TOWN OF CHANDLER, INDIANA

SANITARY SEWER DESIGN AND CONSTRUCTION STANDARDS

SPECIFICATIONS AND DETAILS

Adopted: November 20, 2017

Tonya Wester, President

Cheryl Amos, Member

Andrea Johnson, Member

Sean Johnson, Member

Ron Whitledge, Member

Brian Pace, Clerk-Treasurer

Town of Chandler UTILITIES

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SPECIFICATIONS AND DETAILS

PREPARED FOR:

TOWN OF CHANDLER UTILITIES
101 Constitution Court · Chandler, Indiana 47610
Phone: (812) 925-6213
www.townofchandler.org

PREPARED BY:

WESSLER ENGINEERING
5401 Vogel Road, Suite 710
Evansville, Indiana 47715
Phone: (812) 475-1690
www.wesslerengineering.com

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SECTION 01010 – GENERAL ITEMS

The Town of Chandler is responsible for ensuring the proper installation of all sanitary sewer facilities constructed in or connected to the existing Town facilities. All facilities shall be designed and constructed in accordance with these Standards as well as all applicable State and Federal regulations and requirements.

It shall be the Owner's responsibility to ensure compliance with all requirements of the Town or other authority having jurisdiction on work if such authority imposes greater requirements. Furthermore, the Owner shall be responsible for procuring all necessary permits and licenses, pay all charges and fees for acquiring and recording all easements, and giving all notices necessary and incidental to the work.

The Owner shall be responsible for obtaining all permits which relate to the design and construction of the completed facilities.

Addenda and/or revisions to these Standards may be issued periodically and will be distributed and made available to the public at the Utility Maintenance Facility, 101 Constitution Court, Chandler, Indiana 47610. Users shall be responsible to keep apprised of any changes and revisions to these Standards.

Any conflicts between these Standards and any applicable State laws shall be superseded by such law. If any conflict arises between these Standards and applicable Town or County Ordinances, these Standards shall prevail. These Standards are approved and adopted by the Town Council, Town of Chandler.

The purpose of these Standards is to establish minimum criteria for design and workmanship. The Sanitary Sewer Design and Construction Standards shall have jurisdiction over the entire sanitary sewer system and appurtenances from the point of connection with the building plumbing to the final point of discharge at the treatment facility

PART 1 - GENERAL

1.01 General Items

A. The standard details and specifications for the Town of Chandler (Town) apply to all infrastructure construction. The applicable standard details and specifications shall be incorporated into the construction plans for all projects in the Town.
B. Application fee (capacity fee), review fee, construction inspection fee and reimbursable fee for work performed by the Town due to submission of incomplete or inaccurate Record Drawings shall be as established by the Town in accordance with all applicable ordinances.
C. "Common force main systems" and "low pressure force main systems" will not be permitted.
D. The Town must approve all materials and any proposed deviations from the construction standards prior to construction and installation.
E. One set of plans "approved" by the Town and the Indiana Department of Environmental Management (IDEM), if applicable, shall be maintained on the job at all times.
F. Trenchless installation methods shall be used for all waterway crossings unless otherwise approved by the Town and any State or Federal permitting authority.
G. For roadway crossings, installation method (open trench and trenchless methods) must be approved by the Town and any applicable permitting authority prior to construction.
H. Sump pump discharge piping shall connect to a piped stormwater conveyance or discharge over the ground to a swale or ditch. A sump pump shall not discharge over a sidewalk or to a street or paved surface. Upon approval by the Town, a French drain may be used when soil conditions will promote infiltration into the ground and other alternatives are not available.

1.02 Contact information for the Town of Chandler:

A. Director of Public Services: 812-925-6213

1.03 Meetings

A. A pre-construction conference must be scheduled with the Town a minimum of 48 hours prior to commencement of construction. Contact the Director of Public Services at 812-925-6213.
B. No work shall begin prior to pre-construction meeting with the Town.

1.04 Submittals

A. Final Design Drawings
    1. Submit final design drawings to the Town for review.
    2. Once the final design drawings have been reviewed, a plan review letter from the Town will be provided to the applicant.

3. Revise the design drawings based on review comments and resubmit.
4. Reviewed and approved design drawings are required prior to construction. All other requirements as listed in this Specification must be met prior to construction.
5. Prior to scheduling a Pre-Construction conference, the site owner shall provide three (3) sets of marked “Final Approved Plans”. At the pre-construction meeting the drawings will be stamped and one (1) copy should be available onsite at all times.

B. Construction Schedules
1. Progress schedules are to be submitted by the Contractor to the Town prior to construction.
2. Provide complete sequence of construction by activity showing dates for beginning and completion of each element of construction.

C. Products and Materials
1. The Town of Chandler and Chandler Utilities prefers the use of domestically manufactured products. All materials provided by developers or contractors must be purchased from a local approved, authorized dealer when possible such as J and J Supply, Inc. (Boonville) and Utility Supply Company (Huntingburg). Chandler reserves the right to request any information pertaining to the dealers or venders providing the materials. Chandler has the right to refuse any material or equipment submitted for a project.
2. All materials furnished by the Contractor to be incorporated in the work shall be subject to inspection and approval by the Town prior to installation.
3. Product data shall be submitted to the Town for all utility pipe, utility structures, precast concrete structure coatings and sealants, manhole and frames and covers, casing pipe, all lift station equipment, concrete, asphalt and all associated materials necessary for a complete installation. Such data shall be of sufficient detail to enable the Town to identify the product in question and determine its conformance to the Town's requirements. Mark each copy to identify applicable products, models and options to be supplied.
4. Provide sufficient number of copies of each submittal to the Town such that there is sufficient quantity for the Town to retain 3 copies.

D. Posting of Bond
1. The Town requires the posting of a performance bond and a separate maintenance bond from a company licensed by the State of Indiana to provide such surety. Each bond shall be equal to 100% of the contract amount or an amount established by the Town to provide surety for the satisfactory completion of the improvements and shall name the Town of Chandler as a party who can enforce the obligations included. The duration of each bond shall be one (1) year.
2. The Town may, as an alternative to the posting of such bond, accept other appropriate security such as properly conditioned irrevocable letter of credit which meets the same objective as the bonds described in this section, subject to approval of any other department or agency whose interests are protected by the same bonding requirement. The bank issuing the letter of credit must be a bank situated in Indiana and must be an FDIC insured institution.
3. If the surety on any bond furnished to the Town becomes a party to a supervision, liquidation, rehabilitation action pursuant to IC 27-9 et. seq. or its right to do business in the State of Indiana is terminated, it shall be required that, within 30-days thereafter, a substitute bond and surety be provided, both of which must be acceptable to the Town. Failure to obtain a substitute bond within the state time frame shall be cause for revocation or suspension of the project approval until such time that the bond is furnished to the Town.

E. Record Drawings
1. Provide "Record Drawings” at the completion of the utility construction. Submittal of “Record Drawings” is required prior to acceptance and placement in service of new utility items.
2. Provide 2 hard copies of Record Drawings prior to final inspection. Provide final documents in electronic format consisting of (1) PDF digital copy and (1) CAD digital copy (.dwg format version 2013 or higher) or other file type compatible with the Town’s GIS software in accordance with these Standards.

   a. The names for the files should allow someone unfamiliar with the consulting firms naming conventions to determine the content of the file.

   b. The .dwg files shall be in the NAD83, Indiana State Plane Coordinate System, East Zone projection using U.S. Survey feet. The vertical datum for the files will be NAVD 88.

   c. All pertinent drawing elements will reside in the primary drawing file. There shall be no cells, nodes, blocks, or reference files (x-refs) attached to the drawing.
3. Include all installed utility lines, structures, and all existing gas and electric utility locations on “Record Drawings”.
4. Include any changes to the design drawings, including dimensions and revisions of details.
5. Provide measurements to all laterals and other appurtenances.
6. Final horizontal locations of all manholes and major structures shall be established and recorded with mapping grade accuracy (+/- 0.4 foot).
7. Final vertical elevations shall be established and recorded with “survey grade” accuracy (+/-0.2 foot).
8. Record all pipe sizes, lengths along the centerline of the pipe, manufacturer of each of the materials used in construction, and all easement locations, types, and dimensions.

F. Requirements for Project Acceptance and Dedication (See Checklist)

Sanitary Sewer facilities will not be accepted until all fees are paid and all documents, as required by the Town, are submitted to and approved by the Director of Public Services and the Town, including the following:

1. One (1) Year Maintenance Bond
2. Recorded Covenant and Easement Documents
3. Submittal of Record Drawings
4. Operation and Maintenance manuals for all electrical and mechanical equipment provided and installed.
5. Certified results of all testing that was performed
6. The completion of a final inspection which confirms that the project has been constructed and tested in accordance with the Town's Standards.

1.05 Coordination

A. Give the Town's Director of Public Services a minimum of 48-hour notice prior to commencement of any construction activities.
B. No sewer system construction may begin until approval from IDEM has been received by the Town.
C. Advise the Town of who the Contractor will be prior to the pre-construction conference. The Town reserves the right to reject the Contractor.
D. Coordinate work with other Contractors and the Town. Select order of work and establish schedule or working hours for construction and submit to the Town. The Town reserves the right to assure orderly and expeditious progress of work.
E. Maintain existing services affected by Contractors' operations under the contract. Schedule construction to minimize interruptions to existing services and inconvenience to others.
F. Locate all existing utilities prior to commencement of construction. Call Indiana811 at 811 or 1-800-382-5544.
G. Street closures must be approved by the Town and any other authorities having jurisdiction prior to beginning work.
H. Notify the Town immediately upon the event of damage to any public street during the course of the work and requiring closure thereof. Contractor shall be responsible for repair and costs as determined by the Town.
I. Notify the Town immediately upon event of damage to any utility line. Contractor shall be responsible for repair and costs as determined by the Town. A representative from the Town must be on-site to inspect repair prior to backfill.
J. Notify the Town one (1) working day prior to working on weekends. There will be an additional cost for inspection on weekends to compensate for overtime.

1.06 Quality Control

A. All materials and each part or detail of the work shall be subject to inspection by the Town at all times. The Town shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.
B. Provide quality-control services specified as required.
    1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    2. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
C. Pre-Construction Inspection
    1. The Contractor shall conduct a pre-construction, video recorded, inspection of the construction site to serve as a permanent record of pre-construction conditions.
    2. The product shall be high quality audio and video tape. The video portion shall present bright, sharp, clear pictures with accurate colors. The picture shall be free from distortion, tearing, rolls or other picture imperfection. The audio portion shall be proper volume, clarity and free of distortion. The audio commentary shall be precise and concise explanatory notes.
    3. The recordings shall include coverage of all surface features located along the main route. The tape coverage shall include all existing cross streets, driveways, sidewalks, curbs, ditches, shrubbery or other structures located along the route.

D. Construction Inspection
    1. Prior to issuance of the final project approval and commencement of any construction activities pertaining to the installation of any sanitary sewer project, the Contractor shall execute an Agreement with the Town, which will provide that:
        a. The Town may utilize its own personnel or contract for construction inspection service to ensure that materials and workmanship meets the requirements of the approved plans and specifications.
        b. The Contractor shall be responsible for submitting and certifying air pressure or infiltration test results for all sewer pipe and deflection test results for all flexible and semi-rigid pipe, force main pressure tests, and all other testing as required.

c. The Contractor shall reimburse the Town for the cost of inspection services as established by the Town in accordance with all applicable ordinances. Fee schedule should be determined at the time of execution of the Agreement, and verified by the Contractor throughout construction.
d. No action with regard to the acceptance of the construction and release of the improvement bond pursuant to this section shall be taken until the Contractor has reimbursed the Town in full for the inspection services.
e. All construction of public works facilities intended for dedication to the Town shall be observed and certified pursuant to the Agreement.
f. The Contractor shall furnish the Town with three (3) copies of the approved construction plans and specifications at the time the Agreement is executed.

1.07 Temporary Facilities

A. Provide the following temporary facilities:
1. Sanitary facilities
2. Trash Containers
3. Barricades and enclosures
4. Bulletin Board (for required notices and postings)

B. Sanitary Facilities
1. Provide sanitary facilities for use of all construction personnel including those of other contractors for the duration of the project as follows:
a. Chemical units complete with weathertight enclosure adequately ventilated and equipped with latching door.
b. Maintain chemical units weekly or at lesser periods if determined necessary. Chemical units shall be in accordance with all applicable rules and regulations.
c. Furnish toilet paper and hand sanitizer for the chemical units and replenish supply whenever required.

C. Trash Containers
1. Provide a trash container for the disposal of packaging materials, pieces of broken pipe, rubbish, trash and other debris.
2. Empty trash containers as often as necessary to prevent overflowing, but not less than one time per week.

D. Barricades
1. Provide, erect and maintain all necessary barricades, suitable and sufficient danger signals and signs.
2. Take all necessary precautions for the protection and safety of the public, workmen, structures and equipment. Roads closed to traffic shall be protected by effective barricades. Obstructions shall be illuminated during hours of darkness.
3. Erect warning signs in advance of any location on the project where operations may interfere with the use of the road by traffic and at all intermediate points where the new work crosses or coincides with the existing road. Construct and erect warning signs in accordance with the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) and the Indiana Supplement, latest editions.

1.08 Rights of Access

A. Representatives of the Town, Environmental Protection Agency and the State of Indiana shall have access to the work wherever it is in preparation or progress and that the Contractor will provide facilities for such access and inspection.

1.09 Safety and Health Regulations for Construction

A. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction and CFR Part 1910.46 Permit Required for Confined Space".
B. Upon request, provide the Town with the name of the Contractor's Safety Officer, plus the on-site Safety Representative, if other than the Superintendent.
C. Safety must be kept at all times but the Town is not responsible for overseeing these requirements.

1.10 Erosion Control

A. The Contractor shall be responsible for all temporary and permanent control measures to reduce water pollution, soil erosion, and siltation using berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devises or methods.
B. Must comply with IDEM Rule 5 when construction activity disturbances are greater than 1.0 acre (327 IAC 15-5 Storm Water Runoff Associated with Construction Activity).
C. Authority of Town: The Town has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations, and to direct the Contractor to provide immediate permanent or temporary control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds and areas of water impoundment.

D. The Utility shall be notified when land disturbing activities commence and when they have been completed. The Owner or Contractor shall submit a copy of the Notice of Termination (NOT) letter to the Town as well as regulating authorities.

1.11 Water Main Protection

A. Sewers and building services (laterals) shall be laid at least 10-feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the appropriate reviewing agency may allow deviation on a case-by-case basis, if supported by data from the designer. Such deviation may allow installation of the sewer or service lateral closer to a water main, provided the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer or service lateral and at an elevation so the bottom of the water main is at least 18-inches above the top of the sewer or service lateral.

