids and solidify structure wall. Do not over-trowel.

b. Apply brush finish to trowel finished surface.

10. Follow manufacturer's instructions whenever more than 24 hours have elapsed between applications.

D. Cure materials in accordance with manufacturer's instructions.

1. Install manhole cover within 20 minutes after troweling is complete to avoid moisture loss in the grouts due to sunlight and wind.

2. Concrete Curing Compound:

a. Apply concrete curing compound recommended by grout liner manufacturer if relative humidity is less than 70% within manhole.

b. Apply curing compound in accordance with manufacturer's instructions.

3. Allow the minimum cure time recommended by product manufacturer to elapse before subjecting manholes to flows. Provide bypass pumping as required.

3.7 CORROSION BARRIER COATING

A. Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, safety, and spray equipment.

B. Spray equipment shall be designed to accurately ratio and apply the liner system.

C. Application of multi-component liner system shall be in strict accordance with manufacturer s recommendation. Final installation shall be a minimum of 500 mils.

3.8 MANHOLE FRAME SEAL

A. Surface Preparation

1. Wire brush manhole frame to remove all loose rust and any restoration mortar or epoxy corrosion barrier coating overspray.

a. Surface shall be clean and dry before application of frame seal material.

B. Apply frame seal material to a minimum thickness of 1/4" to top 6” of eccentric cone, grade rings and manhole interior frame. Height of application depends on overall height of chimney, but minimum height shall be 4" (2" above and below joint).

1. Apply material with a putty knife to a uniform thickness and texture.

C. Allow frame seal material to cure at least 24 hours in load bearing applications.

1. Do not apply below 50° F.

2. Protect from freezing for at least 48 hours after application.

3.9 FIELD QUALITY CONTROL

A. Compressive Strength Test:

1. Applicability: Grout materials indicated for compressive strength test.
2. Cast four 2” cubes each day or from each pallet of grout material.
3. Package, label, and provide postage for cubes. Mail cubes to manufacturer or testing laboratory.
4. Independent test laboratory shall test cubes for compressive strength in accordance with ASTM C109.

B. Destructive Dry Film Thickness Tests, ASTM D 4138:

1. Applicability: Corrosion barrier coating.
2. Perform 1 test for every 500 square feet of surface lined. If the thickness is correct, no further testing is required for that area.
3. If the initial test does not indicate correct film thickness, an additional 4 measurements shall be made, the average of which must equal minimum specified thickness. Individual measurements may under run this amount by no more than 20%.
4. Any area not meeting the specified thickness as tested above shall receive additional corrosion barrier coating.
5. If the areas tested are of proper thickness, destructive test sites shall be repaired with the appropriate barrier at Contractor's expense prior to placing the system into service.

C. Spot Adhesion Testing for Grout Liner

1. Perform minimum of 1 uniaxial pull-off adhesion test for every 500 square feet of surface lined.
2. Remove and replace areas not meeting 28 day minimum adhesion requirement.
3. If the minimum pull-off adhesion requirement cannot be met by removing the upper 1/4" of the substrate, work shall not proceed until a course of action has been determined that produces the required adhesion results.

D. Visual and Electrical Inspection for Holidays

1. Applicability: Corrosion barrier coating.
2. Visual Holiday Inspection: Perform visual inspection for holidays. Mark areas identified for repair and reapplication of epoxy corrosion barrier coating.
3. Electrical Holiday Inspection: Perform spark testing in accordance with NACE RP 0188 or as recommended by the manufacturer. Mark areas identified for repair and reapplication of corrosion barrier coating.

E. Visually verify absence of leaks.

END OF SECTION 02541

SECTION 02545
SANITARY FORCE MAINS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Sanitary force mains installed by the open trench method.
2. Low pressure sanitary sewers installed by the open trench method.
3. Products for sanitary force mains installed by horizontal directional drilling, boring and jacking, or pipe bursting methods.
4. Valves, including air valves.

B. Related regulations include the following:

1. 327 IAC 3-6-9 for separation requirements with water mains and wells.

1.2 DEFINITIONS

A. Bedding Course – course placed over trench subgrade before laying pipe

B. HDD – Horizontal Directional Drilling

C. HDPE – high-density polyethylene plastic

D. Initial Backfill – backfill placed beside and over pipe in a trench

E. LPS – Low Pressure Sewer

F. PVC – polyvinyl chloride plastic

G. DI – ductile iron

H. CI – cast iron

1.3 SUBMITTALS

A. Action Submittals

1. Product data for each type of product indicated.
2. Shop Drawings
   a. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
   b. Dimension and detail pipe and fitting layouts for all exposed pipe and all pipe 24” or larger.
   c. Exposed pipe and fitting supports.

B. Informational Submittals

1. Coordination Drawings
   a. Show type, size, material, and elevation of all crossing utilities.
   b. Detail support systems for existing utilities.
   c. Detail temporary or permanent existing utility relocations.

2. Calculations

   a. Thrust and longitudinal tensile stress calculations due to thermal expansion and contraction for HDPE pipe restraint for pipe-to-structure connections and connections to pipes of dissimilar material.

3. Manufacturer Certificates

4. Product and Material Certificates

   a. Pipe.

   b. Valves.

   c. Fittings.

5. Schedule of Tests and Inspections

6. Field Test Reports

   a. Pressure and leakage tests.

7. Manufacturers' Instructions

   a. Pipe installation.

   b. Valve installation.

8. Product Warranties

C. Project Record Documents

1. Product Data

   a. Valves of all types.

2. Field test reports

3. Manufacturer's operations and maintenance literature

   a. Air valves.

4. Record Drawings

1.4 QUALITY ASSURANCE

A. Qualifications

1. Pipe, fitting, and valve manufacturer's quality control system shall be ISO 9001 registered or provide the services of an Independent Inspection Agency. Pipe materials shall bear label and stamp of testing agency.

2. Concrete Valve Vaults

   a. Concrete Testing Agency

      1) Not less than 3 years experience in performing concrete tests of type specified in this specification section.

      2) Capable of performing testing in accordance with ASTM E329.

   b. Allowable Tolerances

      1) Length and width of precast units measured at face adjacent to mold shall be the following:

a) Units 10 feet or under: ± 1/8".

b) Units 10 to 20 feet: + 1/8", - 3/16".

c) Units over 20 feet: + 1/8", - 1/4".

2) Thickness of units shall be + 1/4", - 1/8".

3) Units shall not be out of square more than 1/8" per 6 feet or 1/4" total.

B. Regulatory Requirements

1. Comply with standards of authorities having jurisdiction for sewer service pipe, including materials, installation, and testing.

2. Comply with requirements of IDEM and EPA regarding wastewater facilities and service.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manhole components, pipe, gaskets, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle pipe and structures according to manufacturer's written instructions.

D. Do not skid or roll products on or against other products.

E. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.

F. Do not allow gaskets to come in contact with petroleum products.

1.6 PROJECT CONDITIONS

A. Do not interrupt sewer service or sewer flow unless permitted under the following conditions, and only after providing temporary sewer service:

1. Notify Engineer and Wastewater Superintendent no fewer than 2 days in advance of proposed service interruption.

2. Do not proceed with interruption of sewer service without Wastewater Superintendent’s written permission.

3. Comply with requirements of Town Wastewater Department in providing temporary sewer service.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe and fitting sizes and all references to pipe diameter are intended to be nominal.

B. Special Applications and Material Limitations

1. PVC and HDPE force main pipe shall only be used in buried locations.

2.2 SANITARY FORCE MAINS

A. PVC Force Mains

1. PVC Pipe
    a. Pipe and fittings shall be colored green for identification as wastewater pipe.
    b. Pipe shall meet ASTM D1784.
    c. PVC pipe shall be used only in buried service.
    d. Pipe sizes less than 4” shall conform to ASTM D2241, DR 18.
    e. Pipe sizes 4” to 12” shall conform to AWWA C900, DR 18 or DR 14.
    f. Pipe sizes above 12” shall conform to AWWA C905, DR 21 or DR 18.
2. Pipe Joints
    a. Open Trench or Boring and Jacking Installation
        1) Joints shall be push-on flexible gasket compression-type conforming to ASTM F477.
        2) Joint performance shall be in accordance with ASTM D3139 under both pressure and 22” Hg vacuum.
        3) Joints connecting to dissimilar pipe or fitting types shall be in accordance with manufacturer’s recommendations.
        4) Field-adaptable restraint shall have a working pressure equal to at least the pipe’s working pressure.
        5) No solvent cement joints shall be allowed.
    b. HDD Installation
        1) Restrained boltless flexible type conforming to ASTM F477 with performance in accordance with ASTM D3139.
        2) Do not use joints with bulky glands or flanges that may prevent smooth flow of the drilling fluid over the joint.
        3) Do not use joints that restrain movement by means of teeth, elements in or around the gaskets, or other similar friction or pipe-gripping methods.
        4) Joints shall be UL and FM approved for continuous use at rated pressure in HDD applications.
        5) Joints shall be specified by pipe manufacturer for use in HDD applications.
3. Fittings and fitting joints shall be DI meeting the requirements of AWWA C110, standard pattern or AWWA C153, compact pattern.
    a. Mechanical joints in accordance with AWWA C110 and AWWA C111.
    b. Push-on type joint conforming to AWWA C111.
    c. Manufactured restrained joints under conditions indicated by manufacturer.
    d. Field-adaptable restraint shall have a working pressure equal to at least the pipe’s working pressure rating.

B. Ductile Iron Force Mains

1. Ductile Iron Pipe

   a. Pipe shall conform to AWWA C151.

   b. Pressure class in conformance with AWWA C150:

      1) Pipe sizes through 12” shall be 350 psi pressure class.

      2) Pipe sizes greater than 12” shall be 250 psi pressure class.