B. If it is impossible to obtain proper horizontal and vertical separation as described above, both the water main and sewer or service lateral must be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the agency and be pressure tested to 150 psi to assure water tightness before backfilling.

C. Sewers and service laterals crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or lateral. This shall be the case where the water main is either above or below the sewer or lateral. The crossing shall be arranged so that the joints of the sewer or lateral will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer or lateral, adequate structural support shall be provided for the sewer or lateral to maintain line and grade.

D. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods must be specified:

1 The sewer or lateral shall be designed and constructed equal to water pipe and shall be pressure-tested at 150 psi to assure water tightness prior to backfilling.

2. Either the water main or the sewer or lateral line may be encased in a watertight carrier pipe which extends 10-feet on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main construction.

1.12 Building Sewers (Laterals)

A. Prohibition Against Clean Water Discharges

1. No person shall discharge or cause to be discharged to any sanitary sewers either directly or indirectly:
   a. Storm water
   b. Surface water
   c. Ground water
   d. Roof runoff
   e. Subsurface drainage (gravity or pumped)
   f. Uncontaminated cooling water
   g. Unpolluted water
   h. Unpolluted industrial process water

B. Mandatory Inspection of Building Connections

1. It shall be the responsibility of the Owner to notify the Town that the sewer work is available for inspection. The Town will conduct inspections on all connections after not less than 24-hour notice has been given from 7:00 AM to 3:00 PM Monday through Friday except on observed Town holidays. The building sewer shall be fully exposed from the foundation to the point of connection with the public sewer.
2. The Town may take a minimum of two (2) construction “as-built” photographs for Town record prior to backfilling.
3. The Town and its authorized representative shall have the right of entry upon or through any premises for purpose of inspection of sewer work and any other construction activity performed on or associated with the connection of the building sewer to the Town sewer, including inspection for clear water discharged into the sewer.

C. Building Sewer Responsibility

It shall be the responsibility of the property owner(s) whose property is benefited to provide for, install and make private connections for the use of their premises to an existing public or building sewer. Further, it shall be the responsibility of the Owner to make all necessary repairs, extensions, relocations, changes or replacements thereof and of any accessories thereto. These requirements may be altered, modified or waived at the discretion of the Town when it is shown that compliance is not possible due to extenuating circumstances.

D. Service Line Check valves

If a property owner desires to install a check valve on a private service connection, It shall be the sole responsibility of the property owner with regard to cost of installation and maintenance. The Utility recommends

that a licensed professional be consulted to check over the situation prior to having a licensed plumber make the installation.

1.13 Operations within Right-of-Way

A. In public thoroughfares, all operations of the Contractor, including those of temporary nature, must be confined within the applicable right-of-way limits.

B. If the methods of the construction are such as to require the use of land beyond the public thoroughfares, Contractor shall make his own arrangements with the property owners affected for the use of such additional land. Such additional agreements will not include any liability for the Town.

C. Perform all construction in existing roadways between the hours of 9:00 am and 2:00 pm. Road closures shall be coordinated with the Town prior to construction.

D. Prior to construction activity and if access will be through an existing roadway system (subdivision), the Contractor shall video the route and provide a copy to the Town.

1.14 Permits

A. The Contractor and/or Owner shall obtain all permits which are related to the design and construction of the completed facilities including providing copies to the Town. Permits to be obtained by the Developer include, but are not limited to, permits from the following:

1. Town of Chandler
2. Warrick County
3. Indiana Department of Environmental Management
4. Indiana Department of Homeland Security Fire and Building and Safety Division
5. Indiana Department of Natural Resources
6. U.S. Army Corps of Engineers

B. The construction shall be performed in full accordance with all permit requirements.

1.15 Sanitary Sewer Design Criteria

A. General

All sanitary sewers shall be designed and constructed in accordance with IDEM and Ten States Recommended Standards for Wastewater Facilities. All sanitary sewers shall be designed to carry the estimated flow from the area ultimately contributing to the respective service area of the sanitary sewer. The required capacity shall be established by the Director of Public Services or at the Town's option by means of a study conducted by the Owner/Contractor or his authorized representative engineer.

B. Residential Flows

For design, the average family unit is considered to generate 310 gallons per day per single family home. Peak flows shall be as determined by Ten States Standards.

C. Commercial/Institutional Flows

The average daily flow for these facilities shall be based on Bulletin S.E. 13 from the Indiana State Board of Health, latest edition. These documents shall be used as a general guideline. The Director of Public Services may allow modification of these guidelines based upon information submitted by the Owner/Contractor or developed by the Director of Public Services. Peak flow shall be determined by multiplying the average flow by a factor determined by the Owner/Contractor and approved by the Director of Public Services.

D. Industrial Flows

For those industries which do not have any process wastewater discharge, flows shall be calculated as stated above in "Commercial/ Institutional Flows". For industries which will have a process discharge, the Owner shall submit detailed flow estimates for each process, duration and frequency. Peak capacity shall be determined by multiplying the average discharge by a factor determined by the Owner/Contractor and approved by the Director of Public Services.

E. Infiltration

Sanitary sewer design capacity must include an allowance to carry unavoidable amounts of groundwater infiltration or seepage in addition to the peak sanitary flows. Collector and trunk sewers shall be designed to include an allowance of 200 gallons per day per inch diameter mile of pipe.

F. Pipe Capacities

1. Collector sewers shall be classified as any sewer ranging between 8-inches and 12-inches in diameter. Peak design flow capacities shall be based upon the sewer flowing full without head.

2. Trunk or interceptor sewers shall be classified as any sewer 15-inches in diameter and larger.

3. Peak design flow capacities for trunk or interceptor sewers shall be based on sewers flow full, without head, using the design population density and appropriate land use determined by the Town and Director of Public Services, and shall include an allowance for infiltration which will be reviewed on a case-by-case basis and is subject to the approval of the Director of Public Services.

G. Pipe Diameter

The required diameter of gravity sewers shall be determined by Manning's formula using a roughness coefficient, "n", if 0.013 or required by the latest Ten States Standards. The minimum pipe diameter for gravity sanitary sewers shall be 8-inches.

H. Minimum Slopes and Velocities

All sanitary collector, trunk and interceptor sewers shall be designed and constructed to provide a minimum velocity when flowing full of 2 feet per second. The slope of the pipe shall be such that these minimum velocity requirements are achieved. The minimum acceptable slopes for the design and construction of the sanitary sewers are as follows:

Pipe Size (Inches)	Minimum Slope (ft. per 100 ft., %)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12

These slopes may be modified by the approval of the Town and/or the Indiana Department of Environmental Management.

I. Minimum Depth

In general, sewers shall be sufficiently deep to receive sewage from the first floor of all places served by the sewers. No below ground floors may be directly connected via a gravity sewer to the collector sewer unless the floor is 1-foot above the rim of the upstream manhole. The sanitary sewers shall have a minimum cover of 4-feet unless waived by the Director of Public Services. The top of all sewer entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. The pipe shall have a minimum cover of 3-feet under small streams or ditch crossings. More than 3 feet of cover may be required in major streams and in paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement. The developer shall construct the sanitary sewer at reasonable depths to avoid interference with other utilities or drainage structures. Less cover may be approved only if the proposed sewer crossing will not interfere with future modification s to the stream channel. Justification for requesting less cover shall be provided to the Director of Public Services.

J. Building Sewers (Laterals)

1. Building sewers shall conform to the latest edition of the Uniform Plumbing Code, these Standards, and Town Ordinances. Sewers with more than one (1) connection must be in a dedicated easement, meet all plumbing codes and be approved by the Director of Public Services.
2. The building sewer shall connect to the public sewer at a mainline fitting. In situations where this requirement may not be possible, the Town will allow for connection of the lateral directly to a manhole structure providing the connection occurs at the manhole invert. Under these circumstances, the manhole base shall be pre-formed with a gasketed connection for the lateral line. The invert of the manhole shall also have a formed bench-wall at the flow line to accept the lateral sewer connection. Laterals from two separate buildings may be installed parallel in the same trench but shall be a minimum of 4 feet apart.
3. All single-family, multi-family, commercial, institutional, and industrial dwellings will require 6-inch diameter laterals. Building sewers shall have a 6-inch wye cleanout located within 3-feet of the building's exterior wall and extended to grade. The cleanout shall be fitted with a pop-off lid and shall be constructed such that it is located below the floor level serviced by the gravity sewer to serve as a relief point in the event the municipal sanitary sewer backs up. Industrial buildings shall have a suitable control manhole for observation, sampling, and measurement of the waste stream, as required by the Director of Public Services.
4. Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or extended flush with paving with approved materials and be adequately protected.
5. Building sewers installed for future connections shall be terminated at the right-of-way or easement and plugged to ensure 100% water tightness. A 2-inch diameter PVC pipe shall be installed so that it extends 4-inches above grade. Additionally, a ½-inch metal locator rod or magnetic locator tape shall be installed at the end of the plugged line to within 3-feet of the finished grade.
6. If approved by the Director of Public Services, a service may be cut into a public sewer using a mainline fitting and approved coupling or a saddle connection.

K. Manholes

1. Manholes shall be installed at the end of each line. Cleanouts will not be acceptable. Manholes shall also be installed at all changes in grade, size, materials, or alignment, and at all sewer intersections. The interval between manholes shall not be greater than 400-feet, unless a greater distance is approved by the Town.
2. The minimum inside diameter of manholes shall be 48-inches.
3. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed to the crown of the inlet and outlet pipes to form a "U" as shown in the Standard Details included in this manual.

4. At changes in sewer alignment and/or sizes, the energy gradient elevation shall not increase. This shall be accomplished by keeping the crown elevation continuous where possible for changes in sewer sizes.
5. Manholes proposed to be installed in unpaved areas shall be designed and constructed such that the top of the casting is flush with the finished grade to prevent ponding of water over the casting. Positive drainage away from the manhole shall be provided.
6. Manholes receiving discharge from force mains shall have an internal drop connection. Manholes which have force main discharge lines shall have an internal epoxy coating to prevent corrosion.

L. Outside Drop Connections

1. Outside drop pipe connections shall be provided for all sanitary sewers entering a manhole at an elevation greater than 24-inches above the invert of the manhole.
2. In areas where future residential, commercial, institutional, and/or industrial growth can occur, the Town shall determine which new manholes, 15-feet deep or deeper, shall be equipped with outside drop connections of a size and at an elevation to be determined by the Director of Public Services at the time of design to allow for future connections at these points. The drops shall extend from the base to within 10-feet of the final graded surface elevation.

1.16 Lift Station and Force Main Design Criteria

A. General

1. All lift stations shall be designed and constructed in accordance with IDEM and Ten States Standards. All design criteria and calculations shall be submitted to the Director of Public Services for approval.
2. No lift station shall be approved for a project unless a 50-year life cycle analysis is submitted to the Town to demonstrate that it will be more cost effective for the Town in lieu of constructing a deeper gravity sewer.

B. Pump Sizing Criteria

Lift Station pumps shall be provided to accommodate peak hourly flow with the largest pump out of service. A minimum of two (2) pumps shall be provided at each lift station.

C. Force Main Sizing Criteria

Force mains shall be designed to maintain a minimum of 2 feet per second in order to avoid solids deposition in the pipe. Minimum force main size shall be 4-inches in diameter unless specifically authorized by the Director of Public Services.

D. Lift Station Design

All lift stations shall be wet well/valve vault design utilizing submersible pumps in the wet well with a separate valve vault. Provisions for draining the valve vault into the wet well shall be made.

Provisions shall be made for connection to the Town's portable pumps for use in by-pass pumping.

E. Wet Well Sizing Criteria

The wet well storage below the lowest inlet shall be a minimum of 5'-0" and shall also meet the following criteria:

- OFF level to be set at the pump manufacturer's recommended level but no less than 1'0" from the bottom of the wet well.
- The distance between the OFF level and the lead pump ON level shall be set to provide storage capacity in gallons equal to:

$$\frac{15 \times \text{Rated Pump GPM}}{4}$$

(i.e. 15 minute cycle minimum)

- The lag pump ON level shall be set a minimum of 6-inches above the lead pump ON level.
- The high water alarm shall be set a minimum of 6-inches above the lag pump ON level.
- All level settings shall be set a minimum of 6-inches below the lowest invert.

F. Lift Station Capacity

All lift stations will be designed with a minimum capacity of 80 gpm to meet IDEM's requirement of maintaining 2 fps in force mains. This includes the wet well size, piping, electrical equipment, etc.

1.17 Easements

A. All sanitary sewer lines and lift stations shall be protected by dedicated Sanitary Sewer Easements. No sewer lines shall be placed in the public street rights-of-way unless specifically authorized by the Town.

B. The minimum sewer easements shall be 15-feet wide for force mains; 20-feet wide for sanitary sewers up to 15-feet deep; 25-feet wide for sanitary sewers between 15-feet deep and 20-feet deep; and 30-feet wide for sewers greater than 20-feet deep.

C. All sewers shall be centered in the easement unless a water main is also present. In that case, a minimum of 10-feet separation must be maintained between the water line and the sewer line, and additional easement widths may be required as determined by the Director of Public Services.

D. A minimum 50-foot by 50-foot easement shall be provided for all submersible lift stations.

E. Regulated drain limits shall be shown on all plans.
F. The easements shall be exclusively under the discretion and control of the Town. Ingress and egress shall be shall be available to the Town's crew at all times. No utility companies are allowed to use the easements for installation of their utility lines without the expressed written permission of the Town. All plans sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement.

1.18 Drafting Standards

A. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Indiana.
B. Include all detail sheets and specification sheets as applicable.
C. Design drawings shall be 24-inch by 36-inch.
D. The scale for plan and profile sheets shall not exceed 1"=30' Horizontal and 1"=5' Vertical unless authorized by the Director of Public Services.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 Site Maintenance

A. The working area shall be kept free, at all time, of tools, materials, and equipment not essential to the work in progress. Debris, waste materials, and rubbish shall not be allowed to accumulate and shall properly be disposed. On site burning of trash and debris is prohibited. On-site burial of trash and debris is prohibited.
B. If the site owner should fail to maintain the project site, the Town shall make the necessary arrangements to clean up the site at the Owner's expense. If such action becomes necessary, in the opinion of the Town, the Town shall not be responsible for the inadvertent removal of materials which the Owner would not have disposed of had he affected the required clean up.
C. Where material or debris has washed, flowed, blown, or been purposely deposited into watercourses, drains, ditches, inlets, or elsewhere as a result of the construction operation, such material or debris shall be entirely removed and satisfactorily disposed of immediately upon identification.
D. The site owner shall be responsible to restore or replace any public or private property damaged by operations, equipment, or employees to a condition at least equal to that existing immediately prior to beginning the project.
E. The site owner shall be responsible for the repair of any drainage tile broken or damaged during construction. The replacement pipe shall be installed with pea gravel or any other suitable granular backfill from the bottom of the trench to six inches above the top of the replacement pipe. The repair of the drainage tile shall be installed to the satisfaction of the property owner.
F. Repair all parking lots and drives to their original state of usefulness. Streets and side ditches shall be left in neat and operable condition.
G. Restore the grades to the original contours and condition.
H. The site owner shall be responsible to maintain and mow property, including all easements, right-of-ways, and common areas. If the site owner should fail to maintain the project site, the Town of Chandler shall make the necessary arrangements to mow the site at the site owner's expense.

-END-

TOWN OF CHANDLER, INDIANA

SANITARY SEWER
PROCEDURES FOR CONSTRUCTION (CHECK LIST)

Date Received/ Requested	Date Appr./ Sent	
		PROJECT NO.:_____
		PROJECT NAME:_____
_____	_____	1. Initial Coordination meeting including Developer and Utility Representative(s).
_____	_____	2. Developer submits preliminary plans of proposed development with estimated capacity demand to the Town for preliminary review and response, and application for Sewer Service.
_____	_____	3. Developer submits three (3) sets of construction plans and the for Sewer Service to the Town.
_____	_____	4. Town will review the plans for completeness, conformance with the Town's standards, and evaluate whether the existing collection system can accommodate the sewage generated by this project. The Town will identify necessary changes to the plans or specifications.
_____	_____	5. The Town will submit a review letter which will recommend (not recommend) approval of the plans for construction.
_____	_____	6. After payment of required fees, the Sewer Service Agreement is executed by the Town and Developer and recorded by the Town according to ordinance.
_____	_____	7. Developer transmits Maintenance and Performance Bonds and insurance certificate.
_____	_____	8. Developer receives construction authorization.
_____	_____	9. Developer notifies the Town two (2) weeks in advance that project is ready for construction.
_____	_____	10. The Developer's Contractor begins construction by notifying the Town at least 24 hours in advance of beginning work.
_____	_____	11. Following installation of the sewers, the Developer’s Contractor conducts air tests, mandrel tests, and manhole vacuum tests on the new sewers.
_____	_____	12. The Developer submits two (2) sets of Record Drawings (prints) and any easements required for review.
_____	_____	13. The Town’s representative prepares a punch list for the project.
_____	_____	14. The Developer's Contractor completes punch list items.
_____	_____	15. The Town’s representative re-inspects the project.
_____	_____	16. The Developer submits final documents in electronic format consisting of (1) PDF digital copy and (1) CAD digital copy (.dwg format version 2013 or higher) or other file type compatible with the Town’s GIS software in accordance with these Standards.

Date Received/ Requested	Date Appr./ Sent	
_____	_____	17. Developer submits Maintenance Bond to the Town.
_____	_____	18. The Town recommends approval for acceptance for maintenance to the Town.
_____	_____	19. All easements are accepted and recorded by the Town.
_____	_____	20. Developer submits required documentation for dedication or transfer of sewer system for Town's approval including results of CCTV inspection of all lines. After payment of any remaining fees and reimbursable expenses, the Town approves the sewer system for acceptance.

TOWN OF CHANDLER, INDIANA
PLAN & SPECIFICATION REVIEW CHECKLIST

NAME OF PROJECT:_____

DESIGN ENGINEER:_____

I. Completeness and Conformance With Town Standards

A. Manholes & Cleanouts
1. Manhole Numbers, Rim & Invert Elevations ..... _____
2. Manhole/Cleanout Materials & Construction ..... _____
3. Spaced Max of 400' Apart ..... _____
4. Standard Manhole: 5' Deep or Greater ..... _____
5. Shallow, flat top, Manholes: Less than 5' ..... _____
6. Drop Manhole: 2' Drop of Greater ..... _____
7. Manholes at Finish Grade ..... _____
8. Details Complete ..... _____
9. Specs Complete ..... _____

B. Gravity Sewer Pipe
1. Pipe Numbers, Lengths, Sizes (8" Min.), and Slopes ..... _____
2. All Sewer Lines Planned and Profiles ..... _____
3. Depth: 3' Min. to Top of Pipe ..... _____
4. Pipe Materials ..... _____
5. Pipe Bedding & Backfill Materials & Construction ..... _____
6. Depth Restrictions ..... _____
7. Details Complete ..... _____
8. Specs Complete ..... _____

C. Laterals & Wyes
1. Wyes Connected to Sewer, Not Manholes ..... _____
2. Basement Connection Requirements (See Specs) ..... _____
3. Pipe Size: 6” Min. ..... _____
4. Lateral Provided for All Lots ..... _____
5. Pipe Material ..... _____
6. Lateral Locations, Length Indicated on Plans ..... _____
7. Pipe Slope: Min. 1% (6”) ..... _____
8. Details Complete ..... _____
9. Specs Complete ..... _____

D. Force Main
1. Pipe and Fitting Material ..... _____
2. Valve Types & Materials ..... _____
3. Pipe Size: 4-Inch Min. ..... _____
4. Depth: 3’ Min. to Top of Pipe ..... _____
5. Pipe Bedding & Backfill Materials & Construction ..... _____
6. Specs Complete ..... _____
7. Details Complete ..... _____
8. Air/Vacuum Release Stations ..... _____

E. Pump Stations
1. Wet Well Size: Min. 15 Minute Detention Time ..... _____
2. Pump Able to Pass 3-inch Sphere ..... _____
3. NEMA 4X Enclosure for Controls ..... _____
4. Access Road & Fencing ..... _____
5. Specs Complete ..... _____
6. Details Complete ..... _____

F Connections To Existing Sewers
1. Details of Connections ..... _____
2. Existing Sewer Sizes & Materials Indicated ..... _____
3. Compare Existing Sewers to Town Sewer Map ..... _____
4. Connection to Existing Sewer Made Using New Manhole Over Line ..... _____

G. Other Utility Conflicts
   1. Horizontal Separation of 10' Min. to Water Lines ..... _____
   2. Vertical Separation of 18" to Water Lines ..... _____
   3. Horizontal & Vertical Separation Between Other Utilities ..... _____

H. Miscellaneous
   1. Easement Widths: 15'-force mains; 20'<15' deep; 25'-15-22' deep; 30'>27' deep ..... _____
   2. Engineer's Seals & Signature ..... _____
   3. Page Numbers, Set Complete ..... _____
   4. Specs Complete ..... _____
   5. North Arrow on Each Sheet ..... _____
   6. Benchmark Indicated on Plans ..... _____
   7. Scale Indicated on Plans ..... _____
   8. Roads Labeled ..... _____
   9. Contours Labeled ..... _____
   10. Existing & Final Grade Shown on Profiles ..... _____
   11. Check Additional Notes, Details, Spec. Sections ..... _____

II. Calculations

A. Design Flow
   1. 100 Gallons Per Capita Per Day or 310 Per House Per Day _____
   2. Use 10-States Peaking Factors _____

III. Cost Estimate

PLAN REVIEW DATE:
LETTERS SENT:
PLANS RESUBMITTED:
APPROVAL DATE:

CERTIFICATE OF SUBSTANTIAL COMPLETION

OWNER's Project No.: _____

ENGINEER's Project No.: _____

Project: _____

CONTRACTOR: _____

Contract for: Town of Chandler, Indiana (Development)

Contract Date: _____

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof.

TO Town of Chandler, Indiana
OWNER

And To _____
CONTRACTOR

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

_____
DATE OF SUBSTANTIAL COMPLETION

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ days of the above date of Substantial Completion.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees shall be as follows:

RESPONSIBILITIES:

OWNER: Security, Operation, Safety, Maintenance, Heat, Utilities, Insurance

CONTRACTOR: Warranty Period

The following documents are attached to and made a part of this Certificate:

See Attached Punch List

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER on _____

_____
ENGINEER

By: _____

CONTRACTOR accepts this Certificate of Substantial Completion on _____

_____
CONTRACTOR

By: _____

OWNER accepts this Certificate of Substantial Completion on _____

Town of Chandler, Indiana
OWNER

By: _____

Town of Chandler, Indiana
Submersible Lift Station
Final Inspection Checklist

Date:_____ Location:_____

Lift Station ID:_____ KW Meter Number:_____

Pump Manufacturer:_____ Pump Supplier:_____

Pump Model:_____ Serial number:_____

Voltage:__ Phase:_____

Hertz:_____ Horsepower:_____

Control Panel model:_____ Control Panel Supplier:_____

Contractor:_____ Engineer:_____

I. ELECTRIC

A. Is the power system 3 phase or 1 phase? □ Yes □ No

B. If 3 phase, is grounded neutral power provided? □ Yes □ No

C. If above answer is "No" is transformer installed? □ Yes □ No

D. Voltage readings
   1. Between phases: L1, L2_____ L1, L3_____ L2, L3_____
   2. High phase to ground_____
   3. Other legs to ground_____

E. High Leg (L3) is connected to motor only and not connected to any auxiliary circuits. □ Yes □ No

F. Do latches on control panel work smoothly? □ Yes □ No

II. PUMP AND MOTOR CONTROLS

A. Breaker switches operate property:

1.	Pump # 1	□	Yes	□	No
2.	Pump # 2	□	Yes	□	No
3.	Pump # 3	□	Yes	□	No
4.	Control Circuit	□	Yes	□	No
5.	Remote Control Monitor	□	Yes	□	No

B. Hand-Off-Automatic switches:

1.	Pump #1 hand position operates	□	Yes	□	No
2.	Pump #2 hand position operates	□	Yes	□	No
3.	Pump #3 hand position operates	□	Yes	□	No
4.	Pump #1 Auto position operates	□	Yes	□	No
5.	Pump #2 Auto position operates	□	Yes	□	No
6.	Pump #3 Auto position operates	□	Yes	□	No
7.	Do the floats sequence all pumps with relation to lead, lag, and alternation:	□	Yes	□	No

C. Amperage:

1.	Name Plate Rating (amps) Pump # 1 Motor	□	Yes	□	No
2.	Amps pulled by Pump #1 Motor	□	Yes	□	No
3.	Name Plate Rating (amps) Pump #2 Motor	□	Yes	□	No
4.	Amps pulled by Pump #2 Motor	□	Yes	□	No
5.	Name Plate Rating (amps) Pump #3 Motor	□	Yes	□	No
6.	Amps pulled by Pump #3 Motor	□	Yes	□	No

D. Seal Failure/Heat Sensor:

1.	Seal failure wires connected properly to seal failure circuit:	□	Yes	□	No
2.	Test seal failure circuit OK?	□	Yes	□	No
3.	Heat sensor wires connected properly to heat sensor circuit:	□	Yes	□	No
4.	Test heat sensor circuit OK?	□	Yes	□	No

E. Control Components:

1.	Verify all electrical components are locally available	□	Yes	□	No

F. Alarms:

1.	High water alarm light and horn activate with test button	□	Yes	□	No
2.	Horn silences with silence button.	□	Yes	□	No
3.	High water alarm light and horn activate with float.	□	Yes	□	No

G. Float Settings:

1. Lead pump kicks on at Elv. _____ from wet well bottom
2. Lead pump kicks off at Elv. _____ from wet well bottom
3. Lag pump kicks on at Elv. _____ from wet well bottom
4. Lag pump kicks off at Elv. _____ from wet well bottom
5. Back up pump kicks off at Elv. _____ from wet well bottom
6. Back up pump kicks of at Elv. _____ from wet well bottom
7. Height of influent sewer above floor of wet well _____
8. Height of high water alarm above floor of wet well _____

9. Top of basin Elev._____
10. Total basin depth_____

Remarks: _____

III. PUMPS AND MOTORS

A. Operation:

1.	Are pumps running quietly?				
	a. Pump # 1	□	Yes	□	No
	b. Pump # 2	□	Yes	□	No
	c. Pump # 3	□	Yes	□	No
2.	Are motors running quietly?				
	a. Pump #1	□	Yes	□	No
	b. Pump # 2	□	Yes	□	No
	c. Pump # 3	□	Yes	□	No
3.	Is excessive vibration noted?				
	a. Pump #1	□	Yes	□	No
	b. Pump # 2	□	Yes	□	No
	c. Pump #3	□	Yes	□	No

B. Installation

1.	Are guide rails exactly vertical (plumb)?	□	Yes	□	No
2.	Is base elbow installed level?	□	Yes	□	No

Remarks: _____

IV. REMOTE MONITOR PANEL

A. Verify start-up procedure completed properly and put "On-Line" with the Wastewater Plant by remote monitor panel suppler. □ Yes □ No

V. VALVES

A. Check valves:

1.	Do clappers swing freely?	□	Yes	□	No
2.	Does packing leak?	□	Yes	□	No
3.	Are counter weights adjusted properly?	□	Yes	□	No

B. Plug valves:

1.	Do valves open and close freely?	□	Yes	□	No
2.	Does packing leak?	□	Yes	□	No
3.	During operation, are all gates completely open?	□	Yes	□	No

Remarks: _____

_____

_____

_____

VI. PUMP STATION TESTING

A. Draw Down Test

Diameter of wet well _____

(5'-0" = 150 gal/ft 6'-0"-212 gal/ft 7'-0"-288 gal/ft 8'-0"-376 gal/ft)

	Time	Depth	Vo. Per Unit Depth	Total Vol.	Pump Capacity
Pump # 1 On	_____	_____	_____	_____	_____
Pump # 1 Off	_____	_____	_____	_____	_____
Pump # 2 On	_____	_____	_____	_____	_____
Pump # 2 Off	_____	_____	_____	_____	_____
Pump # 3 On	_____	_____	_____	_____	_____
Pump # 3 Off	_____	_____	_____	_____	_____
Pump # 4 On	_____	_____	_____	_____	_____
Pump # 4 Off	_____	_____	_____	_____	_____
Pump #1,2 On	_____	_____	_____	_____	_____
Pump #1,2 Off	_____	_____	_____	_____	_____
Pump #1,3 On	_____	_____	_____	_____	_____
Pump #1,3 Off	_____	_____	_____	_____	_____
Pump #2,3 On	_____	_____	_____	_____	_____
Pump #2,3 Off	_____	_____	_____	_____	_____
Pump #1, 4 On	_____	_____	_____	_____	_____
Pump #1, 4 Off	_____	_____	_____	_____	_____
Pump # 2,4 On	_____	_____	_____	_____	_____
Pump # 2,4 Off	_____	_____	_____	_____	_____
Pump #3,4 On	_____	_____	_____	_____	_____
Pump #3, 4 Off	_____	_____	_____	_____	_____