2. Open Trench or Boring and Jacking Installation

   a. Mechanical joints in accordance with AWWA C110 and AWWA C111.

   b. Push-on type joint conforming to AWWA C111.

   c. Gaskets meeting AWWA C111.

   d. Manufactured restrained joints under conditions indicated by manufacturer.

   e. Field-adaptable restraint shall have a working pressure equal to at least the pipe’s working pressure rating.

3. HDD Installation

   a. Pipe Joints

      1) Restrained boltless flexible type.

      2) Do not use joints with bulky glands or flanges that may prevent smooth flow of the drilling fluid over the joint.

      3) Pipe joints shall be specified by pipe manufacturer for use in horizontal directional drilling applications.

   b. Fitting Joints

   c. Fitting joints shall be field-adaptable restraints and shall have a working pressure equal to at least the pipe’s working pressure rating.

4. Exposed Service

   a. Threaded flanges, gaskets, and flange fittings in conformance with AWWA C115.

   b. ASME B16.5, Class 150 for other flanges, gaskets, and flange fittings.

   c. Flange Backup Rings

      1) Flange backup rings shall be of the type and pressure rating as the pipe.

      2) Ductile iron backup rings shall be of the convolutant type, fabricated from ductile iron per ASTM A536, grade range 60/40/18 to 65/45/12. Ductile iron flange backup ring bolting dimension shall conform to ASME B16.5 Class 150.

      3) Backup rings shall be finished and cast with flash removed from all edges and bolt holes to the specified dimensions. Finish shall be epoxy coated with bitumastic 300M high build coal tar epoxy in

accordance manufacturer's recommendations or as noted on the plans.

5. Coatings

   a. Interior seal-coated cement mortar lining shall meet the requirements of AWWA C104.

   b. Exterior coating shall meet the requirements of AWWA C151.

   c. Interior and exterior coatings shall be provided for all pipe and fittings

   d. Exterior coatings shall be provided for all adapters.

6. Encasement

   a. Polyethylene encasement shall conform to AWWA C105.

   b. Shall be green in color.

7. Fittings shall be DI meeting the requirements of AWWA C110, standard pattern or AWWA C153, compact pattern.

   a. Special fittings not included in applicable AWWA specifications shall be reviewed on a case-by-case basis.

      1) Manufacturer shall legibly mark specials in accordance with the laying schedule and marking diagram.

C. HDPE Force Mains

1. HDPE Pipe

   a. HDPE pipe shall meet ASTM D3350 and ASTM F714.

   b. Shall be SDR 11 for all pipe sizes.

   c. Pressure class shall be Class 160

   d. HDPE shall be used only in buried service. Pipe shall be green-striped or green in color.

2. Joints

   a. Fusion butt-welded.

3. Fittings

   a. Manufactured in accordance with standard design pressure classes, dimensions, and temperature ranges specified for HDPE pipe.

   b. Same manufacturer and materials as the pipe.

   c. Do not use tapping sleeves for main-to-main connections.

   d. Fittings shall not be field fabricated.

   e. Stiffeners shall be provided by fitting manufacturer and acceptable to pipe manufacturer.

2.3 WARNING TAPE

A. General

1. Warning tape shall be made of inert materials, resistant to alkalis, acids, and other destructive agents found in soil.
2. Warning tape shall have a minimum thickness of 4 mils.
3. Warning tape width shall be a minimum of 3” and a maximum of 6”.
4. Imprint shall repeat a minimum of once every 2 feet of tape length.
5. Warning tape shall be aluminum-backed or have a foil core detectable by a cable locator.

B. Material

1. Warning tape shall be imprinted with “CAUTION – SANITARY SEWER BURIED BELOW” or similar wording.
2. Tape shall be green in color or green striped with black printed lettering.

C. Warning tape shall be Terra Tape Sentry Line by Reef Industries, Inc., or approved equal.

2.4 TRACER WIRE

A. Tracer wire shall be 21% conductivity annealed copper-clad high carbon steel high strength tracer wire.

B. Insulation shall be HDPE complying with ASTM D1248, 30 volt rating.

C. Composite conductivity shall be 21% IACS (International Annealed Copper Standard).

D. Minimum physical characteristics:

1. AWG: 10
2. Insulation thickness: 0.030”
3. Breaking load: 1,000 lb

E. Connectors shall be from manufacturer’s packaged kit, consisting of insulating spring-type connector or crimped joint and epoxy resin moisture seal, suitable for burial.

2.5 TRACER WIRE BOXES

A. General

1. Cylindrical construction with removal round lid.
2. Support flange at the base at least 1/2” wide.
   a. If box is designed for use with integral valve support, flange may be omitted.
3. Telescoping design with upper and lower tubes overlapping 3” when the box is extended to its maximum length.
4. Magnetized to amplify tracer signal.
   a. A magnet shall be securely attached on the upper inside of the box or encapsulated within the lid.

B. Material

1. Box material shall be high grade ABS or equivalent rigid plastic that meets ASTM D1788, Type 1.

2. Lid material shall be cast iron or ductile iron, with tensile strength or ductility meeting ASTM A126-B.

C. Box Lid

1. Colored green for wastewater per APWA standards.

2. Lock with a tamper-resistant pentagon locking nut.

3. Internal corrosion-resistant brass wire lug for tracer wire connection, and a wax pad to block out moisture at the wire connection.

D. Tracer wire boxes shall be Snakepit Lite Duty Access Point by Copperhead Industries in unpaved areas, Snakepit Roadway Access Point by Copperhead Industries in paved areas, or approved equal.

2.6 PLUG VALVES

A. Plug valves shall be resilient-seated eccentric conforming to MSS SP-108.

1. Mechanical joints shall conform to AWWA C111.

2. Flanges conforming to ANSI B16.1, Class 125 or ANSI B16.5, Class 150.

3. Body shall be cast iron or ductile iron.

4. Pressure Rating

a. 3” – 12” Valves: 175 psig minimum.

b. 14” – 72” Valves: 150 psig minimum.

5. Seat material shall be as recommended by manufacturer for wastewater service.

2.7 AIR VALVES

A. Air Release Valves and Combination Air Valves

1. Connections

a. Valves shall have full size NPT inlets equal to nominal valve size.

b. All valves shall have additional NPT connections for backwash accessories, gauges, testing, and draining.

c. Valves shall be connected to force main with single or double-strap tapping sleeve designed for use with potable water connections for same type of pipe.

d. Full flow ball-type shut-off valve of same size as valve inlet shall be provided.

2. Body and Seat

a. Valve body shall be corrosion resistant reinforced nylon or stainless steel construction.

b. Valve seat shall provide drop tight shut-off to the full pressure rating.

3. Backwash accessories, including shut-off valve, quick-connect couplings, and flexible extension hose, shall be provided by manufacturer.

4. Valve shall have a corrosion resistant operating mechanism allowing the valve to fully open under full operating pressure.

5. Valve shall be rated for a maximum working pressure of at least 150 psi.

6. Wastewater combination air valves shall be the following as manufactured by ARI, or approved equal:

   a. D-025 for force mains with diameter 4” or less.

   b. D-025L for force mains with diameter 6” to 12”.

   c. D-26 for force mains with diameter larger than 12”.

B. Air Valve Vaults

1. Precast reinforced-concrete vault designed for A-16 load designation according to ASTM C857 and constructed according to ASTM C858.

2. Frame and cover shall be 1022 by East Jordan Iron Works, or approved equal.

2.8 SHUT-OFF VALVES

A. Shut-off valves 3” and larger:

1. Ball type with ductile iron body per ASTM A395.

2. Valve stem and ball shall be chrome plated carbon steel.

3. Seat shall be PTFE.

4. Provide lever handle for operation.

5. Victaulic Series 726 or approved equal.

B. Shut-off valves 2-1/2” and smaller:

1. Ball type with ductile iron body per ASTM A536.

2. Type 316 stainless steel ball and stem.

3. Seat shall be TFE.

4. Provide lever handle for operation.

5. Victaulic Series 721 standard port ball valve or approved equal.

2.9 TAPPING AND LINE STOP SLEEVES

A. PVC and Ductile Iron Force Main Sleeves

1. Sleeves for branches up to 12” in size:

   a. 304 stainless steel or equivalent.

   b. Provide a 360 degree seal around the pipe.

   c. ANSI/NSF Standard 61 Certified.

   d. Body construction:

      1) Outlet Half (load bearing half):

         a) Outlet sizes 2" - 8”: 12 gauge stainless steel

         b) Outlet sizes > 8”: 10 gauge stainless steel

      2) Back Half (conforming half): 14 gauge stainless steel

   e. Length:

1) Outlet Size Length

2”-6”	15"
8”	21"
10”	27"
12”	30"

f. Outlet construction: Schedule 10 stainless steel pipe

g. Sized to accept cutter with an AWWA C207 Class D, ANSI 150 lb. drilling flange, corrosion resistant coating and recessed for tapping valve.

h. Bolting lugs

1) Pass-through bolt design to avoid alignment problems and allow tightening from either side of the pipe.

2) Triangular design with a maximum 3" bolt center spacing.

3) Not integrally welded to the sleeve.

i. Bolts, nuts, and washers shall be 304 stainless steel. The bolts shall be track head type with permanently lubricated heavy hex nuts and stainless washers.

j. The full circumferential gasket shall be molded of synthetic rubber compounded for use with water and sewage. The gasket shall have a gridded surface, be a full 1/4" thick with 304 stainless steel bridge plates molded flush into the gasket with a raised hydromechanical outlet seal to protect against line surges and water hammer.

k. The sleeves shall be rated at 150 psi hydrostatic with a test pressure of 200 psi on pipe with a full circumferential break.

2. Sleeves for branches larger than 12” in size:

a. Fabricated A-36 steel, 18-8 stainless steel, or equivalent.

b. Bolts and nuts shall be high strength, low alloy steel, ASTM A242 or AWWA C111.

c. Gasket shall be SBR ASTM D2000 BA508, 180°F maximum operating temperature.

d. Flange shall be AWWA C207 Class D ANSI 150# drilling, recessed to accept standard tapping valve.

e. Finish

1) A-36 Steel: Fusion bonded epoxy.

2) Stainless Steel: Fully passivated to ASTM A380.

f. Rated for a pressure at least equal to 150% of actual operating pressure.

3. Completion Plugs and Covers

a. Completion Plug: DI per ASTM A536.

b. Cover plate for A36 steel: Fusion bonded epoxy.

c. O-Rings and Gaskets: Molded of synthetic rubber compounded for use with water and sewage.

4. Line Stop Expandable Stoppers

a. Recommended by manufacturer for use with type and material of pipe.

b. Rated at or above operating pressure in main.

B. HDPE Tapping Saddles

1. Service saddles shall be designed for use with HDPE pipe.

2. Saddles shall utilize wide double stainless steel straps or be of full-circumference stainless steel sleeve design. Strap saddles shall have a ductile iron body coated with a fusion epoxy or nylon coating.

3. Gasket shall be a broad pressure activated design bonded into a cavity in the saddle body or have spring-tensioning to accommodate pipe thermal expansion.

4. Straps, bolts, nuts and washers shall be Type 304 stainless steel with all welds passivated for corrosion resistance.

2.10 TAPPING VALVES

A. Description

1. Resilient seated type, cast iron body.

2. Epoxy coated per AWWA C550.

3. Comply with AWWA C509 or AWWA C515 and designed for use specifically as tapping valves.

B. Rating

1. Rated at zero leakage at 250 psi water working pressure and have a 400 psi hydrostatic test for structural soundness.

C. End Configurations

1. Tapping sleeve side: ANSI B16.1 flanged end with centering ring.

2. Outlet side: Mechanical joint with accessories per AWWA C111.

2.11 VALVE ACCESSORIES AND SPECIALTIES

A. Comply with AWWA M44 for cast iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering “SEWAGE” and bottom section with base that fits over valve and with a barrel approximately 5” in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Operators, unless indicated otherwise:

1. Buried Service: 2” AWWA Operating Nut.

2. Exposed Service to 6’-6” above finished floor: Lever.

3. Exposed Service above 6’-6” above finished floor: As directed by Engineer.

C. Stems shall be non-rising unless indicated otherwise.

2.12 MISCELLANEOUS PIPE FITTINGS

A. Ductile Iron Rigid Expansion Joints

1. Three piece ductile iron assembly consisting of telescoping sleeve with gaskets and restrained-type DI bell-and-spigot end sections.
2. Comply with AWWA C110 or AWWA C153.
3. Include AWWA C111 ductile iron glands, rubber gaskets, and steel bolts.
4. Pressure rating 250 psig minimum.

B. Ductile Iron Flexible Expansion Joints

1. Compound ductile iron fitting with combination of flanged and mechanical joint ends complying with AWWA C110 or AWWA C153.
2. Include two gasketed ball joint sections and one or more gasketed sleeve sections.
3. Include AWWA C111, ductile iron glands, rubber gaskets, and steel bolts.
4. Pressure rating 250 psig minimum.

C. Longitudinal Restraint Fittings

1. Applicability: HDPE pipe 6” and larger in size.
2. Longitudinal restraint shall be flexible HDPE saddles designed for attachment to HDPE pipe using the electrofusion method.
   a. Manufactured of pre-blended virgin resin with a PPI listing of PE3408 and in compliance with ASTM D1248 and ASTM D3350.
   b. Minimum axial resistance rating of 7,000 lb-ft per saddle.

2.13 PIPE SPECIALTIES

A. Transition Fittings: Manufactured fitting same size as pipe to be joined. Pressure rating at least equal to and ends compatible with pipe to be joined.

B. Tubular Sleeve Pipe Couplings:

1. Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, and end rings, ends of same sizes as pipe to be joined.
   a. Standard: AWWA C219.
   b. Center-Sleeve Material: Ductile iron.
   c. Joint: Mechanical joint.
   d. Gasket Material: Natural or synthetic rubber.
   e. Pressure Rating: 200 psig minimum.
   f. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Connect force mains per Town standards.

1. HDPE Pipe Connections

a. Provide longitudinal restraint designed to withstand thermal expansion and contraction of pipe at all connections to structures and pipe of dissimilar materials.

b. Use stiffeners approved by pipe manufacturer for at all mechanical connections except flange adapters.

1) Install flange adapters according to pipe and adapter manufacturer's recommendations.

B. Install ductile iron pipe and fittings according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.

C. Install PE pipe and fittings according to the following:

1. ASTM D2774 and ASTM F645.

2. Handbook of Polyethylene Pipe.

3. AWWA M55.

D. Install PVC pipe and fittings according to ASTM F645 and AWWA M23.

E. Sanitary force mains shall be laid at least 10 feet horizontally from any existing or proposed water main, measured edge to edge. Notify Engineer if this separation cannot be met.

F. Sanitary force mains crossing water mains shall be laid so that 18" of vertical clear space remain between the force main and water main. Notify Engineer if this separation cannot be met.

3.2 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Ductile Iron Pipe Gasketed Joints: AWWA C600 and AWWA M41.

2. PE Pipe: ASTM D2774 and ASTM F645.

3. PVC Pipe Gasketed Joints: Use materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.

4. Dissimilar Materials Pipe Joints: Use adapters compatible with both pipe materials, with OD, and with system working pressure.

3.3 ANCHORAGE INSTALLATION

A. General

1. Install underground pipe with restrained joints at horizontal and vertical changes in direction.

2. Install anchorages for tees, plugs and caps, bends, crosses, and valves.

3. Anchorages and restrained-joint types that may be used include:

a. PVC Pipe

1) Field-adaptable restraint systems.

b. DI Pipe

1) Locking mechanical joints.

2) Bolted flanged joints.

3) Field-adaptable restraint systems.

c. HDPE

1) Heat-fused joints.

B. Include anchorages for the following pipe systems:

1. Gasketed-Joint, Ductile Iron Force Main Pipe: per AWWA C600.

2. Gasketed-Joint, PVC Force Main Pipe: per AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.4 VALVE INSTALLATION

A. Plug valves shall comply with AWWA C600 and AWWA M44. Install each plug valve with stem pointing up. Install valve box for all buried applications.

3.5 AIR VALVE INSTALLATION

A. Install in a vertical position with the inlet facing downwards.

B. Install at all high points where indicated with exact location determined at time of construction.

C. Maintain a continuous positive grade of the pipe to the air valve location and a continuous negative grade of the pipe away from the air valve to avoid high spots in the lines between the valves.

1. Pipe shall be installed to a grade necessitating only the number of valves indicated.

D. No air valves and vaults shall be placed in areas subject to vehicular traffic without prior written approval of Engineer and Wastewater Superintendent.

E. Depth of force main shall be adjusted downwards as necessary to provide adequate clearance between top of valve vault with top of valve and fittings.

3.6 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C891.

B. Elevation of valve vault and grading around the vault shall provide for positive runoff away from the vault.

3.7 FLUSHING CONNECTIONS

A. Install every 400 feet and at dead ends on LPS mains, and where two LPS mains come together.

3.8 INSTALLATION OF WARNING TAPE

A. Warning tape shall be installed over all buried non-metallic pipe in accordance with manufacturer's installation instructions.

B. Warning tape shall be installed 12" above the pipe centerline unless noted otherwise on plans.

3.9 INSTALLATION OF TRACER WIRE

A. Provide two tracer wires on the crown of all pipes and tubing.

B. Wires shall be installed along the pipe and securely fastened by two full wraps of duct tape at no more than 20 foot intervals.

C. Terminate tracer wires above ground at each at-grade or above-ground structure and at intervals of no more than 400 feet.

1. Bring tracer wires to grade through a tracer wire box where no structures exist.

2. Do not terminate tracer wires within limits of waterways.

D. Individually test each tracer wire strand after installation. At least one of the two tracer wires shall provide continuous transmission of tracing signal along the full pipe length.

3.10 PAINTING

A. Paint all exposed pipe and valves.

3.11 FIELD QUALITY CONTROL

A. Hydrostatic Tests

1. Provide all equipment for testing and conduct tests in presence of Engineer.

2. Test all new force mains, valves, and air valves.

a. Test pressure shall be at least 1.5 times the working pressure at the point of testing, or 50 psig, whichever is greater.

b. Test each valved section separately.

c. Install necessary test ports and blow-offs using service saddles and corporation stops.

d. Prior to tests, slowly fill pipe with potable water, then flush to expel air.

3. Fill pipeline with potable water and apply test pressure 24 hours before testing.

4. Conduct hydrostatic tests for 2 hours to 6 hours.

5. Follow AWWA C600 for DI pipe and AWWA C605 for PVC pipe.

6. Do not exceed pipe and/or thrust resistant design pressures during test.

7. Do not vary pressure by more than ± 5 psi for the duration of the test.

B. Pressure Test

1. Apply pressure with a hydrostatic test pump designed specifically for the purpose. Pump system shall include accurate pressure gauge measuring outlet pressure.

2. Examine exposed pipe, fittings, valves, and joints during the test.

3. Correct visible leaks or defects discovered during the pressure test. Repeat the test until no defects are identified.

4. At the conclusion of the pressure test, cap the corporation stop outlets.

C. Leakage Test

1. After the completion of the pressure test, conduct a leakage test to determine the quantity of water lost by leakage under the specified test pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled.