B. Pressure Test

1. No Pumps Running – Static Back Pressure: _____
2. Pump No. 1 Operating – Pressure: _____
3. Pump No. 2 Operating – Pressure: _____
4. Pump No. 3 Operating – Pressure: _____
5. Pump Nos. 1 & 2 Running – Pressure: _____
6. Pump Nos. 2 & 3 Running – Pressure: _____
7. Pump Nos. 1 & 3 Running 0 Pressure: _____

Remarks: _____

VII. EQUIPMENT

A. Pumps

B. Motors

C. Pump Circuit Breaker

D. Starters

E. Heaters

F. Control Circuit Breaker

G. Remote Monitor Circuit Breaker

H. Alternator

I. H-O-A Switches

J. Plug Valves

K. Check Valves

L. Pressure Gauge

M. Transducer

N. Floats

O. Other

Remarks: _____

_____

_____

_____

VIII. COVERT ALARM SYSTEM

A.	Do latches on control panel work smoothly?	□	Yes	□	No
B.	Code indication functioning				
	1. Pump overload trip	□	Yes	□	No
	2. Crew on site key switch	□	Yes	□	No
	3. Wet well high water	□	Yes	□	No
	4. Dry pit high water or submersible seal failure	□	Yes	□	No
	5. Power failure	□	Yes	□	No
	6. Open	□	Yes	□	No
	7. Restore to normal	□	Yes	□	No
	8. Low battery	□	Yes	□	No

Remarks: _____

_____

_____

_____

I CERTIFY THIS REPORT IS ACCURATE

_____
Start-up date/time

_____ _____
Start-up Coordinator Factory Representative

_____ _____
Wastewater Utility Superintendent Wastewater Utility Operator

_____ _____
Engineer Contractor

SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 Summary

A. Section Includes

1. General reference standards, rules and regulations that govern construction work, alterations, repairs, mechanical installations and appliances connected therewith
2. Abbreviations used in these Specifications

1.02 Quality Assurance

A. Regulatory Requirements: Work shall comply with the following:

1. Occupational Safety and Health Act
2. Indiana State Construction Industry Safety Code
3. State Building rules and regulations of the Indiana Department of Homeland Security Fire and Building Safety Division
4. Indiana State Fire Marshal
5. Indiana Department of Environmental Management
6. Indiana Department of Natural Resources
7. Army Corps of Engineers
8. National Electric Code
9. National Electric Safety Code
10. Uniform Building Code
11. Life Safety Code
12. Utility regulations
13. Local ordinances, state, and federal rules and regulations pertaining to the Work

B. Such rules, regulations and ordinances are to be considered part of these Specifications.

C. Fees for licenses shall be paid by the Contractor.

1.03 Reference Abbreviations

A. Reference to a technical society, trade association or standards setting organization may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAR	Association of American Railroads
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-Friction Bearing Manufacturers Association
A-E	Architect/Engineer
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
APA	The Engineered Wood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute

CISPI	Cast Iron Soil Pipe Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
FS	Federal Specifications
FHWA	Federal Highway Administration, Department of Transportation
FM	Associated Factory Mutual Laboratories
GANA	Glass Association of North America
HPVA	Hardwood Plywood and Veneer Association
ICEA	Insulated Cable Engineers Association
IDEM	Indiana Department of Environmental Management
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
IGCC	Insulating Glass Certification Council
INDOT	Indiana Department of Transportation
IPCEA	Insulated Power Cable Engineers Association
ISPC	Indiana State Plumbing Code
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NAIMA	North American Insulation Manufacturers Association
NAVFAC	U.S. Naval Facilities Engineering Command
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NIST	National Institute of Standards and Technology
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCI	Precast Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PFI	Pipe Fabricators Institute
SAE	Society of Automotive Engineers
SPECS	Specifications
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry
SSPC	The Society for Protective Coatings
STI	Steel Tank Institute
TCNA	Tile Council of North America
UL	Underwriter's Laboratories, Inc.
USBR	US Bureau of Reclamation
WWPA	Western Wood Products Association

1.04 Definitions

Acceptance: The formal written acceptance by the Town of Chandler (Town) of an entire project which has been completed in all respects in accordance with the approved Plans, Specifications, and these Standards including any previously approved modifications thereof.

Adequate Public Facilities: Facilities determined to be capable of supporting and servicing the physical area and designated intensity of the proposed subdivision as determined by the Town Council based upon specific levels of service.

Backfill: Earth and/or other material used to replace material removed from trenches during construction which is above the pipe bedding.

Bedding: That portion of the trench backfill which encases the sewer or water pipe to a minimum depth above and below the bell/barrel of the pipe for the purpose of properly supporting the pipe.

Building Sewer (lateral): The conduit for transporting waste discharged from the building to the public sewer commencing three (3) feet outside the building walls and ending at the wye or tee fitting at the connection to the public sewer.

Comprehensive Plan: A plan, or any portion thereof, adopted by the Town Council, showing the general location and extent of present and proposed physical facilities including residential, industrial, and commercial uses, major streets, parks, schools, and other community facilities. This plan establishes the goals, objectives, and policies for the physical development of the Town.

Contractor: Any Contractor who meets the Town's requirements and is licensed to enter into contracts for and to perform the work of installing sewers.

Construction Plan: The maps or drawings accompanying a subdivision plat and showing the specific location and design of improvements to be installed in the subdivision in accordance with the requirements of the Plan Commission as a condition of the approval of the plat.

County: The County of Warrick, State of Indiana

Design Criteria: Standards that set specific improvement requirements.

Drainage: Surface water runoff and the removal of water from land by drains, grading or other means during and after construction or development.

Drop Manhole: A manhole having a vertical drop pipe connecting the inlet pipe to the elevation of the outlet pipe. The vertical drop pipe shall normally be located immediately outside the manhole.

Easement: Easements are areas along the line of all public sanitary sewers, storm sewers, and water lines which are outside of dedicated utility or road easements or rights-of-way, and are recorded and dedicated to the Town granting rights along the line of the sewer. Easements shall be exclusively for the new sanitary sewers. No other easements shall be constructed or encroach upon the easement except with the expressed written approval of the Town.

Elevation: A vertical distance above or below a fixed reference level, or a flat scale drawing of the front, rear or side of a building.

Engineer: The Engineer for the Owner.

Erosion: The detachment and movement of soil, sediment or rock fragments by water, wind, ice or gravity.

Erosion and Sediment Control Measure: A practice or a combination of practices to control erosion and resulting off-site sedimentation.

Erosion and Sediment Control Plan: A written description and drawings of pertinent information concerning erosion and sediment control measures designed to meet the requirements of this ordinance.

Excavation: Removal by any means whatsoever of soil, rock, minerals, mineral substances or organic substances other than vegetation, from water or land on or beneath the land surface thereof, whether exposed or submerged.

Existing Grade or Elevation: The vertical location of the ground surface prior to excavating or filling.

Flood Elevation: The maximum level of high waters for a flood of given return period and rainfall duration.

Grade: The average level of the finished surface of the ground adjacent to the exterior walls of the building or structure. (May also refer to the slope of a roadway along the centerline.)

Infiltration/Inflow: The total quantity of water from both infiltration and inflow without distinguishing the source.

Inlet: An opening into a storm sewer system for the entrance of surface water runoff, more specifically defined as a storm water inlet.

Inspector: An agent of the Town assigned to make detailed inspections of any or all portions of the work and materials. The inspector has full authority to reject materials and/or any portion of the work not supplied and installed in accordance with these Standards.

Land Disturbing Activity or Non-Agricultural Land Disturbing Activity: Any manmade change of the land surface including removing vegetative cover, excavating, filling, transporting, and grading. It includes any activity requiring a Town of Chandler Improvement Location Permit, but does not include agricultural land uses.

Lift Station: Any arrangement of pumps, valves and controls that lift and/or convey wastewater to a higher elevation.

Local Government: The Town Council of the Town of Chandler.

Maintenance Guarantee: Any security that may be required and accepted by the Town Council to assure that necessary improvements will function as required for a specific period of time.

Manhole: A storm or sanitary sewer structure, through which a person may enter to gain access to a storm or sanitary sewer or other enclosed structure. A manhole may also be an inlet for the storm sewer system.

Monument: A permanent marker conforming to the requirements of this Ordinance used to identify the location of a property corner or other survey point

Municipality: See *Local Government*.

Non-Residential Subdivision: A subdivision whose intended use is other than residential, such as commercial or industrial

Official Zoning Map: The map established by the Town Council, pursuant to law, showing the streets, highways, parks, drainage systems and setback lines laid out, adopted, and established by law, and any amendments or additions thereto adopted by the Town Council resulting from the approval of subdivision plats by the Plan Commission and the subsequent filing of the approved plats.

Off-Site: Any premises not located within the area of the property to be subdivided, whether or not in the common ownership of the applicant for subdivision approval.

Other Specifications and Materials: Wherever in these Standards other specifications or regulations are mentioned, it shall be understood that the materials and methods mentioned therewith shall conform to all requirements of the latest revision of the specifications so mentioned.

Owner: Any individual, partnership, firm, corporation or other entity who, as property owner, is initiating the work.

Pavement: That part of a street having an improved surface or brick, paving stone, concrete, or asphalt placed on the surface of the land.

Pavement Markings: Painted, thermoplastic, or other Town approved method of providing regulatory striping, including turn lane arrows and “Only” designations, onto the street or road surface.

Plans: Construction plans, including system maps, sewer plans, and profiles, cross sections, utility plans, detailed drawings, etc., or reproductions thereof, approved or to be approved by the Town Engineer which show location, character, dimensions and details of the work to be done.

Primary Plat: The primary drawing or drawings, indicating the proposed layout of the subdivision to be submitted to the Plan Commission for approval.

Project: All work to be completed under the Town’s permit in accordance with the approved plans, specifications, these Standards and the permit conditions.

Record Drawings (As-Builts): Plans certified, signed and dated by a professional engineer registered in the State of Indiana, indicating that the Plans have been reviewed and revised, if necessary, to accurately show all as-built construction and installation details including, but not limited to, key elevations, locations, and distances.

Registered Engineer: An engineer properly licensed and registered in the State of Indiana.

Regulatory Signs: Signs established by Ordinance and posted within the public road right-of-way to control motorist behavior. (Stop signs, No Parking signs, etc.)

Right-of-Way: A strip of land occupied or intended to be occupied by a street, crosswalk, railroad, road, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer main, shade trees, or for any other special use. The usage of the term "right-of-way" for land platting purposes shall mean that every right-of-way hereafter established and shown on a secondary plat is to be separate and distinct from the lots or parcels adjoining such right-of-way and not included within the dimensions or areas of such lots or parcels. Rights-of-way intended for streets, crosswalks, water mains, sanitary sewers, storm drains, shade trees, or any other use involving maintenance by a public agency shall be dedicated to public use by the maker of the plat on which such right-of-way is established.

Road Right-of-Way Width: The distance between property lines measured at right angles to the centerline of the street.

Sewer: A pipe or conduit for carrying wastewater (sanitary sewer) or storm water (storm sewer).

Sidewalk: A paved, surfaced, or leveled area, usually parallel to and separate from the street, used as a pedestrian walkway.

Specification: A detailed instruction that designates the quality and quantity of materials and workmanship expected in the construction of streets and roads.

Standard Drawings: The drawings of structures, sanitary sewer lines, or devices commonly used and referred to on the Plans and in these Standards.

Standards: The Sanitary Sewer and Transportation Design and Construction Standards for the Town of Chandler, Indiana as contained herein and all subsequent additions, deletions, or revisions.

Storm Water Drainage System: All means, natural or manmade, used for conducting storm water to, through or from a drainage area.

Structure: Anything constructed or erected, the use of which requires permanent location on the ground or attached to something having a permanent location on the ground.

Substantial Completion: The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the project plans and specifications, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

Subsurface Drain: A tile drain installed for the purpose of lowering the ground water table.

Ten State Standards (Sewage Works): Recommended Standards for Sewage Works, latest edition, developed by the Committee of the Great Lakes – Upper Mississippi River Board of State Sanitary Engineers.

Tile Drain: A perforated drain required parallel to a swale or ditch.

Town: The Town of Chandler, Indiana

Town Engineer: Authorized Agent by the Town of Chandler.

Uniform Plumbing Code: The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition.

Watercourse: The meaning of watercourse shall include channel, creek, ditch, river or stream.

Work: All the work to be done, in accordance with the approved Plans, Specifications, these Standards and permit conditions.

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SECTION 02220 - TRENCHING, BACKFILLING AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.01 Summary

A. Section Includes: Performing surface preparation and excavation work as required for the installation of utilities and appurtenances including excavation, trenching, bedding, backfilling and other related work.

B. Related Sections

1. Section 02101 - Storm Water Pollution Prevention and Erosion Control
2. Section 02730 - Gravity Sanitary Sewer Systems

1.02 References

A. American Society for Testing and Materials (ASTM), latest editions

1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance (flowable fill)
2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
3. ASTM D6024 - Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application (flowable fill)
4. ASTM D6103 - Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM) (flowable fill)

B. Indiana Department of Transportation (INDOT) Standard Specifications, latest edition

1. Section 213 – Flowable Backfill (flowable fill)
2. Section 904 – Aggregates

C. Occupational Safety & Health Administration (OSHA) Regulations (Standards – 29 CFR), latest editions

1. Part 1926 – Safety and Health Regulations for Construction (excavations >20 feet deep)

1.03 Definitions

A. Bedding – Granular material placed beneath the pipe to establish line and grade and to provide pipe support.

B. Final (Trench) Backfill – Granular or other specified material placed from the top of the Initial Backfill to the top of the trench, or to just beneath the surface to be restored.

C. Granular Backfill – Class 1 or Class 2 material as described in 2.01 A and B.

D. Haunching – Granular or other specified material placed from the top of the bedding to the springline (center) of the pipe, installed uniformly in lifts on each side of the pipe, and shoveled under the sides of the pipe to provide resistance against soil and traffic loading.

E. Initial Backfill – Granular or other specified material placed from the springline of the pipe to the specified height above the crown of the pipe, to provide adequate pipe support and to protect the pipe from damage due to compaction of the final backfill.

F. Pavement/Structure Loading Zone - the area within 5 feet of any edge of pavement, curb, gutter, sidewalk, building, or other structure.

1.04 Submittals

A. Product Data

1. Class I material source and gradation
2. Class II material source and gradation
3. Flowable Fill Mix Design
    a. Provide mix design which includes:
        1) List of all ingredients
        2) Source of the materials
        3) Gradation of aggregates
        4) Names of admixtures and dosage rates
        5) Batch weights
        6) Mix design designation number
    b. If requested, provide a trial batch demonstration.
    c. Provide test data from a laboratory inspected by the Cement and Concrete Reference Laboratory that shows the proposed mix design is in accordance with the requirements listed in this specification.