2. Leakage shall not be measured by a drop in pressure over time.

3. No ductile iron pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = SD * P/133{,}200$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in psi

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

$$L = ND * P/7{,}400$$

Where:

L = allowable leakage, in gallons per hour

N = number of joints in length tested

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in psi

5. Acceptance

a. Acceptance shall be determined based on allowable leakage. If any test indicates leakage greater than that specified, the Contractor shall at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

b. All visible leaks are to be repaired regardless of calculated leakage.

c. If a tested section contains sections of various diameters, allowable leakage will be the sum of the computed leakage for each size.

D. Prepare and submit reports of testing activities to Engineer.

END OF SECTION 02545

SECTION 11310
SUBMERSIBLE LIFT STATION

PART 1 - GENERAL

1.1 SCOPE

A. This section includes submersible lift station structures and equipment, including:

1. Wet wells and valve vaults.
2. Pumps.
3. Guide rails and pump removal components.
4. Site Pipe and Valves.
5. Pump control system.
6. Alarm dialer.
7. Control panel.

1.2 DEFINITIONS

A. AFBMA – Anti-Friction Bearing Manufacturers Association

B. NEC – National Electric Code

C. FM – Factory Mutual

D. ANSI - American National Standards Institute.

E. ASTM - American Society for Testing & Materials.

F. HI - Hydraulic Institute.

G. NEMA - National Electric Manufacturer's Association

H. NFPA – National Fire Protection Association

I. UL – Underwriters Laboratories

1.3 SUBMITTALS

A. Product Data:

1. Control system products.
2. Pump and motor data, including:
   a. Size, type, design, and model.
   b. Performance characteristics.
   c. Materials of construction.
3. Guide rails and pump removal system components.
4. Alarm dialer.
5. Valves.
6. Manufactured steps and ladders.

B. Shop Drawings

1. Wet well and valve vault construction, including:

a. Dimensioned drawings of precast concrete components, including details of reinforcing steel.

b. Calculations indicating compliance with standards and specifications, sealed by an engineer registered in the location of the project.

2. Dimensioned pipe, structure, and valve layouts.

3. Electrical control panels.

C. Manufacturer Test Reports

1. Manufacturer's factory test results on pumps.

2. UL certification for control panel.

3. Test reports of compressive strength test on precast concrete components.

4. Schedule of Tests and Inspections

5. Manufacturer's instructions.

6. Product warranties.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Pumps shall be manufactured and tested in accordance with the applicable requirements of the Hydraulic Institute and ASTM/ANSI standards.

2. All pump and control equipment shall be an integral package supplied by a single pump manufacturer.

3. Pump manufacturer shall have a local certified repair company capable of providing on-site emergency service within 24-hours of notice.

4. Valves, gear actuators, and motor operators shall comply with AWWA or ASTM standards.

5. Control panel manufacturer shall be certified by Underwriters Laboratories (UL) as being a UL 508 and UL 698A listed systems panel manufacturer certified to install a serialized label for quality control and insurance liability considerations.

B. Regulatory Requirements

1. Motors and electrical controls shall meet all applicable requirements of the National Electrical Code and state and local regulations.

2. Comply with standards of authorities having jurisdiction for sewer-service pipe, including materials, installation, and testing.

3. Comply with requirements of IDEM and EPA regarding wastewater facilities and service.

1.5 WARRANTY

A. Pump manufacturer shall warrant the pumps being supplied against defects in workmanship and materials for a period of 5 years under normal use, operation, and service. Manufacturer shall replace parts which shall become defective through normal use and wear on a progressive schedule of cost for a period of 5 years, including mechanical seal, impeller, pump housing,

wear ring, and ball bearings. Warranty shall not start until the equipment has been placed in operation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection

1. Environmentally sensitive equipment shall be protected against injury or corrosion due to environmental conditions or physical damage.
2. Contractor shall not store submersible pump units in the wet well.
3. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.
4. Concrete Structures
   a. Protect concrete units from dirt and damage during transportation and handling.
   b. Store units off the ground.
   c. Place stored units so that identification marks are discernible.
5. Promptly remove damaged products from the site. Replace damaged products with undamaged products.

1.7 SCHEDULING

A. Ensure completion and acceptance of upstream and downstream facilities prior to testing and commissioning.

PART 2 - PRODUCTS

2.1 OPERATING CONDITIONS

A. Furnish a complete submersible lift station consisting of submersible non-clog sewage pumps, motors, pipe, valves, concrete wet well, electrical controls, guide system, and other appurtenances as specified in this section and as shown on the drawings.

2.2 ACCEPTABLE PUMPING SYSTEMS

A. Pumps 10 HP and larger: as manufactured by KSB, Inc. or approved equal.

B. Pumps less than 10 HP: as manufactured by Pentair/Myers or approved equal.

2.3 PUMPS, GENERAL

A. Pumps shall be capable of handling raw, unscreened sewage and 3” diameter spherical solids.

B. Pumps shall automatically and firmly be connected to the discharge pipe when lowered into place on its mating discharge connection, which shall be permanently installed in the wet well.

C. Pumps shall be easily removable for inspection or service, requiring no nuts, bolts, or other fastenings to be disconnected. There shall be no need for personnel to enter the wet well for inspection or service.

2.4 PUMP CONSTRUCTION

A. All major parts of each pump shall be gray cast iron, Class 30, with smooth surface devoid of irregularities.

B. All pump surfaces that will come in contact with sewage shall be protected by a sewage-resistant coating.

C. All exposed nuts and bolts shall be 304 stainless steel.

D. Wear ring shall consist of stationary ring of nitrile rubber molded with a steel ring insert drive-fitted to the volute inlet, and rotating 304 stainless steel ring drive-fitted to the impeller eye.

E. Impeller shall be gray cast iron, non-clogging design capable of handling solids, fibrous material, heavy sludge, and other matter found in normal sewage applications.

F. Impeller shall be dynamically balanced.

G. Volute shall be of a single piece design and have smooth fluid passages large enough to pass any size solid which can pass through the impeller.

H. Pumps shall be capable of operation for 24 hours in a dry condition without damage to the pump motor or mechanical seal.

I. Pump shaft shall be ANSI 420 stainless steel.

J. All mating surfaces of major parts shall be machined and fitted with nitrile o-rings where watertight sealing is required.

K. Internal thermal sensors shall be required on each pump motor. The thermal sensors shall show and/or sound an alarm and automatically shut down the pump before motor damage occurs.

L. Moisture sensing probes shall be installed in the mechanical seal cavity of each pump unit. These probes shall send a signal to the panel mounted alarm device and shut down the pump immediately upon sensing the intrusion of pumped liquid into the seal cavity.

2.5 PUMP REMOVAL SYSTEM

A. The guide rail system for pump removal shall be provided by the pump manufacturer for the pump model provided.

B. Base and Discharge Elbow

1. Each lift-out system shall consist of a cast or ductile iron discharge base, cast or ductile iron pump carrier and sealing plate, steel pump guide plate, and cast iron elbow. All exposed nuts, bolts, and fasteners shall be 300 series stainless steel.

2. Discharge elbow shall be of the size indicated and integral to the base assembly.

3. A sealing plate shall be threaded or bolted to the pump. A simple downward sliding motion of the pump and guide plate on the guide rails shall cause the unit to be automatically connected and sealed to the base.

C. Seal

1. The open face of the sealing plate shall have a dove-tailed groove machined into the face to hold an “O”-ring seal or bellows seal.

D. Guide Rails

1. Two rail pipes shall be used to guide the pump to the discharge base connection.

2. The guide rails shall be firmly attached to the access hatch frame.

3. The guide rails shall be 2" Schedule 40 galvanized steel pipe.

4. The weight of the pump shall bear solely on the discharge base and not on the guide rails.

5. Rail systems which require the pump to be supported by legs which might interfere with the flow of solids into the pump suction will not be considered equal.

6. Systems deeper than 12 feet shall use an intermediate guide for each 12 feet of wet well depth.

E. Lifting Chain

1. An adequate length of stainless steel lifting chain shall be supplied for removing each pump.

2. The chain shall be connected to the pump or discharge flange as recommended by the pump manufacturer and also connected near the access hatch above the pumps to allow easy accessibility to the chain.

3. The chain shall provide at least 4:1 safety factor in strength.

2.6 LEVEL CONTROL SENSORS

A. Submersible Pressure Transducer

1. Pumps shall be controlled by a submersible pressure transducer.

2. Isolated diaphragm sensor design specifically manufactured for use in hostile fluids and gasses.

3. Silicon pressure cell sensor with integral, compliant stainless steel barrier diaphragm.

4. Sensor assembly case shall be rugged 316 SS with variety of pressure inputs as well as electrical output connections.

5. Static accuracy of +/- 1% FSO BFSL.

6. Certified intrinsically safe for hazardous locations.

7. Datalogger compatible.

8. Fully temperature compensated.

B. Float Switches

1. Backup control of pump on, off, lag, and alarm levels shall be by float switches.

2. Switches shall consist of a mercury tube switch sealed in a corrosion-resistant polypropylene housing with minimum 18 gauge, 2 wire, SJOW/A jacketed cable.

3. Float switches shall be suspended from a bracket so that adjustment or replacement may be done without the use of any tools.

C. Cable shall be of sufficient length to reach the control panel with no splices.

D. Level controls shall be UL/CSA listed.

2.7 PUMP CONTROL PANEL

A. Control panel shall be Arc Armor by Primex or approved equal.

B. Control panel shall be one freestanding enclosure consisting of four different compartments within one footprint:

1. Service Compartment: NEMA Type 3R rated compartment housing the main service power components.

2. MCC Compartment: NEMA Type 3R rated compartment housing the motor starter components.

3. Control Compartment: NEMA Type 4X rated compartment housing all controls associated with the panel.

   a. Maximum voltage in the Control Compartment shall be 120 VAC.

4. Skirt Compartment: Non-rated, vented compartment housing conduits from the wet well.

C. All compartments shall be fabricated as one complete unit with singular common separation walls resulting in one complete enclosure. Exterior and interior finish of the panel shall be 3-4 mil minimum polyester powder coat finish.

D. Control panel enclosure shall be Type 304 stainless steel, with a minimum thickness of 14 gauge. Interior wall construction shall be one sheet of Type 304L stainless steel. Double walls are not acceptable.

E. All penetrations through compartments shall be performed to maintain the NEMA ratings of each individual compartment.

   1. All conduit entries into the enclosure from the wet well shall be sealed to prevent moisture and vapors from entering the enclosure.

F. Exterior door handles shall be die-cast aluminum alloy powder coated black. Door handles shall be fully lockable and NEMA rated to maintain the rating of the associated compartment. Door hinges shall be continuous Type 304L stainless steel piano type hinges finished with white powder coating.

G. Mechanical door stops shall be mounted at the bottom of the Control Compartment and MCC Compartment doors to secure the doors in the open position.

H. A gray thermoplastic data pocket is to be mounted on the door of the MCC Compartment.

I. Two lifting eyebolt rings, each rated for the entire weight of the panel, shall be installed on top of the panel and enter into the MCC Compartment. Eyebolt rings shall have gaskets to prevent water entry to the MCC Compartment. Eyebolt rings shall be high tensile strength steel finished with a white powder coating.

J. A drip cap shall be installed as one continuous sheet of stainless steel covering the entire top of the enclosure. The drip cap shall be minimum 14 gauge stainless steel finished with a white powder coating.

K. Control Compartment shall have a dead front inner door constructed of 1/8” aluminum with a piano type hinge to mount controller, indicator, and switches.

L. The interior of the enclosure shall be provided with properly sized corrosion inhibitors.

M. The back panel shall be a minimum of 1/8" aluminum mounted to the enclosure by 3/8” studs and nuts.

N. A thermostat and heater shall be provided for each exterior control panel to prevent condensation and freezing.

O. A surge suppressor shall be provided in the control panel to protect all connected electrical equipment.

P. Panel shall include override relay, terminal blocks, 2 ground lugs, and all necessary wiring and brackets.

Q. All internal wiring shall be neat and color coded. Each wire shall be a different color or stripe (except for ground), and all incoming wires shall terminate into a box clamp type terminal block (except incoming power). A schematic diagram showing wire color shall be permanently fastened to the inside of the enclosure.

R. Circuit breakers shall be provided for each pump and for the control circuit.

S. A control transformer with primary fusing shall be provided for the control circuits where 120V power supply is not available.

T. For all control panels provided 3-phase power, socket-type power phase monitor shall shut down the control circuit and protect the 3-phase equipment upon loss of phase, phase imbalance, or phase reversal.

U. A weatherproof flashing alarm light with a red bulb shall be mounted on the outside of exterior control panels. A weatherproof audible alarm horn shall be mounted on the outside of exterior control panels. Horn shall be rated at 103 dB minimum.

V. A 20A weatherproof 120V GFI convenience outlet shall be located on the outside of the control panel.

W. The control panel shall be UL listed as an assembly and shall bear the UL label certifying that the system meets all UL requirements, including UL 508 and UL 698A.

X. A mounting package shall be furnished to mount the control panel. All necessary hardware to mount the control panel shall be stainless steel.

Y. Controllers mounted on top of the wet well shall be in accordance with NFPA 820.

Z. Explosion-proof conduit sealing fittings or Intrinsically Safe Relays (ISRs) shall be used at all locations necessary to meet IEC and local requirements. Conduit seal fittings shall be ductile iron. ISRs shall be UL and FM approved and designed to interface devices in hazardous locations with equipment in non-hazardous locations. The ISR shall operate from 120VAC and accept a minimum of 2 inputs from a hazardous area.

2.8 PUMP CONTROLS

A. The pump controls shall be mounted on an internal panel face and be capable of controlling the pumping system.

B. Pump Controls

1. HOA Switches - Each pump shall be controlled by a hand-off-auto switch.

2. Digital Pump Controller

a. Shall be Energy View by Primex or approved equal.

b. Digital readout and a keypad for entering operational settings.

c. Capable of accepting a pressure input of 0 to 35 feet, a current input of 4 to 20mA, or a voltage input of 0 to 10 volt (field selectable) that will function with any type of level transmitter.

d. Control adjustments shall be accomplished by direct digital inputs (potentiometers or other analog adjustments shall not be acceptable).

e. Allows for programming changes and complete level simulation from the front of the control plate without codes or special keypad sequences.

f. LED indicators shall be lighted and identify the function to be changed as the operator steps through the programming mode.

g. One 4 to 20 mA analog output.

h. Digital outputs from the controller shall be normally open relay contacts rated for 120 vac.

i. One RS485 serial port capable of operating with standard Modbus protocols.

C. Pump Control Sequence

1. Lead pump shall be started in Auto mode by the "On" level sensor.

2. Lag pump shall be started in the "Auto" mode by the "Lag" level sensor.

3. Alarm light shall be activated by "Alarm" level sensor.

4. All pumps shall be turned off by the "Off" level sensor. Pumps may continue to be operated in "Hand" position with the level below the "Off" level sensor.

D. Control Lights and Switches

1. Control lights on the inside panel shall be provided for the following conditions:

a. Pump run (green) for each pump.

b. Moisture in pump (amber) for each pump.

c. Power on (red) for control panel.

2. Switches or buttons will be provided on the inside panel for:

a. alarm test (pushbutton).

b. alarm reset (pushbutton).

c. test lights (pushbutton).

3. No control lights shall be provided on the panel exterior.

E. Motor Starters

1. Combination Starters – For pumps less than 25 HP, unless indicated otherwise, provide IEC rated Full Voltage Non Reversing (FVNR) starters.

2. Soft-Start Starters – Where otherwise indicated and for pumps over 25 HP, provide Reduced Voltage Solid State (RVSS) starters. Starters shall be equipped with isolation and bypass contactors. IEC rated contactors are allowed.

F. Alarm Dialer

1. Shall be Pump Watch Express by Primex or approved equal.

2. Alarm Conditions.

a. Low Level

b. High Level

c. Pump 1 Seal Fail

d. Pump 1 Overload Trip & Over Temperature

e. Pump 2 Seal Fail

f. Pump 2 Overload Trip & Over temperature

g. Power Failure.

3. Provide local telephone service to dialer. Coordinate account and phone number programming with Wastewater Superintendent.

G. A solid state alternator relay shall be provided to automatically alternate pumps between lead and lag operation after each run.

H. Provide motor winding heat sensor circuit from each pump equipped with heat sensor. Circuit shall disconnect the starter upon high temperature signal and automatically reset when condition is corrected.

I. Provide seal failure alarm circuit from each pump equipped with seal failure sensor. Seal failure alarm shall energize panel alarm light but not disconnect the starter.

J. Time-Delay Relays:

1. Relays shall be of the plug-in socket design.

2. Operate on 24 or 120VAC, as applicable for the controls design, and shall have DPDT contacts rated at 10A minimum.

3. Have a red LED for output contact status.

4. Be on-delay or off-delay as required.

5. Delay the start of the lag pump upon restoration of power after outage.

K. Nameplates and Identification

1. Provide screw-in type, engraved nameplates or laser-screened laminated mylar identification labels for all controls, disconnects, indicators, and lights on outer or inner panel doors.

2. Provide laser-screened laminated mylar identification labels for major components inside panel such as circuit breakers, motor starters, and transformers

3. Provide permanent printed labels or legible permanent marker identification for relays, fuses, phase monitors, surge arrestors, and any other minor equipment within panel.

4. All control wiring shall be numbered on each termination.

L. Surge Protection

1. Provide Category C-1 surge suppressor where the largest downstream motor is 10 horsepower or less, Category C-2 for motors to 25 HP, and C-3 for motors are larger than 25 HP.

2. Surge suppressor shall be designed for use at service entrance.

M. Acceptable Manufacturers:

1. Motor starters and control components: Allen Bradley, Danfoss Inc. (MCD3000 series)

2. Circuit breakers and motor circuit protectors: Square “D”

3. Level sensor: Amertek (model 575), Danfoss Inc. (Danfoss Preslev)

4. Beacon light: Federal Signal (Fireball 2)

5. Alternator: Furnas

2.9 PRECAST CONCRETE WET WELL AND VALVE VAULT

A. Contractor shall furnish and install a monolithic concrete or precast manhole type wet well as indicated on the drawings. Pumps and related equipment shall be installed or mounted as shown.

B. A concrete valve vault shall be furnished and installed to house the valves and appurtenances.

C. All bases, barrels, and tops for wet wells and valve vaults shall be precast reinforced concrete capable of withstanding external pressures including live surface loads, soil pressures and groundwater elevations to the finished grade in combination with internal pressures due to variable liquid elevations from empty to the top of the structure.

D. Material

1. All precast concrete structures shall be watertight and of durable materials not subject to decay or excessive corrosion.

2. Minimum compressive strength for all concrete shall be 4,000 psi at 28 days.

3. Reinforcing steel shall meet ASTM A615 with a yield strength of 60,000 psi.

4. Design of concrete structures shall meet specification ACI 350, AASHTO load factor design method including an HS20 loading, ASTM C890, ASTM C857, and ASTM C478, as applicable.

5. Manufacturing of precast reinforced sections shall conform to ASTM C478. Sections at depths greater than 12 feet shall be reinforced with two cages of reinforcement as is required for Class III reinforced concrete sewer pipe of same diameter per ASTM C76.