B. Quality Control Submittals

1. Backfill Compaction Test Results
2. Flowable Fill Test Results
    a. Unconfined Compressive Strength
    b. Flow Consistency
    c. Setting and Early Strength
3. Delivery Tickets

1.05 Quality Assurance

A. Qualifications
   1. Provide the services of a qualified, independent testing laboratory to perform all field tests.

1.06 Warranty

A. Refill and restore to the original grade settlement in the backfill which takes place within the 1-year warranty period at no additional cost to the Town. Restore the surface area where settlement has occurred, including, but not limited to seeding, fertilizing, erosion control and restoration of streets, drives, yards, and sidewalks.
B. Guarantee all disturbed and replaced trees and shrubs for a period of 1 year from date of substantial completion of project.

PART 2 - PRODUCTS

2.01 Bedding and Backfill Material Classifications

A. Class I: Angular, 6 to 40 millimeters (1/4 to 1-1/2 inches) graded stone such as crushed stone. No. 8 gravel possessing a minimum 50 percent mechanical crush count, and meeting the following nominal sizes and percents passing will be considered an equivalent Class I material:
   1. 100 percent passing 1-inch sieve
   2. 75-95 percent passing 3/4-inch sieve
   3. 40-70 percent passing 1/2-inch sieve
   4. 0-15 percent passing No. 4 sieve
B. Class II: Coarse sands and gravel-sand mixtures with a maximum particle size of 40 millimeters (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. Provide Class II material which meets the requirements of INDOT Standard Specifications Section 904 classification for Structure Backfill.
C. Excavated Material: Excavated material suitable for use as trench backfill must be clean and free of rocks and frozen soil lumps larger than 6 inches, wood, debris, or other extraneous material.
D. Flowable Fill: Removable, self-leveling, self-compacting, flowable material with a minimum unconfined compressive strength (28 day) of 50 psi and a maximum unconfined compressive strength of 150 psi. Provide Removable Flowable Backfill material which meets the requirements of INDOT Standard Specifications Section 213 and Section 904 classification for Type 4 Structure Backfill.

2.02 Sheeting and Bracing

A. Provide sheeting, shoring and bracing capable of sustaining the lateral forces of the trench and pit banks and that comply with all applicable OSHA requirements. Protective systems for excavations 20 feet deep or greater must be designed and certified by a registered Professional Engineer.

PART 3 - EXECUTION

3.01 Preparation

A. Planning
   1. Maintain traffic flow at all streets and service drives during construction.
   2. Farm fences shall not be cut when gates are available within a reasonable distance to move equipment from one field to another.
   3. Comply with the terms and limits of easements. Obtain property access permission prior to accessing or traversing yards or fields outside easements.
B. Protection
   1. Before any excavation is started, provide adequate protection for all lawns, trees, landscape work, shrubs, fences, hydrants, sidewalks, utility poles, and other objects that are to remain in place.
   2. Maintain such protection for as long as necessary to prevent damage from operations.
   3. Movable items such as mailboxes and roadway signs may be temporarily relocated during construction unless shown otherwise on the Drawings. Reinstall movable items in their original location immediately after backfilling and compacting is complete. Replace movable items damaged during construction with new items at the Contractor's expense.
   4. Verify the location of existing storm sewers, sanitary sewers, water mains, gas mains, electric ducts, telephone ducts, utility services, and other underground structures. Determine the exact location of and the means of protection for these facilities and structures. Protect, support and maintain operation of these facilities during construction.
C. Site Preparation
   1. Complete site clearing and grubbing.
   2. Remove existing pavement and walks from the areas of excavation.
   3. Strip topsoil and vegetation from the areas of excavation.
      a. Clean topsoil may be stockpiled for reuse.

b. Do not mix grass, weeds, roots, brush, and stones larger than 1-inch in diameter with stockpiled topsoil. Dispose of root contaminated topsoil.

3.02 Excavating

A. Excavate carefully and cautiously to avoid damaging existing underground utilities and structures.
   1. Repair, or have repaired, existing utilities and structures broken or otherwise damaged during Construction.
   2. Immediately bring to the attention of the Town any unforeseen conflicts with existing utilities exposed during excavation and preparation of trenches and pits.
   3. If proposed utility cannot be installed at locations shown on the Drawings, contact the Town as soon as is practicable so adjustments in its alignment or relocation of the existing utilities can be discussed and approved by the Town.

B. Store excavated materials suitable and necessary for backfilling in a neat pile adjacent to the excavation in a manner that will not interfere with traffic. Do not place such materials at heights or within the proximity of excavations where they may cause earth slides or cave-ins. Do not stockpile excavated material closer than 2 feet from the top edge of the excavation wall at ground surface.

C. Remove excavated material not suitable for backfilling and excess suitable material from the job site. Dispose of the materials in accordance with all local, state, and federal regulations.

D. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering excavations. Use appropriate measures to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Filter water from dewatering operations to remove sediment before discharge in accordance with Section 02101.

3.03 Sheeting and Bracing

A. Properly shore, sheet, brace, or cut back at the proper slope, all excavations to safely install utilities and to protect adjacent streets and structures.

B. The Contractor is responsible and accountable for all sheeting and bracing used. Damages to persons or property resulting from the improper quality, strength, placement, maintenance and removal of the sheeting, shoring, and bracing, including damage to trees, shrubs, walkways and other property are the sole responsibility of the Contractor.

3.04 Trenching

A. Excavate trenches to the depths and widths shown or as required for the proper installation of the pipe and appurtenances.

B. Excavate trenches in straight lines. Trenches shall be as near vertical as possible and properly sheet and/or brace, as required. Perform open cut excavation except where otherwise approved or noted on Drawings.

C. Provide a continuous, uniform bearing support for the pipe on bedding within the trench, dished to provide circumferential support to the lower third of each pipe. Dig out holes to receive pipe bells.

D. Remove rock and soft material encountered in the trench which, in the opinion of the Town is incapable of providing adequate bearing to support the pipe. Remove material to accommodate the minimum specified bedding depth below the required elevation and fill with Class I or Class II material as specified. Field measure with the Town any locations where additional granular backfill is required due to rock or soft material, prior to backfilling.

E. Do not open more than 50 feet of trench in advance of the installed pipe, unless otherwise directed or permitted by the Town. Excavate the trench within 6 inches of full depth for a distance of at least 30 feet in advance of the pipe installation, unless otherwise directed or permitted.

F. Support all sewer, gas, water or other pipes or conduits crossing the trench to prevent damage and service interruptions. The manner of supporting such pipes or conduits will be subject to the approval of the Town and/or the inspector under the direction of the Town.

G. Provide adequate sheeting and bracing in trenches and pits to protect life, property and the Work. Renew and maintain sheeting, planking, timbering, shoring, bracing, and bridging, and do not remove until sufficient backfill has been placed to protect the pipe.

H. Where rock is encountered in excavations, remove the rock by mechanical means. Where practical, use a rock trencher which produces excavated material commensurate to granular backfill, which can then be used as bedding for pipe in areas of rock excavation. Blasting is not permitted.

I. Where sanitary force mains are to be installed under asphalt or concrete driveways, roads or streets, install the main by boring a hole and inserting the main in the bore hole. No casing shall be required unless so indicated on the Drawings. No addition payment shall be made for uncased borings.

3.05 Trench Backfill

A. Specifications regarding trench backfilling also apply to excavated pits.

B. Do not backfill trenches until all piping and utilities have been inspected by the Town.

C. Backfill all trenches within State Highway right-of-way in accordance with INDOT Specifications. Backfill all trenches within the right-of-way of other public authorities having jurisdiction in accordance with requirements of the public authority.

D. For any trench that intersects any portion of the pavement loading zone use Class I backfill materials and use 2:1 structure loading zone rule for the placement of compacted bedding and backfill materials.

E. Comply with details shown on the Drawings for the placement of bedding and backfill materials for each pipe material.

F. Placement and Compaction Requirements:
   1. Place Bedding, Haunching, and Initial Backfill materials in 6 to 8-inch balanced lifts to ensure proper compaction and filling of all voids.
   2. Use procedures and equipment for the Standard Proctor compaction test in accordance with ASTM D698/AASHTO T99.
   3. Outside the pavement/structure loading zone:
      a. Place final backfill in maximum 12-inch lifts.
      b. Compact each layer to a minimum of 90 percent of the maximum Standard Proctor dry density.
      c. Additional compaction if required to minimize settling. Limited mounding of backfill above finish grade may be performed to compensate for settlement with the approval of the Town.
      d. Place 6 inches of topsoil over areas to be seeded.
   4. Within the pavement/structure loading zone:
      a. Place final backfill in 6 to 8-inch lifts, except place final 12 inches in 6-inch lifts.
      b. Compact each layer to 95 percent of the maximum Standard Proctor dry density, except the final 12 inches under pavement, compact each 6-inch lift to 100 percent of the maximum Standard Proctor dry density.
      c. Prepare upper portion of trench for pavement replacement as applicable.
   5. Stone and unpaved driveways and alleys:
      a. Place final backfill in 6 to 8-inch lifts.
      b. Compact each layer to 95 percent of the maximum Standard Proctor dry density.
      c. Replace the last 12 inches of surface with the same material as the original surface unless otherwise specified and compact to 100 percent of the maximum Standard Proctor dry density.
   6. Footers:
      a. Use Class I material
      b. Place in 6 to 8-inch lifts
      c. Compact each layer to 100 percent of the maximum Standard Proctor dry density.

G. Compaction Procedures
   1. Place trench backfill in balanced lifts to ensure proper compaction and filling of all voids.
   2. Class I material: Shovel slice or otherwise carefully place; walk or hand tamp into place.
   3. Class II material: For the first 24 inches of backfill over the pipe, use hand-operated tamping devices. Use standard mechanical methods (powered tampers, vibrators, etc.) for the remainder of the trench.
   4. Do not flood or puddle with water to consolidate backfill.
   5. When compaction test results are unsatisfactory, re-excavate, re-compact the backfill and retest until the specified compaction is obtained.

H. Flowable Fill
   1. Discharge the mixture from mixing equipment into the space to be filled. Do not float pipe when placing flowable fill. Bring the flowable fill up uniformly to the fill line. Keep each filling stage continuous.
   2. Protect flowable fill from freezing until the material has stiffened and bleeding water has subsided. As the temperature nears freezing, additional curing time may be needed.
   3. Concrete may be placed on the flowable fill as soon as bleeding water has subsided. Place all pavements on flowable fill according to manufacturer's recommendations.

I. Maintenance of Trenches
   1. Maintain backfilled trenches in a smooth and uniform condition until paving or seeding operations are completed.

3.06 Field Quality Control

A. Tests
   1. Class II Compaction Tests: Perform compaction tests for Class II trench backfill material in accordance with ASTM D698 and as follows:
      a. At each road crossing: vertically at 2-foot intervals in the trench
      b. At every 1,000 feet longitudinally in roadways along the pipe alignment and vertically at 2-foot intervals in the trench
      c. Notify the Town 24 hours prior to the tests so that he may be present for the compaction tests.
      d. No additional payment will be made for compaction tests. Compaction tests are considered incidental to the Work.
   2. Flowable Fill Tests: Perform the following tests for flowable fill:
      a. Unconfined Compressive Strength
      b. Flow Test: Conduct flow consistency testing in accordance with ASTM D6103 by filling a 3-inch diameter by 6-inch high open-ended cylinder placed on a smooth, nonporous, level surface. Pull the cylinder straight up within 5 seconds and measure the spread of the fill. The diameter of the spread shall be 8 inches or more with no noticeable segregation.

c. Setting and Early Strength Test: Determine whether the flowable fill has hardened sufficiently for loads to be applied and construction activities to continue by conducting one of the following tests:
   1) Penetration Resistance test in accordance with ASTM C403 – minimum value of 500 psi required for loading
   2) Ball Drop test in accordance with ASTM D6024 – maximum indentation diameter of less than 3 inches required for loading

3.07 Material Disposal

A. All existing utility infrastructure and appurtenances (piping, structures, etc.) that are to be replaced or removed to allow for new construction are the responsibility of the Contractor. As these materials are excavated, remove them from the job site and dispose of them in accordance with applicable local, state and federal rules and regulations.

-END-

SECTION 02224 – TRENCHLESS EXCAVATION – HORIZONTAL BORINGS

PART 1 - GENERAL

1.01 Scope

A. Furnish and install casing pipes beneath highways, railroads, and/or other locations as required including related work necessary to complete work as specified.

B. Related Sections

1. Section 02220 - Trenching, Backfilling and Compaction for Utilities
2. Section 02730 – Gravity Sanitary Sewer Systems
3. Section 02733 - Testing Sanitary Sewers
4. Section 02737 - Force Main Sewer Systems

1.02 Permits

The permits for crossing(s) shall be obtained by the Owner. The Contractor shall give notification to the applicable agency or officials prior to the start of the work. Work shall not commence until all arrangements are completed and permission to start work is given by the INDOT District Highway Engineer, County Highway Engineer, Railroad Authority, or authorized representative as applicable.

1.03 Borings and Casings

The Contractor shall be responsible for installing welded steel pipe casings as shown and specified, in accordance with approved jacking and boring methods. The Contractor shall maintain the lines and grades, as shown, for the entire length of the steel casing. Before beginning any work, the Contractor shall submit to the Town plans and details describing the materials and methods of installation. Work shall not proceed until such plans and methods have been reviewed for conformity with the approved permit by the Town. The review by the Town of any plan or method shall not relieve the Contractor of his responsibility in any way.

1.04 Submittals

A. Quality Control Submittals

1. Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards.
2. Certified copies of reports of factory tests specified in this Section and required by the referenced standards.
3. Plans and details describing materials and methods proposed by the Contractor for use in special crossings.
4. Experience Documentation:
   a. Upon request by the Town the Contractor (or Subcontractor) shall provide documentation showing successful completion of previous horizontal bore installation of piping, or shall obtain the services of an experienced sub-contractor to supervise the installation prior to commencing any work. Conventional trenching shall not be considered as applicable experience.
   b. All supervisory personnel shall be adequately trained and shall have at least four years' experience in this trenchless installation method. If requested the Contractor shall also submit the names and resumes of all supervisory field personnel for review by the Town prior to commencing any work.

1.05 General Procedures

A. The Contractor shall be prepared to attend all meetings and provide all necessary data, reports, information, details, and construction schedules as requested by the governing officials.