6. Joints shall have tongue and groove O-ring seals, butyl joint sealer, and exterior joint collar meeting requirements of WM-9 and ASTM C443.

7. Handling or lifting lugs shall be provided for ease of unloading and placement.

8. Pipe connections through all precast concrete walls for all but ductile iron pipe shall be flexible connectors meeting ASTM C923.

9. Pipe connections through all precast concrete walls for ductile iron pipe shall be flexible connectors meeting ASTM C923 or modular seals designed for precast concrete structure pipe penetrations, similar to Link-Seal Model S-316.

10. External joint wrap shall comply with ASTM C877.

11. Joint wrap shall be External Joint Wrap by Cretex Specialty Products, or approved equal.

2.10 SITE PIPE AND FITTINGS

A. Pipe

1. Pipe shall be ductile iron conforming to AWWA C151.

2. Pressure class shall be 350 psi pressure class in conformance with AWWA C150:

B. Joints

1. Exposed Service

a. Threaded flanges, gaskets, and flange fittings in conformance with AWWA C115.

b. ASME B16.5, Class 150, DI or ASME 16.1, Class 125, CI for other flanges, gaskets, and flange fittings.

c. Flange Backup Rings

1) Flange backup rings shall be of the type and pressure rating as the pipe.

2) Ductile iron backup rings shall be of the convolutant type, fabricated from ductile iron per ASTM A536, grade range 60/40/18 to 65/45/12. Ductile iron flange backup ring bolting dimension shall conform to ASME B16.5 Class 150.

3) Backup rings shall be finished and cast with flash removed from all edges and bolt holes to the specified dimensions. Finish shall be epoxy coated with bitumastic 300M high build coal tar epoxy in accordance manufacturer's recommendations or as noted on the plans.

2. Buried Service

a. Mechanical joints in accordance with AWWA C110 and AWWA C111.

b. Push-on type joint conforming to AWWA C111.

c. Gaskets meeting AWWA C111.

d. Manufactured restrained joints under conditions indicated by manufacturer.

e. Field-adaptable restraint shall have a working pressure equal to at least the pipe's working pressure rating and shall be Megalug 1100 as manufactured by EBAA Iron, Uni-Flange Series 1400 (16" or less) by Ford Meter Box Company, or equal.

C. Coatings

1. Interior seal-coated cement mortar lining shall meet the requirements of AWWA C104.

2. Exterior coating shall meet the requirements of AWWA C151.

3. Interior and exterior coatings shall be provided for all pipe and fittings

4. Exterior coatings shall be provided for all adapters.

D. Encasement

1. Buried Service: Polyethylene encasement shall conform to AWWA C105.

2. Exposed Service: None.

E. Fittings

1. DI meeting the requirements of AWWA C110, standard pattern or AWWA C153, compact pattern.

2. Specials

a. Special fittings not included in applicable AWWA specifications shall be reviewed on a case-by-case basis.

b. Manufacturer shall legibly mark specials in accordance with the laying schedule and marking diagram.

F. DI expansion couplings shall be provided in all underground pipe extending between structures and at the transition to the force main.

G. Pipe shall be supported independently of the pump flanges and shall not bear on the concrete structures at penetrations.

2.11 FLOW METERS

A. Flow meters, where required, shall be Magflux by MJK or approved equal.

B. Meter inaccuracy shall be no more than 0.5% of actual flow rate for all flows above 1 foot per second.

C. Flow meter shall be suitable for operation at ambient temperatures from 40°F to 140°F.

D. Flow meter and transmitter shall be rated for accidental submergence.

E. Flow meters shall indicate, totalize, and transmit flow in full pipes.

2.12 PLUG VALVES

A. Plug valves shall be resilient-seated eccentric.

1. Standard: MSS SP-108.
2. Connections, as applicable:
   a. Mechanical-joints: conform to AWWA C111.
   b. Flanges: conform to ANSI B16.1, Class 125 or ANSI B16.5, Class 150.
3. Body: Cast iron or ductile iron.
4. Pressure Rating
   a. 3” – 12” Valves: 175-psig minimum.
   b. 14” – 72” Valves: 150 psig minimum.
5. Seat Material: As recommended by manufacturer for sewage service.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "SEWAGE" and bottom section with base that fits over valve and with a barrel approximately 5” in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Operators, unless indicated otherwise:

1. Buried Service: 2” AWWA Operating Nut.
2. Exposed Service to 6’-6” above finished floor: Lever.
3. Exposed Service above 6’-6” above finished floor: As directed by Engineer.

D. Stems: Non-rising unless indicated otherwise.

2.13 CHECK VALVES

A. General

1. Check valves shall be swing checks of the rubber flapper type conforming to AWWA C508. Check valves shall have an external adjustable weighted lever and a flexing, sprung, internally steel reinforced flapper of Buna-N with an o-ring seating edge and be designed for 175 psi working pressure.

B. Cushioned Swing Check Valves

1. Application: Cushioned swing check valves shall be used in applications greater than 120’ TDH or where indicated on the Drawings.

2. Cushioned swing check valves shall have an air cushioning cylinder assembly externally attached to the side of the valve body to eliminate valve slamming.

2.14 GATE VALVES

A. General

1. Gate valves 4” and larger shall be ductile iron body, non-rising stem gate valves meeting the requirements of AWWA C500 or C509 and shall have mechanical joint ends.

2. Exposed bolts and nuts shall be stainless steel.

3. Joint accessories shall meet AWWA C110.

4. Valve opening direction shall be counter-clockwise.

5. Gate valves shall be as manufactured by Waterous, U.S. Valve, or equal.

2.15 POWER SUPPLY AND DISTRIBUTION

A. Provide underground or overhead power supply to power meter according to directions of power company.

B. Provide mounting panels for power supply and control panels as shown on drawings.

C. Provide disconnects, grounds, conduit, fuse and breaker boxes, wiring, and other electrical power distribution components as provided in the contract documents and as required by electrical codes.

2.16 VENTS

A. Vents shall be PVC.

B. Vent shall exit the wet well and turn down toward the ground at sufficient height to allow for installation of the vent scrubber.

C. Provide odor control vent scrubber attached to the vent pipe on the exterior of the wet well with tightened thumb screws.

1. Vent scrubber shall be sized appropriately to slide properly over the vent stack and allow for tightening.

2. Vent scrubber shall be Peacemaker Odor Control Vent Scrubber by Syneco Systems, or approved equal.

2.17 STRAIN RELIEF GRIPS

A. All pump power and sensor cables shall be fitted with stainless steel Kellem type strain relief grips.

B. Cable restraints shall support the cables from the top of the wet well.

C. Strain relief grips shall be attached by stainless steel hooks with snap clips.

2.18 NAMEPLATES

A. Each piece of mechanical equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. A second identical nameplate shall be provided for all submersible pumps and affixed to the interior of the control panel.

2.19 SPECIALTY TOOLS

A. Furnish with each different type, kind, or size of pumping unit, 2 sets of any special tools, gauges, and fixtures required to operate, maintain, or repair the pump.

B. Tools shall be suitably marked high-grade items.

PART 3 - EXECUTION

3.1 WET WELL AND VALVE VAULT INSTALLATION

A. Granular material shall be placed and graded to be flat and level in the bottom of the excavation prior to installation. Material type and depth shall be according to manufacturer's instructions, but depth shall not be less than 6".

B. All joints shall be sealed watertight with butyl rubber sealant according to precast concrete manufacturer's direction.

C. Install external joint collar on all wet well and valve vault joints.

D. Coat exterior surface below grade with a two part bituminous epoxy or approved equivalent. Coat interior surface where indicated.

E. Test wet well in accordance with ASTM C1244.

3.2 POWER SUPPLY

A. Coordinate with local power company to provide necessary power to the site.

B. Coordinate with Town and power company for location of power poles, guy wires, power lines, easements, and location of electric meter.

C. Install power poles, guys, weatherheads, meter bases, service entrances, grounds, and other power supply items required by power company for service.

D. Provide required power from electric meter to all electrical components and systems.

3.3 PUMP INSTALLATION

A. All pumps and pumping equipment shall be installed per the manufacturer's recommendations.

B. During pump installation, the open power cable ends are to be suspended above the maximum flood elevation or maximum expected water level. If not installed in this manner, Contractor may be required to replace the pump motors and cables with new units to ensure that water has not penetrated the cable and entered the motor housing.

C. The discharge elbow of each pump shall be securely anchored to the wet well base and properly aligned with the guide system and upper guide bracket.

3.4 TESTING

A. Pumps will be tested after installation using clean water. Tests shall include:

1. Pumping draw-down test to confirm pump output meets or exceeds design.
2. Test controls for proper function.
3. Amp test to confirm power draw within equipment limits.

B. Each pump shall be fully tested in accordance with manufacturer's written instructions.

3.5 CONTROLS AND POWER DISTRIBUTION

A. Control wiring and pump power wiring shall be installed in separate conduits from the wet well to the control panel. Seal conduits watertight on both ends.

B. Control panel shall be mounted at the location indicated on the drawings.

3.6 VALVES

A. Locate and orient exposed valves to allow valve to be readily operated without operator binding. Operating levers or wheels on valves should be horizontal (operating stem vertical) with adequate space to fully open and close the valve. Check valve swing arms should be capable of freely operating without binding or touching other components.

B. Orient buried valves, valve box, actuator, and other components to allow valve to be readily operated. Operating nuts should be vertical and centered in the valve box.

C. Valve boxes shall be carefully installed over each buried valve (except combination valves) and supported in a manner that will not allow surface loads to be transmitted to the valve or pipe. Care shall be taken to see that the bottom of the box is clear and free of debris, rocks, etc., which will interfere with the operation of the valve stem.