B. The Contractor shall notify the Town when each individual boring and receiving pit has been staked in the field. The Contractor shall not proceed with the work until the survey information is obtained for the respective boring location and is approved by the Town.

C. The Town or proper officials shall review and modify as necessary the scheduling of all construction activities under the highway right-of-way to prevent interruption to traffic. The Contractor shall include the cost for such procedures in his bid and shall not be entitled to any change in contract amount.

D. A Town of Chandler Permit must be obtained for proposed boring(s) under roadways within the Town of Chandler. The boring plan and pit locations must be reviewed and approved by the Town. The traffic maintenance plan and boring pit locations shown in the drawings must be in accordance with that review. No deviation will be allowed.

E. An INDOT Permit must be obtained for the proposed boring(s) under State Highways. The traffic maintenance plan and boring pit locations shown in the drawings must be in accordance with that permit. No deviation will be allowed without the approval of the INDOT Permit inspector.

F. A railroad permit must be obtained for the proposed boring(s) under any tracks. The boring pit locations shown in the drawings must be in accordance with that permit. No access to the railroad right-of-way will be allowed.

G. A Warrick County Highway Permit must be obtained for proposed boring(s) under County roadways. The boring plan and pit locations must be reviewed and approved by The Warrick County Highway Department. The traffic maintenance plan and boring pit locations shown in the drawings must be in accordance with that review. No deviation will be allowed without the approval of The Warrick County Highway Department.

H. The Contractor shall notify the proper officials before beginning the installation of casing pipe on each individual boring.

I. All work shall be done in a careful, workmanlike manner to the satisfaction of the proper officials, as well as the Town.

1.06 Related Work Specified Elsewhere

A. Trenching, Backfilling and Compaction for Utilities – Section 02220
B. Trenchless Excavation – Directional Drilling – Section 02226

PART 2 - PRODUCTS

2.01 Steel Casing

A. The casing pipe and joints shall be of steel construction. The casing pipe and joints shall be capable of withstanding the load of traffic or the load of pavement, subgrade, and traffic, as applicable. The casing pipe and joints shall be constructed to prevent leakage of any matter from the casing or conduit throughout its entire length including the ends of the casing pipe.
B. The casing pipe shall be welded steel pipe, new and unused material in accordance with current ASTM Specifications A-139 Grade B for "Electric Fusion of Welded Steel Pipe" with a minimum yield of 35,000 psi. The inside diameter shall be at least 6 inches greater than the largest bell diameter of the conduits main joint.
C. The minimum wall thickness of the casing pipe shall be as shown in the following table:

Diameter of Casing	Minimum Wall Thickness (Inches) Under Highway	Under Railroad
Under 14"	0.250	0.188
14"	0.250	0.219
16"	0.250	0.219
18"	0.250	0.250
20"	0.375	0.281
22"	0.375	0.312
24"	0.375	0.344
26"	0.375	0.375
28"	0.500	0.406
30"	0.500	0.406
32"	0.500	0.438
34"	0.500	0.469
36"	0.500	0.469
38"	0.500	0.500
40"	0.500	0.500
42"	0.500	0.500

D. The exterior walls of casing shall be coated with protective coal tar or bitumastic material, after the welding of each joint has been completed.
E. When casing is installed without benefit of a protective coating and the casing is not cathodically protected, the wall thickness shown above shall be increased to the nearest standard size, which is a minimum of 0.063 inch greater than the thickness shown except for diameter under 12-3/4 inches.
F. The diameter, gauge, ASTM specification and manufacturer's name must be marked on the exterior of each pipe length.
G. Install casing pipe spacers to provide uniform support throughout the entire length of the casing. Casing pipe spacers shall have stainless steel bands and risers, plastic liner and runners as manufactured by Cascade Waterworks Manufacturing Company or approved equal.

PART 3 - EXECUTION

3.01 Installation of Casing Pipe

A. The casing operation and installing shall proceed from a pit, excavated at a minimum of 30 feet from the edge of the improvement and shall be constructed without interruption to traffic. Prior to entering property to do work, the Contractor is responsible to contact the Owner of said improvement.
B. The conduit shall be installed inside a casing pipe of the length indicated on the plans. Except as otherwise permitted by the above mentioned permits; the casing pipe shall be bored or jacked into place to satisfactory alignment and grade for its entire length. Where indicated on the drawings, open cut installation of casing pipe will be permitted.
C. The jacking pipe shall be constructed to provide not less than 30 feet clearance between the side of the pit adjacent to the road and the edge of pavement of the road measured at right angles. Open trenches shall be properly

sheeted and braced in accordance with all applicable OSHA requirements, when and where sheeting is necessary to provide safe working conditions and protection for highway, roads, structures, and utilities.

D. Provide, maintain during casing and conduit installation, and backfill pits at locations shown on plans or as directed by the Town. Excavation for pits shall be sheeted as necessary, in accordance with all applicable OSHA requirements. Excavation and backfilling shall be as specified in Section 02220.
E. Remove all excavated material and replace or change existing structures or utilities encountered to the satisfaction of the Town.
F. Install casing pipe by Directional Drilling under highways at the required locations and elevations shown on the Drawings as specified in Trenchless Excavation – Directional Drilling - Section 02226. All work shall be in strict accordance with the authority having jurisdiction. Contractor shall not proceed with work until notified that crossing permits are approved.
G. Casings under railroads shall be set as shown on Drawings with top not less than 5-1/2 feet below base of the rails. Casing shall be a minimum of 99 feet long centered under the track and measured at normal angle to centerline of track.
H. After casings are installed, push successive lengths of pipe through and make connections to the mains. Ends of casing pipe shall be blocked up in such a way as to prevent the entrance of foreign material, and shall be tightly sealed. Grouting of the void space between the casing and the sewer main shall not be required.

3.02 Construction of Casing Pipe by Methods Other Than Jacking or Boring

The installation of the casing pipe by methods other than the jacking method must be performed in a manner which meets with prior approval of the authorities. Any expense incurred in connection with the construction of the crossing, removal, replacement, or maintenance resulting from the construction of the casing pipe and the conduit shall be at the expense of the Contractor.

3.03 Installation of Conduit

A. The conduit designated on the Drawings shall be as specified in other Sections for the type of conduit.
B. Jointing of the conduit pipe shall be as specified in other Sections for the type of pipe material and joint fittings.
C. Fill or plug the space between the outer shell of the conduit and casing at the ends of the casing pipe to provide a watertight seal.
D. Place the conduit into and through the steel casing at locations shown on Drawings. Employ suitable methods to maintain tight joints, to the satisfaction of the Town.
E. Each end of the casing pipe shall be referenced to a minimum of two (2) permanent reference points for Record Drawing purposes.

-END-

SECTION 02226 - TRENCHLESS EXCAVATION - DIRECTIONAL DRILLING

PART 1 - GENERAL

1.01 Scope

A. Furnish and Install force main by the directional drilling method within the limits indicated on the Drawings and performing all related work necessary to complete work shown and specified.

B. Related Sections

1. Section 02101 - Storm Water Pollution Prevention and Erosion Control
2. Section 02220 - Trenching, Backfilling and Compaction for Utilities
3. Section 02730 – Gravity Sanitary Sewer Systems
4. Section 02733 - Testing Sanitary Sewers
5. Section 02737 - Force Main Sewer Systems

1.02 Permits

Permits for roadway crossing(s) shall be obtained by the Town. The Contractor shall give notification to the applicable agency or officials prior to the start of the work. Work shall not commence until all arrangements are completed and permission to start work is given by the INDOT District Highway Engineer, County Highway Engineer, Railroad Authority, or authorized representative as applicable.

1.03 Submittals

A. Quality Control Submittals

1. Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards
2. Certified copies of reports of factory tests specified in this Section and required by the referenced standards
3. Details of equipment and written procedure with working drawings describing in detail the proposed boring method and the entire operation to be used as described
4. Documentation of experience requirements per paragraph 1.04A.

1.04 Quality Assurance

A. Qualifications

1. Demonstrate experience and expertise in trenchless excavation methods by providing a list of 6 references for whom similar work has been performed prior to commencing any work. Include a name and telephone number for each contact.
2. Provide documentation showing successful completion of at least 50,000 linear feet of directional drilling or obtain the services of an experienced directional drilling subcontractor meeting the experience requirements of this section to supervise the installation prior to commencing any work. Conventional trenching is not considered as applicable experience.
3. Adequately train all supervisory personnel and ensure they have at least 4 years of experience in directional drilling. If requested by the Town submit the names and resumes of all supervisory field personnel for review by the Town prior to commencing any work.

B. Regulatory Requirements

1. Perform all directional drilling work in accordance with laws, permits, requirements and regulations of the authority having jurisdiction of the Rights-of-Way.

C. General Procedures

1. Attend all meetings and provide all necessary data, reports, information, details and construction schedules as requested by the Town.

2. Complete all work in a careful, workmanlike manner to the satisfaction of the Town.

PART 2 - PRODUCTS

2.01 Pipe

Meet the requirements as specified in Section 02730 or as otherwise required by the Director of Public Services.

PART 3 - EXECUTION

3.01 Examination

A. Verify the location of all known and unknown utilities and structures. Perform test pitting as necessary prior to any boring or drilling. These utilities and structures may include, but are not limited to:

1. Underground utilities such as, but not limited to:
   a. Storm drains
   b. Electric cables
   c. Water mains
   d. Sewer lines and septic systems
   e. Gas lines
   f. Telephone lines
   g. Fiber optic lines
   h. Cable television lines
   i. Wells
   j. Field drain tiles

2. Above-ground utilities and other obstructions such as, but not limited to:
   a. Electric and telephone poles
   b. Buildings
   c. Trees
   d. Existing road signs

B. Be responsible for inspecting the site, for conducting investigations, surveys and tests, including subsurface investigations and tests necessary for the complete execution of all the work under this Contract.

3.02 Installation

A. Equipment

1. The directional drilling system to be used must have the following features:
   a. The system shall be remotely steerable and permit electronic monitoring of tunnel depth and location. The system shall be able to control the depth and direction of the pipe and must be accurate to a window of ± 2 inches.
   b. The system shall utilize a fluid-cutting process, using a liquid clay such as bentonite. This clay shall be totally inert and contain no risk to the environment.
   c. The liquid clay shall remain in the tunnel to increase the stability of the tunnel and to provide a lubricant to reduce frictional drag when the pipe is installed.
   d. Recover spoils by use of a vacuum system mounted on a vehicle for removal of the spoils. Do not discharge spoils into sewers or storm drains. Properly dispose of all spoil material.
   e. Equipment shall be fitted with a permanent alarm system capable of detecting an electrical current. The system will have an audible alarm to warn the operator when the drill head nears electrified cables within a safe operating distance. Refer to paragraph 3.02B for additional safety requirements.

B. Safety

1. Mechanical, pneumatic or water-jetting methods are not acceptable due to the risk of surface subsidence and damage.
2. Upon completion of drilling and pipe installation, remove all spoils from all starting and termination pits. Restore pits to their original condition.
3. Where manholes or grinder pumps are to be installed, use adequate protection in the form of steel plates in traffic areas and timber shutters in other areas until such times as the manhole or grinder pump is installed and the pit is backfilled and stabilized. Contractor shall be responsible for maintaining these areas.
4. Because directional drilling may be performed while existing buried electrical cable is energized; meet the following safety requirements:
    a. Include a permanent, inherent alarm system capable of detecting an electrical current on all drilling equipment. Equip the ground system with an audible alarm to warn the operator when the drill head nears electrified cable within a safe operating distance.
    b. Provide all crews with grounded safety mats, heavy gauge ground cables with connectors, hot boots and gloves.
    c. Adequately train all supervisor personnel having direct supervisory experience in directional drilling.

C. General

1. Before beginning any work, submit to the Town plans and details describing the materials and methods which are proposed for use. Do not proceed with the work until such drawings and methods have been reviewed for conformity with the approved permit by the Town. The review by the Town of any drawings or method shall not relieve the Contractor of his responsibility in any way.
2. Notify the Town 48 hours in advance of starting directional drilling work. Do not begin the directional drilling until the Town, or authorized representative, is present at the job site and proper preparations for the operation have been made. The Town's consensus for beginning the installation shall in no way relieve the Contractor of the responsibility for the satisfactory completion of the work as authorized under the Contract.
3. Do not cut or disturb pavement, asphalt or excavate within the relative limits of the roadway surface to retrieve any lost boring appurtenances or equipment.
4. Maintain a log of drilling operations which includes vertical depths of the pipe at established horizontal intervals every 50 feet.

D. Drilling Procedure

1. Grade or fill the work site as indicated on the drawings, within the right-of-way, to provide a level working area. Make no alterations beyond what is required for operations. Confine all activities to the designated work areas and construction limits.
2. Accurately survey the entire drill path and place entry and exit stakes in the appropriate locations within the areas indicated on the drawings. If the Contractor is using a magnetic guidance system, survey the drill path for any surface geo-magnetic variations or anomalies.
3. Place environmental protection necessary to contain any hydraulic or drilling fluid spills as needed, including berms, liners, turbidity curtains and other erosion control measures as specified in Section 02101. Adhere to all applicable environmental regulations. Do not store fuel and oil in bulk containers within 200 feet of any water-body or wetland.
4. Place pipe resting on paved or hardened surfaces (i.e., sidewalks, asphalt, concrete, gravel, etc.) on pipe rollers before being pulled into the drill hole with rollers spaced close enough to prevent excessive sagging and dragging of the pipe upon rough surfaces which could scar the pipe.
5. Calibrate the directional drilling head locator at the start of the day and at each new directional drilling operation. Keep a daily calibration log for the Town's review.
6. Ensure the directional drilling operator has full control of the direction of the drilling tool at all times. Abandon and fill shallow, misdirected or other unsuccessful drills at the direction of the Town and at own expense.
7. The maximum drill angle shall be 15 degrees measured perpendicular to grade to the design depth elevation.
8. Drill a pilot hole on the drill path with no deviations greater than 5 percent of depth over a length of 100 feet. In the event the pilot hole does deviate from the drill path more than 5 percent of depth in 100 feet, notify the Town and the Town may require pull back and re-drill from the location along the drill path before the deviation.
9. In the event of a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns

loss continues, cease operations and notify the Town. The Town and Contractor will discuss additional options and work will then proceed accordingly.