3.7 FIELD PAINTING

A. Field paint all new equipment, exposed pipe, valves, and fittings, submerged and exposed structural steel, exposed electrical conduits, miscellaneous metal items including galvanized steel, and aluminum surfaces in direct contact with concrete.

B. Do not field paint stainless steel, fiberglass, aluminum, grating, or items with special coatings.

C. Shop coats of paint or other protective coatings damaged in transit or during construction shall be touched up in the field with primer coat before start of finish coats.

D. Colors of paint where not specified shall be as selected by the Town.

3.8 FIELD QUALITY CONTROL

A. Testing, General

1. Test new wet wells, controls, pumping, and pipe systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
2. Inspect and test completed pipe systems.
3. Schedule inspections and tests with Town representative and Engineer with at least 48 hours' advance notice.
4. Submit separate report for each test.
5. Any visible leaks, evidence of leaks, or malfunctioning or improperly functioning equipment or controls shall result in a failed test.
6. Failures of inspections or tests indicate defects that must be repaired or replaced.
7. Replace failed work using new materials, and repeat testing until test results are within allowances specified.

B. Cleaning

1. Conduct standard cleaning prior to acceptance testing.

C. Wet Well Exfiltration Test

1. Applicability

   a. All new wet wells shall be tested by a water exfiltration test.

   b. Test after:

      1) Installation with all pipe connections in place.

      2) Installation of all electrical conduits and other penetrations to the wet well structure.

      3) Plugging of all lift holes.

      4) Installation of drop connections.

      5) Backfilling to design grade.

      6) Groundwater has been lowered to below the bottom of the wet well.

      7) Curing of any coating or lining applied to the interior of the wet well.

   c. Test before:

      1) Installation of pumps, electrical power and controls wiring, and other electrical and mechanical systems.

2. Procedure

   a. Seal all inlets and outlets with watertight plugs or bulkheads. The wet well vent shall be screened, capped, flanged, or otherwise blocked.

   b. Fill the wet well with water until the elevation of the water is above the interface of the concrete and the hatch frame. Clearly mark the test level in the wet well.

   c. Fill and maintain full of water for a period of at least 24 hours prior to the start of the test to allow for absorption of water by the concrete.

   d. Prior to initiation of the test, raise the water level to the test level mark.

   e. Conduct the test a minimum of 24 hours. Once the test begins, the hatch shall only be opened in the presence of Engineer.

   f. At the end of the test period, refill the wet well to the test level, measuring the volume of water added.

3. Determination of Wet Well Acceptance: If the volume of water required to refill the wet well to the initial test level is less than or equal to the following volumes, the wet well shall have passed the test.

   a. The maximum leakage allowance for unlined wet wells shall be 0.05% of the water volume per 24 hours.

   b. No leakage shall be allowed for lined wet wells.

4. Determination of Wet Well Failure: If the volume of water required to refill the wet well to the initial test level is more than the acceptable volumes, the wet well shall have failed the test.

5. Correction

   a. If the wet well fails this test, locate defects and notify Engineer of findings. Repair or replace defects in a manner acceptable to Engineer.

D. Pump and Controls Tests

1. All new lift station pumps and controls shall be tested.

2. Test after:

   a. Installation of all electrical and mechanical systems have been completely installed, with all connections in place.

3. Backfilling to design grade.

   a. Completion and acceptance of force main(s) discharging from lift station.

   b. Manufacturer's successful start-up of all mechanical, electrical, and controls systems.

      1) Submit manufacturer's start-up records with request for testing.

4. Procedure

   a. Provide the following pump test equipment and materials:

      1) Clean water to conduct test

      2) Amp/volt meter

      3) Stop watch

      4) Tape or level rod to measure float settings

      5) Pressure gauge to measure operating head, calibrated in feet of water from 0 to 100 feet (or next higher normal gauge range if pump shut-off head is higher) in 1 foot increments.

      6) A connection for the pressure gauge on the tee or cross in the valve vault. Equip the gauge stem connection with a gauge cock or miniature ball valve to close the connection after testing is complete. The connection shall be left in place and shall be suitable for use as an air bleed off.

   b. Conduct the following in the presence of Engineer and Town representative:

      1) Manually check floats' on/off operations, alarm/run lights, and alarm horns.

      2) Check performance of control switches, alternators, and gauges.

      3) Confirm proper functioning of the SCADA or remote monitoring system.

      4) Determine pump capacity for each pump individually and all pumps operating simultaneously.

         a) Determine inflow rate (if any).

         b) Perform full-cycle pump-down test of each pump. Check amperage draw of each leg of each pump motor.

         c) Perform full-cycle pump-down test of all pumps. Check voltage at motor power cable connections.

         d) Determine each pump's capacity with force main full.

         e) Plot performance of each pump on pump curves.

5. If all pumps and controls function as designed and intended, the pumps and controls shall have passed the test. Otherwise, the pumps and controls shall have failed the test.

6. If the pumps and controls fail this test, locate defects and notify Engineer of findings. Repair or replace defects in a manner acceptable to Engineer.

END OF SECTION 11310

SECTION 16415
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes automatic transfer switches rated 600 V and less.

1.2 DEFINITIONS

A. ATS – Automatic Transfer Switch.

1.3 SUBMITTALS

A. Shop drawings and product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists.

B. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.

C. Single-line diagrams of transfer switch units showing connections between ATS, power source, and load, plus interlocking provisions.

D. Operation and maintenance data for each product. Include all features and operating sequences. List all factory settings of relays and provide relay setting and calibration instructions.

E. Manufacturer's certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the project.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70 for components and installation.

B. Manufacturer Qualifications

1. Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than 8 hours from time of notification.

2. ISO 9001 or 9002 certified.

C. The transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:

1. NEMA ICS 1 - Industrial Control and Systems: General Requirements.

2. NEMA ICS 10 – AC Transfer Switch Equipment.

3. NFPA 70.

4. NFPA 110 – Emergency and Standby Power Systems.

5. UL 1008 unless requirements of these specifications are more stringent.

6. UL 991 - Tests for Safety-Related Controls Employing Solid-State Devices.

7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

8. IEC 801-2, 3, 4, and 5

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ATS shall be manufactured by Cummins or approved equal.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30% of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings adequate for duty imposed by protective devices at installation locations in project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be +/- 2% or better over an operating temperature range of -20 to +70 °C.

D. Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical operation shall be by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switches shall be designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch action shall be double throw, mechanically held in both directions.

3. Contacts shall be silver or silver alloy for load-current switching. ATS units rated 225 A and higher shall have separate arcing contacts.

G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

H. Equip switches exposed to outdoor temperatures and humidity with an internal heater. Provide thermostat within enclosure to control heater.

I. Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Train and bundle factory wiring and label consistent with shop drawings, either by color-code or numbered/lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Equip control wiring with lugs suitable for connection to terminal strips.

K. Enclosures

1. General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508 where installed within motor control center. Paint with manufacturer's standard light gray ANSI 61 paint.

2. NEMA 4 stainless steel, non-painted where installed within an environmentally controlled structure.

3. NEMA 4X stainless steel, non-painted where installed in locations exposed to weather.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Double-throw switching arrangement, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

D. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the 2 sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70% or more of nominal voltage.

E. Automatic Transfer Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from 0 to 6 seconds, and factory set for 1 second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer switch normal- and emergency-source sensing circuits.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: 2 normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240 V AC.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: 1 isolated and normally closed, and 1 isolated and normally open, rated 10 A at 32 V DC minimum.

11. Engine Shutdown Contacts: Time delay adjustable from 0 to 5 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    b. Push-button programming control with digital display of settings.

    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment to ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost if necessary to accommodate required wiring.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   1. Check for electrical continuity of circuits and for short circuits.

   2. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

E. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least 3 times.

   1. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

   2. Simulate loss of phase-to-ground voltage for each phase of normal source.

   3. Verify time-delay settings.

   4. Verify pickup and dropout voltages by data readout or inspection of control settings.

   5. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

   6. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

F. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   1. Verify grounding connections and locations and ratings of sensors.

G. Coordinate tests with tests of generator and run them concurrently.

H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

I. Remove and replace malfunctioning units and retest as specified above.

J. Perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of project completion.

2. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Coordinate this training with that for generator equipment.

END OF SECTION 16415

SECTION 16620
PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 SCOPE

A. This section includes packaged diesel-engine generator sets with the following features and accessories:

1. Dual wall fuel tank.
2. Engine-generator set.
3. Muffler.
4. Exhaust pipe external to set.
5. Outdoor enclosure.
6. Remote stop switch.

1.2 DEFINITIONS

A. Power Output Rating – Gross electrical power output of generator set minus total power requirements of electric motor-driven accessories normally constituting part of the engine assembly.

B. Operational Bandwidth – the total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

C. Steady-State Voltage Modulation – the uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.3 SUBMITTALS

A. Product Data:

1. Data on features, components, accessories ratings, and performance.
2. Thermal damage curve for generator.
3. Time-current characteristic curves for generator protective device.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
3. Power, signal, and control wiring diagrams.

C. Welding certificates.

D. Qualification data for installer and manufacturer.

E. Test Reports:

1. Report of factory test on units to be shipped, showing evidence of compliance with specified requirements.
2. Report of sound generation.
3. Report of exhaust emissions showing compliance with applicable regulations.
4. Field quality-control test reports.

F. Certification of Torsional Vibration Compatibility indicating compliance with NFPA 110.

G. Operation and Maintenance Data:

1. For packaged engine generators.
2. Include a list of tools and replacement items recommended to be stored for ready access. Include part and drawing numbers, current unit prices, and source of supply.