10. Upon successful completion of the pilot hole, ream the drill hole to a minimum of 25 percent greater than the outside diameter of the pipe using the appropriate tools. Do not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
11. After successfully reaming the drill hole to the required diameter, pull the pipe through the drill hole. In front of the pipe will be a swiveling mandrel. Once pull-back operations have commenced, operations must continue without interruption until the pipe is completely pulled into the drill hole. Do not apply more than the maximum safe pipe pull pressure at any time during pull-back operations.
12. Pull back a single strand of tracer wire with the pipe. Tracer wire shall be Copperhead Direct Burial #12 AWG Solid, steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density yellow polyethylene jacket complying with ASTM D1248, 30-volt rating or approved equal. Include the tracer wire in the cost of the pipe.
13. In the event the pipe becomes stuck during pull-back, cease pulling operations to allow any potential hydro-lock to subside and then commence pulling operations. If the pipe remains stuck, notify the Town. The Town and the Contractor will discuss options and then work will proceed accordingly.
14. At all drill pits and directional drilling entrances and exits to the surface, use a backhoe or equivalent to gradually return the bore depth to the prescribed depth.
15. Backfill and compact all drill pits and directional drilling entrances and exits to the surface as specified in Section 02220 - Trenching, Backfilling and Compaction for Utilities.

3.03 Field Quality Control

A. Maintain a daily calibration log of the directional drilling head locator. Provide completed forms or computer generated output to the Town on a daily basis for checking line and grade of the drilling operation.

B. Dig test/pressure relief holes (potholes) as needed along the bore route to confirm alignment and grade, and to relieve subsurface pressure.

C. Replace sections of pipe that do not meet the above requirements at no additional cost to the Town. If the new pipe installed does not meet the above requirements, either grout and abandon the pipe in place, or remove the pipe and fill the void as directed by the Town at no additional cost to the Town.

D. Pressure test the installed sewer as specified in Section 02732.

-END-

SECTION 02730 – GRAVITY SANITARY SEWER SYSTEMS

PART 1 - GENERAL

1.01 Scope

A. Furnish and install all gravity sanitary sewers, manholes and appurtenances as shown on the Drawings and as specified herein.

B. Before installing piping, the Contractor shall carefully verify location, depth, type of joint needed and size of pipe to which connection is proposed. He shall assure himself the lines can be run as designed. Any necessary deviation shall be referred to the Town for final approval prior to construction commencement.

C. All lengths of pipe shall be dimensioned accurately to measurements established at the site, and shall be worked into place without forcing. Cut sections of pipe shall be cut using proper equipment such as a chop saw to provide a beveled end.

1.02 Related Work Specified Elsewhere

A. Section 02220 - Trenching, Backfilling and Compacting for Utilities

B. Section 02733 - Testing Sanitary Sewers

C. Section 02737 - Force Main Sewer Systems

1.03 Quality Assurance

Test all sanitary sewer systems installed in accordance with Section 02733.

1.04 Material Delivery, Storage and Handling

A. Contractor shall be responsible for the delivery, storage and handling of all materials including loading and unloading all pipe, fittings, manhole sections and appurtenances in a manner to avoid shock and damage. Do not drop materials. Lifting shall be by hoists or skids when hand lifting is not feasible. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. Damaged or defective pipe and appurtenances shall be replaced. Store materials in an area safe from damage and deterioration. Keep the interior of pipe, fittings, manhole sections and appurtenances free from dirt and foreign matter. Store gaskets in a cool location out of direct sunlight and free from contact with petroleum products.

1.05 Domestic Product Requirements

All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States unless approved otherwise by the Director of Public Services.

PART 2 - PRODUCTS

2.01 General

A. All pipe, fittings, manholes, and appurtenances shall be as shown on the Drawings and as specified herein. Each length of pipe and fitting shall be plainly stamped, marked or color coded to an acceptable standard as to weight, class, and type thereof, and the manufacturer's trademark or name.

B. Alternate sewer pipe material thickness or types may be necessary for lines that are more than 20 feet deep. Owner shall be responsible for hiring an Engineer licensed by the State of Indiana to determine what the proper pipe wall specification needs to be for main lines and laterals. Engineer will be required to provide documentation to the Town for approval by the Director of Public Works. In lieu of Engineer’s analysis and documentation the Owner may opt to use ductile iron pipe.

C. Alternate sewer pipe materials consisting of ductile iron, concrete encased pipe, or PVC conforming to ASTM D2241 SDR-21 pipe must be used when one or both of the following conditions apply:

1. Where sewers or laterals must cross under existing water mains and cannot achieve or maintain 18” of clearance, use alternate pipe materials for at least one full pipe length centered under the crossing.
2. Where sewers or laterals must be routed horizontally closer than ten (10) feet clearance from existing water mains.

2.02 Polyvinyl Chloride (PVC) Pipe

A. Polyvinyl Chloride (PVC) gravity sewer pipe shall be solid wall PVC gravity sewer pipe. Joints shall be bell and spigot type with elastomeric seals per ASTM D3212, with gaskets conforming to ASTM F-477.

B. Gravity sewer pipe shall be solid wall PVC, SDR-26 conforming to ASTM D3034.

C. Fittings such as wyes, tees, and bends shall be made in such a manner as will provide strength and watertightness at least equal to the class of the adjacent main line pipe to which they are jointed and shall conform to all other requirements specified for pipe corresponding class and internal diameter. Joints shall be of the same type as used on the adjoining pipe. Fabricated branches for wyes and tees shall be securely attached to the wall of the pipe in a watertight manner and shall be flush with the inside surface of the pipe. Ten gage copper tracer wire required on service lines as shown on Drawings.

D. Building service laterals shall be a minimum of 6" diameter PVC SDR-35 or SDR-26 conforming to ASTM D3034.

E. Repair couplings shall be 5000 RC Series by Fernco or Hymax 2000 by Total Piping Solutions, Inc., or approved equal.

2.03 Ductile Iron Pipe (DIP)

Ductile iron pipe and fittings shall conform to the requirements of ANSI/AWWA A21.51/C151 and ASTM A746, Ductile Iron Gravity Sewer Pipe.

A. Thickness class requirements of ductile iron pipe to be used in conveyance of sanitary sewage by gravity shall be Pressure Class 350.
B. Outside surfaces of the pipe and fittings shall be bituminous-coated complying with ANSI/AWWA A21.51/C151 and ANSI/AWWA A21.10/C110.
C. Inside surfaces of all pipes, fittings and adapters shall be lined with cement mortar and a bituminous seal coat. Cement mortar lining and bituminous seal coat shall meet the requirements of ANSI/AWWA A21.4/C104.
D. Ductile iron pipe joints shall be push-on type conforming to ANSI A21.11 (AWWA C111), latest revision. Fittings shall be ductile iron and shall comply with ANSI Specification A21.10, latest revision, with push-on or mechanical joints rated for 150 psi working pressure.

2.04 Manhole and Accessories

A. Manholes shall be constructed of reinforced precast concrete sections conforming to ASTM C478. Base sections shall be a minimum 6-inch thick for 48” diameter manholes and minimum 8-inch thick for greater than 48” diameter. Manhole cones shall be of eccentric cone type. Manhole risers shall be 48" I.D. unless otherwise noted on the Drawings. Eccentric cone sections shall have a 24" opening.
B. All pre-cast concrete shall contain waterproofing additive Xypex or approved equal.
C. All pre-cast concrete for force main receiving manholes and all new manholes within 500 feet upstream and downstream of the receiving manhole shall contain anti-corrosion additive, Conshield or approved equal.
D. Joints for manhole sections shall include a flexible butyl rubber joint gasket conforming to ASTM C-443, or a pre-formed butyl-based flexible rope sealant, Kent Seal or approved equal.
E. Manhole frames and lids shall have machined horizontal and vertical bearing surfaces. Watertight frames and lids for sanitary sewers shall have a grooved rubber gasket with concealed pick holes and shall be as manufactured by East Jordan Iron Works, No. 1022Z1 Frame and 1020AGS Cover or Neenah R-1772-C Frame and Cover or approved equal. All manhole frames and lids shall be watertight unless shown otherwise on the Drawings. Lids shall be imprinted with the words “SANITARY SEWER” in raised letters. All frames and lids shall be products of one manufacturer.
F. Steps for manholes shall be made from steel reinforcing rod encapsulated in a copolymer polypropylene resin as manufacturer by M.A. Industries, Inc., American Step Company, Inc. or approved equal. Manhole steps shall have a minimum of ten (10) inches clear step width.
G. Each manhole shall have precast openings where the pipes enter the manhole. Field core drilled openings for pipe penetrations may be allowed on a case-by-case basis with the written authorization of the Director of Public Services. A flexible molded boot or resilient seal shall be installed to secure the pipe. The boot shall be Kor-N-Seal as manufactured by National Pollution Control Systems Inc. or approved equal. The resilient seal shall be A-Lok or approved equal. Contractor shall apply minimum 4,000 psi quick-set, non-shrink grout to the pipe penetration from inside the manhole.
H. Manhole benchwalls shall be precast or constructed using a concrete mixture with a low cure time and the ability to be troweled to a smooth finish. The benchwall shall exhibit a 28-day compressive strength of no less than 4,000 psi.
I. EZ-Wrap Rubber or EZ-Wrap Plastic joint sealer as manufactured by Press-Seal Gasket Corporation or approved equal product, shall be custom fit, full perimeter seal that meets or exceeds ASTM-C877 (Type II) Standard and passes the ASTM C-1244 vacuum test. Tape shall be 6” wide and shall be overlapped a minimum of 12”. The tape shall not be stretched during application and primer or adhesive as recommended by the supplier shall be employed for adverse conditions. Each barrel section joint and any adjustment rings shall be wrapped in accordance with the Manufacturer’s requirements.
J. Rubber adjustment rings shall be minimum 80% by weight recycled rubber and minimum 10% by volume, recycled RFL coated fiber. All rubber manhole adjustment rings shall meet minimum physical property standards equal to that of the INFRA-RISER rubber adjustment risers as manufactured and supplied by East Jordan Iron Works, Inc., or approved equal. Thickness of the ring shall be between ½” minimum and 2” maximum. Maximum height for adjusting rings shall be 3 @ 2” for a total height of 6”.

PART 3 - EXECUTION

3.01 General

A. Provide all tools, labor and equipment necessary for the safe and expeditious installation of all sanitary sewers, manholes, and appurtenances as shown on the Drawings and specified herein.
B. Inspect sewer pipe, manhole sections and appurtenances prior to installation and promptly remove damaged or unsuitable materials and replace with new and unused materials.

3.02 Installation of Sewer Pipe

A. Sewer pipe shall be laid uniformly to line and grade so the finished sewer will present a uniform bore.

B. The Contractor, at his own expense, shall set line and grade by means of laser beam and target for alignment and grade.
C. Sewer pipe shall be laid progressively upgrade with bell upstream in a manner to form close, concentric joints with smooth bottom inverts.
D. After the joint is made, sufficient bedding material shall be placed along each side of the pipe to prevent conditions that might tend to move the pipe off line or grade.
E. Installed piping systems shall be temporarily plugged at the end of each day's work, or other interruption of progress on a given line. Plugging shall be installed in a manner satisfactory to the Director of Public Services, and it shall be adequate to prevent entry of animals into the pipe or the entrance or insertion of deleterious materials.
F. Where applicable, laterals shall be installed at a minimum slope shall be 1/8" per foot (1%). Install a mechanical plug at the end of each lateral and at the end of all sewer stubs. It shall be the responsibility of the Contractor to install the lateral at a depth and location to allow each customer to connect to the end of the lateral.
G. Install a ½" metal locator rod or "T" post at the end of each sewer lateral for marking. It shall be the responsibility of the Contractor to protect these markers and to verify all laterals have been properly marked.
H. Remove all debris and excess soil from all pipe installed under this Contract by flushing with clean water. If flushing is not adequate to clean the pipes, the Contractor shall clean the pipes by jetting. It shall be the Contractor's responsibility to obtain necessary water and equipment to flush the pipes to the satisfaction of the Director of Public Services.

3.03 Installation of Manholes

A. Manhole excavation shall be kept free from water during construction. Space excavated below the depth required for the manhole base shall be refilled with compacted sand or crushed stone at the Contractor's expense.
B. Benchwalls shall have a minimum ½" per foot slope starting at the manhole wall/benchwall interface and then slope towards the top of the trough. The trough shall have a minimum depth equal to the diameter of the incoming and exiting sewers.
C. Precast concrete risers and adjusting rings shall be used in such combination that the top of the eccentric cone section, when installed, will be at proper elevation for the manhole frame. Adjusting rings shall be allowed up to a maximum of 6" height adjustment. Manholes needing more than 6" adjustment shall have a concrete riser section installed to the proper elevation. Flattop sections shall be utilized in lieu of cone sections where shown on the drawings.
D. Manhole frames shall be brought to grade, leveled and centered.
E. Steps shall be built into all manholes 4-feet in depth or greater and shall begin 8-inches below the bottom of the chimney. Steps shall be installed at 12-inches on center minimum to 16-inches on center maximum. Steps shall be installed with minimum 3-inch wall embedment and shall project a minimum clear distance of 4-inches from the wall measured from the point of embedment.
F. Install precast concrete risers and cone sections so the axis of the manhole is vertical. Install gaskets for riser joints in accordance with the manufacturer's recommendations. Wrap riser joints with external joint seals in accordance with manufacturer's recommendations.
G. Install rubber composite adjustment rings in accordance with manufacturers recommendations.
H. Unless otherwise indicated on the Drawings, set castings for manholes at finish grade level.
I. Manhole frames located in pavement shall be wrapped in minimum 3/8" preformed joint filler. The joint filler shall extend from the top to the bottom of the frame.
J. Remove all debris and excess soil from manhole after construction and prior to flushing the sewer pipes.

-END-

SECTION 02733 - TESTING SANITARY SEWERS AND SANITARY FORCE MAINS

PART 1 - GENERAL

1.01 Scope

A. Work under this section includes testing of the manholes, gravity sewers and force mains installed as applicable.

B. Provide all necessary equipment and instrumentation required for proper completion of the flushing and testing of manholes and piping systems. Source and quality of water, test procedures, and disposal of water shall be approved by the Town.

C. All tests shall be made in the presence of the Town Representative. Preliminary tests made by the Contractor without being observed by the Town will not be accepted. Notify the Town at least 36 hours before any work is to be inspected or tested.

D. All defects in piping systems shall be repaired and/or replaced and retested until acceptable to the Town. Repairs shall be made to the standard of quality specified for the entire system.

E. Sections of the system may be tested separately, but any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested at no cost to the Town.

F. All manholes and piping systems shall be tested in accordance with these test methods in addition to any test required by Indiana Department of Environmental Management, State or Local plumbing codes and/or building authorities.

1.02 Related Work Specified Elsewhere

A. Section 02730 - Sanitary Sewer Systems

B. Section 02730 - Force Main Sewer Systems

C. Section 02226 – Trenchless Excavation – Directional Drilling

1.03 Quality Assurance

A. Standards (As Applicable)

1. ASTM F1417, standard test method for installation acceptance of plastic gravity sewer lines using low pressure air, latest revision.