H. Warranty:

1. Manufacturer's standard from in which manufacturer agrees to repair or replace components of packaged engine generators and associated components that fail within a period of 5 years from the date of substantial completion.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Firms experienced in manufacturing equipment of the type and capacity indicated with a record of successful in-service performance.
2. Maintain a service center within 200 miles of site capable of providing training, parts, and emergency maintenance repairs.
3. Not more than 4 hours normal travel time from manufacturer's place of business to site.

B. Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Qualify welding procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

D. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100.

E. Comply with NFPA 30.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

I. Engine exhaust emissions shall comply with applicable state and local government requirements.

J. Noise emission shall comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver engine generator set and system components to their final locations in protective wrappings or other protection that will exclude dirt and moisture and prevent damage from construction operations.

B. Remove protection only after equipment is safe from dirt, moisture, and damage.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering and identified with labels:

1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
2. Pilot Lights: 2 for every 6 of each type used, but not less than 2 of each.
3. Filters: 1 set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, products shall be by Cummins or approved equal.

2.2 ENGINE-GENERATOR SET

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.

B. Comply with safety standards in ASME B15.1.

C. The generator shall be sized to start one pump to be installed, plus 5 kilowatts of load at 0.8 power factor, 480 volt, 3 phase, 60 hertz, within 25% voltage dip, as measured using an oscilloscope.

D. Output connection shall be 3 phase, 4 wire for 480Y/277 volt services.

E. Internal and external supports for components and fastenings for wiring and pipe are designed to withstand static or anticipated seismic forces in any direction. For each item, use a minimum force value equal to the item’s weight.

F. Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, model number, and serial number.

2.3 GENERATOR-SET PERFORMANCE FOR SENSITIVE LOADS

A. Voltage Regulation: 1% of rated output voltage from no load to full load.

B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.

C. Transient Voltage Performance: Not more than 10% variation for 50% step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

D. Frequency Regulation: 0.25% of rated frequency from no load to full load.

E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

F. Transient Frequency Performance: Less than 2-Hz variation for a 50% step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 3 seconds.

G. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2% total with no slot ripple. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 5%.

H. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 300% of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

I. Performance of excitation system shall be unaffected by voltage distortion caused by nonlinear load.

J. Start time shall comply with NFPA 110, Type 10, system requirements.

2.4 SERVICE CONDITIONS

A. Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient temperature: 5°F to 104°F.
2. Relative humidity: 0% to 95%.
3. Altitude: Sea level to 1000 feet.

2.5 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Comply with NFPA 37.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90% of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Natural gas engine fuels systems shall be used if natural gas is available at the site. Natural gas fuel system includes unit mounted electric solenoid fuel shut-off valve, flexible fuel line, and secondary fuel pressure regulator.

F. Use diesel engine fuel systems only if natural gas in unavailable at the site. Diesel engine fuel systems include integral injection pumps, main fuel pumps mounted on the engine, fuel oil filters ahead of the injection pumps, and relief/bypass valve regulating pressure in the fuel line.

G. Jacket Coolant Heater: Electric type, factory-installed. Unit is rated and thermostatically controlled to maintain engine block temperature of 90°F. Provide an oil pressure cutout to turn the heater off when the engine is running. Provide shut-off valves on the engine side to allow for replacement of the heater and hoses without draining the system.

H. Speed Governor: Adjustable isochronous type with speed sensing.

2.6 ENGINE COOLING SYSTEM

A. Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

B. Radiator: Factory-piped and rated for specified coolant.

C. Coolant: Solution of 50% ethylene-glycol-based antifreeze and 50% water.

D. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

E. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

1. Rating: 50-psig maximum working pressure with coolant at 180°F, and non-collapsible under vacuum.

2. End Fittings: Flanges or steel pipe nipples with clamps to suit pipe and equipment connections.

2.7 DIESEL FUEL SUPPLY SYSTEM

A. Comply with NFPA 30.

B. Dual wall sub-base fuel tank sized to support the generator set for 24 hours at 100% of rated load.

2.8 ENGINE EXHAUST SYSTEM

A. Muffler shall be sized as recommended by engine manufacturer. Sound level measured at a distance of 10 feet from exhaust discharge shall be 85 dBA or less.

B. Condensate drain for muffler shall be Schedule 40 black steel pipe connected to muffler drain outlet through a petcock.

C. Exhaust pipes per NFPA 37.

2.9 COMBUSTION-AIR INTAKE

A. Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

2.10 STARTING SYSTEM

A. 12 or 24 volt DC electric with negative ground. Include the following items:

1. Components sized so they will not be damaged during a full engine-cranking cycle.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery cable sized as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

5. Battery heater shall be 120 volt heater capable of maintaining battery temperature at 50°F.

2.11 CONTROL AND MONITORING

A. When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

B. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common UL-listed control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Generator overload.

D. Supporting items include sensors, transducers, terminals, relays, and other devices and wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil low-pressure shutdown.
3. Overspeed shutdown.

4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.
9. Overcrank shutdown.
10. Coolant low-temperature alarm.
11. Control switch not in auto position.
12. Battery-charger malfunction alarm.
13. Battery low-voltage alarm.

F. Remote emergency-stop switch shall be protected from accidental operation.

2.12 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 80% rated; complying with NEMA AB 1 and UL 489.

1. Trip rating as shown on the Contract Drawings.
2. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
3. Mount adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, Article 700-7(d). Integrate ground-fault alarm indication with other generator-set alarm indications if shown on the Contract Drawings.

2.13 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1 and specified performance requirements.

B. Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical insulation shall be Class H or Class F.

D. Stator-Winding Leads shall be brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125% of rating, and heat during operation at 110% of rated capacity.

F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.

G. Enclosure shall be drip-proof.

H. Instrument transformers shall be mounted within generator enclosure.

I. Voltage regulator shall be solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5% adjustment of output-voltage operating band.

J. Strip heater shall be thermostatically controlled unit arranged to maintain stator windings above dew point.

2.14 OUTDOOR GENERATOR-SET ENCLOSURE

A. Sound-attenuated, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110% of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

D. Convenience Outlets: Factory wired and arranged for external electrical connection.

2.15 FINISHES

A. Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.16 SOURCE QUALITY CONTROL

A. Comply with NFPA 110, Level 1 energy converters.

B. Generator tests shall comply with IEEE 115.

C. Use instruments calibrated within the previous 12 months and with accuracy directly traceable to National Institute of Standards and Technology (NIST).

D. Perform hydrostatic test on radiator, heat exchanger, and engine water jacket.

E. Complete system operation test:

1. Nonstop operation for 4 hours minimum, including 1 hour at 1/2 load, 1 hour at 3/4 load, and 2 hours at full load.

2. If unit stops during test, repeat the complete test.

3. Record the following data at the start and end of each load run and at 15-minute intervals between those times:

a. Lubricating oil temperature and pressure.

b. Generator load current and voltage, each phase.

c. Generator system net output kW.

F. Complete system performance test:

1. Include the following to demonstrate conformance to specified performance requirements:

a. Single-step load pickup.

b. Transient and steady-state governing.

c. Transient and steady-state voltage performance.

d. Safety shutdown devices.

G. Provide 2 weeks advance notice of tests and opportunity for Town representative to observe testing.

H. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of pipe systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

3.3 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Field install pipe and ductwork as indicated on the drawings.

C. Maintain minimum working space around components according to manufacturer’s shop drawings and NEC.

D. Install packaged engine generators level on concrete base.

E. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

F. Install cooling-system pipe, accessories, hangers and supports, and anchors for complete installation.

G. Install exhaust-system pipe. Extend to point of termination outside structure. Size pipe according to manufacturer's written instructions.

H. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

I. Arrange and pay for the services of a factory-authorized representative to supervise installation, connections, testing, and adjusting of the unit.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of pipe and specialties. The following are specific connection requirements:

1. Install fuel, cooling-system, and exhaust-system pipe adjacent to packaged engine generator to allow service and maintenance.
2. Connect cooling-system water supply and drain pipe to diesel-engine heat exchangers. Install flexible connectors at connections to engine generator and remote radiator.
3. Connect fuel pipe to engines with a gate valve and union.
4. Connect exhaust-system pipe to engines.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
2. Perform tests recommended by manufacturer.
3. Perform tests required by NFPA 110.
4. Verify proper installation, connection, and integrity of each element of engine-generator system before and during operation. Check for air, exhaust, and fluid leaks.
5. Exhaust Emissions Test: Comply with applicable test criteria.
6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50% and 100% step-load increases and decreases and verify that performance is as specified.
7. Harmonic-Content Tests: Measure harmonic content of output voltage under 25% and at 100% of rated linear load. Verify that harmonic content is within specified limits.
8. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at 4 locations on the property line, and compare measured levels with required values.
9. Simulate malfunctions to verify proper operation of protective, alarm, and monitoring devices.
10. Operate nonstop for a minimum of 4 hours, including 1 hour at 1/2 load, 1 hour at 3/4 load, and 2 hours at full load. If unit stops during the test, repeat the complete test. Record the following minimum data at the start and end of each load run, and at 15-minute intervals between those times:
    a. Lubricating oil temperature and pressure
    b. Generator load current and voltage, each phase.
    c. Generator system net output kW.

B. Coordinate tests with tests for transfer switches and run them concurrently.

C. After installation, charge system and test for leaks. Repair and retest until no leaks exist.

D. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Remove and replace malfunctioning units and retest as specified above.

G. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 STARTUP SERVICE

A. Upon complete installation and inspection of system components, remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars to finish to match original finish. Clean components internally using methods recommended by manufacturer.

B. Engage a factory-authorized service representative to perform startup service.

C. Inspect field-assembled components and equipment installation, including pipe and electrical connections. Report results in writing.

D. Complete installation and startup checks according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain packaged engine generators.

1. Coordinate this training with that for transfer switches.

END OF SECTION 16620