PART 2 - PRODUCTS

2.01 Deflection Mandrel

A. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. Dimensions shall be per appropriate standard. Statistical or other “tolerance package” shall not be considered in mandrel sizing.

B. Mandrel Design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more “runners” or “legs” as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75 percent of the inside diameter of the pipe. The rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing.

PART 3 - EXECUTION

3.01 Sanitary Sewer Testing

A. Flush all piping systems with water to remove any debris prior to testing.

B. Gravity Sewers

1. General: After backfill has been placed, the Town will visually inspect all gravity flow lines to check alignment and grade. Remove all obstructions. Any sewer in which the direct light of a lamp cannot be viewed in either direction between adjacent manholes shall be considered unsatisfactory and shall be repaired by the Contractor without additional compensation.

2. Tests: Unless otherwise directed by the Town, all underground sewer system piping for gravity flow shall be subjected to an air test rather than an infiltration or exfiltration tests, however, infiltration and exfiltration test methods have been included if requested by the Town during construction. When leakage occurs in excess of the specified limits, defective pipe or joints shall be located and repaired. The Contractor, at his own expense, shall remove and reconstruct, along with retesting, as much of the original work as necessary to obtain a sewer test within the allowable leakage limits.

a. Air Test: The sewer line to be tested shall be tested in increments between manholes. The line shall be sealed at each end. The seal at one end shall have an orifice through which to pass air into the pipe. An air supply shall be connected to the orifice at one end of the line. The air supply line shall contain an on-off gas valve and a pressure gauge having a range of 0 to 5 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of ± 0.04 psi.

The pipe line under test shall be pressurized to 4 psig. The line shall be allowed to stabilize between 4 psig and 3.5 psig for a period of no less than 5 minutes. If necessary, air shall be added to the line to maintain the pressure above 3.5 psig. After the stabilization period, the gas valve shall be closed. When the line pressure stabilizes above 3.5 psig, commence timing with a stop watch. The stop watch shall be allowed to run until such time as the line pressure drops 1.0 psig or the allowable time in Table 1 is exceeded. If the test time is greater than the allowable time for 1.0 psig pressure drop, the test section will have passed the pressure test.

Allowable time shall be as shown in Table 1.

Table 1
Minimum Specified Time Required for a 1.0 psig Pressure Drop
For Size and Length of Pipe Indicated, Q=0.0015

Pipe Dia., In.	Minimum Time, min:s	Length for Minimum Time, ft.	Time for Longer Length, s	Specification Time for Length(L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.864 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	189	3.418 L	11:20	11:20	11:20	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	66:22	79:45	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106.50	124:38	142:26	60:15
33	31:10	72	26.852 L	43:06	64:38	86:10	107:48	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

If the time lapse is greater than that specified, the section undergoing tests shall have passed. If the time for 1.0 psig drop is less than that specified, the line has not passed the test and the Contractor shall be required to make all repairs and retests. If the pipe line to be tested is beneath the ground water level, the test pressure shall be increased .433 psi for each foot the ground water level is above the crown of the pipe. The Contractor shall furnish all equipment and personnel required to make all tests including pipe stoppers, air compressor, air storage tank, pressure regulating valves, pressure gauges, stopwatch, etc. Contractor shall take precautions necessary, including blocking of stoppers or plugs, to protect the safety of property and personnel.

3. Deflection Tests shall be performed on all flexible pipe after the final backfill has been in place at least 30 days. No pipe shall exceed a vertical deflection of 5%. Conduct testing on a manhole-to-manhole basis after the line has been completely flushed out with water. Mandrel testing shall conform to ASTM D 3034. The following are considered nonflexible pipes:

   a. Vitrified Clay Pipe
   b. Concrete Pipe
   c. Ductile Iron Pipe
   d. Cast Iron Pipe
   e. Asbestos Cement Pipe

C. Force Mains

1. General: All sewage force mains shall pass a hydrostatic pressure test as specified. All buried piping with slip-type or mechanical joints shall pass a leakage test. No leakage is allowed in exposed piping or buried piping with flanged, threaded, welded or mechanical joints.

2. Tests for exposed piping shall be made before covering and insulation is placed and prior to concealment within the building construction.

3. The pressure and leakage tests for buried piping shall be made after all jointing operations and backfilling are completed, and concrete reaction blocks and restraints have cured at least 14 days. Piping tested before backfill is in place shall be retested after compacted backfill is placed.

4. Sections of piping between valves, and other short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the ends of the test section shall be furnished and installed by the Contractor, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipe line. The Contractor shall be solely responsible for any damage which may result from the failure of test plugs or supports.

5. Hydrostatic Tests: Piping systems shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all air valves are installed and open in the section being filled, and the rate of filling does not exceed the venting capacity of the air valves. After the section of line to be tested has been filled with water, the specified test pressure shall be applied and maintained for a minimum period of 2 hours and for such additional period necessary for the Town to complete the inspection of the line under test. If defects are noted, repairs shall be made and the test repeated until all parts of the line withstand the test pressure. Hydrostatic test pressures shall be 150% of system (working) pressure, but not less than 150 psi. Test duration shall be two hours.

6. Leakage Test: After the specified hydrostatic test has been completed, the line shall be subjected to leakage test under a hydrostatic pressure the same as the pressure specified for the hydrostatic test. The pressure shall be maintained within a maximum variation of 5 percent during the entire leakage test. Leakage measurements shall not be started until a constant test pressure has been established. The line leakage shall be measured by means of a water meter installed on the supply side of the pressure pump, or method as approved by the Town.

   a. The tested section will not be accepted if it has a leakage rate in excess of the rate determined by the formula:

      L = 0.000135 ND(P)1/2 in which;

      L = Maximum permissible leakage rate, in gallons per hour, throughout the entire length of line being tested.

      N = Number of gasketed joints (two for each flexible coupling joint) in the line under test.

      D = Nominal internal diameter (in inches) of the pipe.

      P = The actual pressure in psig on all joints in the tested portion of the line. This actual pressure shall be determined by finding the difference between the average elevation of all tested pipe joints and the elevation of the pressure gauge and adding the difference in elevation head to the required pressure.

   b. Where the leakage rate exceeds the permissible maximum, the Contractor shall locate and repair leaking joints to the extent required to reduce the total leakage to the required amount.

   c. All leaks discovered within one year from the date of final acceptance of the work by the Town shall be located, repaired and retested by the Contractor, regardless of the total line leakage rate.

3.02 Manhole Vacuum Testing

A. A vacuum test shall be conducted by the Contractor on all manholes to ensure water tightness and manhole integrity.

B. The equipment required to conduct a vacuum test on manholes includes inflatable pipe plugs, test head, vacuum pump, flexible air hose and a vacuum gage. The test equipment shall be capable of drawing a vacuum of 10-inch Hg. The equipment shall be designed specifically for the purpose of testing manholes and shall be as manufactured by P.A. Glazier, Inc., Worchester, Massachusetts, 10002 or as approved by the Town.

C. The procedure for conducting an air test on manholes shall be in accordance with the following procedure:

   1. If possible, each manhole shall be tested immediately after assembly and prior to setting the casting or backfilling around the structure. If a test is performed after backfilling, Contractor shall be responsible for all re-excavation required to locate and correct all leaks identified.

2. All lift holes shall be plugged with non-shrink grout.

3. All pipes entering the manhole shall be securely plugged and adequately braced against the inside of the manhole to prevent being drawn out of the pipe.

4. The test head shall be placed on the inside of the cone section and sealed with an inflatable seal.

5. A vacuum of 10 inches of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than the following:

	Diameter (In)		
	48"	60"	72"
Depth	Time in Seconds		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97

-END-

SECTION 02737 – FORCE MAIN SEWER SYSTEMS

PART 1 - GENERAL

1.01 Scope

A. Furnish and install all force mains, air release valves and appurtenances as shown on the Drawings and as specified herein.

B. Before installing piping, the Contractor shall carefully verify location, depth, type of joint needed and size of pipe to which connection is proposed and assure the lines can be run as contemplated. Any necessary deviation shall be referred to the Town for final approval prior to construction commencement

C. All lengths of pipe shall be dimensioned accurately to measurements established at the site, and shall be worked into place without forcing. Cut sections of pipe shall be cut using pipe cutters to provide a square end.

1.02 Domestic Product Requirements

All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States unless approved otherwise by the Director of Public Services.

1.03 Material Delivery, Storage and Handling

A. Contractor shall be responsible for the delivery, storage and handling of all materials including loading and unloading all pipe, fittings, manhole sections and appurtenances in a manner to avoid shock and damage. Do not drop materials. Lifting shall be by hoists or skids when hand lifting is not feasible. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. Damaged or defective pipe and appurtenances shall be replaced. Store materials in an area safe from damage and deterioration. Keep the interior of pipe, fittings, manhole sections and appurtenances free from dirt and foreign matter. Store gaskets in a cool location out of direct sunlight and free from contact with petroleum products.

1.04 Related Work Specified Elsewhere

A. Section 02224 - Trenchless Excavation – Horizontal Boring

B. Section 02226 - Trenchless Excavation – Directional Drilling

C. Section 02730 – Gravity Sanitary Sewer Systems

D. Section 11200 – Submersible Lift Station

PART 2 - PRODUCTS

2.01 General

All pipe, fittings, and appurtenances shall be as shown on the Drawings and as specified herein. Each length of pipe and fitting shall be plainly stamped, marked or color coded to an acceptable standard as to weight, class, and type thereof, and the manufacturer's trademark or name.

2.02 Restrained Joint Polyvinyl Chloride (PVC) Pipe – Force Main

A. Pipe and couplings shall be made of unplasticized PVC compounds, minimum cell classification of 12454, as defined in ASTM D1784.

B. The PVC restrained joint pipe system shall be SDR-17 and conform to ASTM D2241, including pressure test requirements.

C. PVC restrained joint pipe system shall be Certa-Lok Yelomine pipe with couplings as manufactured by CertainTeed Corporation, or approved equal.

2.03 Polyvinyl Chloride (PVC) Pipe - Force Main

A. Pipe shall conform to ASTM D 2241, SDR 21. Pipe materials shall conform to ASTM D 1784, Type 1, Grade 1, 2,000 psi design stress. Pipe joints shall be single gasket bell and spigot type, the bells being formed integrally with the pipe.

B. Fittings shall be mechanical joint iron or ductile iron conforming to ANSI A21.10/AWWA C 110 and ANSI A21.11/AWWA C 111. Restrained joints may be used instead of mechanical joints and thrust blocking and shall be mechanical wedge-action type as approved by the Town.

2.04 Ductile Iron Pipe (DIP) Force Main

A. Pipe shall be centrifugally cast in metal or sandlined molds and shall conform to ANSI A21.51/AWWA C 151. Minimum thickness class shall be Class 50 for all sizes. Each length of pipe shall be marked to show manufacturer's name or trademark, pipe class, and year of manufacture. Pipe joints shall be push-on type and conform to ANSI A21.11/AWWA C 111. Fittings shall be mechanical joint and iron or ductile iron conforming to ANSI A 21.10/AWWA C110 and ANSI A21.11/AWWA C 111.

B. Fittings - shall be mechanical joint and iron or ductile iron conforming to ANSI A 21.10/AWWA C 110 and ANSI A21.11/AWWA C 111. Restrained joints may be used instead of mechanical joints and reaction thrust blocking and shall be Lok-Tyte, Loc-Fast, or approved equal.

C. Coatings - all pipe and fittings shall have a standard thickness cement mortar lining as specified in ANSI A 21.4/AWWA C 104 and an outside coating as specified in ANSI A 21.51/AWWA C 151.

D. Gaskets - for mechanical joints and push-on joints shall conform to ANSI A 21.11/AWWA C 111.

2.05 Sewage Air and Vacuum Valves

Sewage Air Release and Air Vacuum Valve shall have cast iron body and cover with a 2" N.P.T. inlet and 2" N.P.T. outlet. Stainless steel float and float guide. Valve shall be APCO Sewage Air/Vacuum Valve Model 400, or approved equal.

2.06 Steel Casing (As Needed)

A. Steel Casings shall be as specified in Trenchless Excavation – Horizontal Boring – Section 02224.

2.07 Tracer Wire

Tracer wire shall be single strand of Copperhead Direct Burial #12 AWG Solid, steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density yellow polyethylene jacket complying with ASTM D-1248, 30-volt rating or approved equal. The tracer wire shall be included in the cost of the pipe. Connect tracer wire splices with "Snakebite" Direct Bury Lug, Part # SCB-01SR Multi Wire Splice, or Part # 3WB-01, Multi Wire Service Connection as manufactured by Copperhead Industries, LLC or approved equal.

2.08 Location Material

Location material shall be metallic type tape such as Terra Tape Detectable as manufactured by Reef Industries, Inc. or approved equal. Location material shall be marked with "Caution Sewer Line Buried Below".

PART 3 - EXECUTION

3.01 General

A. Provide all tools, labor and equipment necessary for the safe and expeditious installation of all force mains, and appurtenances as shown on the Drawings and specified herein.

B. Inspect sewer pipe, and appurtenances prior to installation and promptly remove damaged or unsuitable materials with new and unused materials.

C. Force main shall be laid uniformly to line and grade so the finished sewer will present a uniform bore. The Contractor shall set force main alignment and grade for all sewers for the minimum depth of cover as shown on the Drawings.

D. Contractor shall take precautions to avoid constructing "high points" in the force main other than those already shown on the Drawings. The Contractor shall be responsible for installing any additional Air Release Valves necessary in these areas to vent accumulated air and gases trapped at these "high points".

E. Tracer Wire shall be installed on PVC pipe; tracer wire shall be taped to pipe at intervals of 15 to 20 foot. A minimum of two tracer wires shall be provided for all pipe except as noted herein. If pipe is installed by drilling or boring, a minimum of three tracer wires is required unless Copperhead Reinforced Tracer Wire as manufactured by Copperhead Industries or approved equal is used, in which case one wire is acceptable. Do not wrap wire around pipe. Install tracer wire boxes at intervals not to exceed 5,000 feet. Coil tracer wire inside meter box with enough wire to extend two feet above the box. Install tracer wire on outside of all valve boxes between collar and box. Seal splices and branch connections with epoxy and wrap with tape. Install one pound anodes every mile or less. Provide a continuity test on all tracer wire installed.

F. Install service valve assemblies within right of way, where shown on the drawings. Set valve vertically and bed curb box solidly on trench bottom. Set curb boxes plumb and center over operating nut. Tamp backfill on all sides of each curb box to the undisturbed trench face. Leave curb box flush with finish grade and readjust as necessary until final settling is complete.

G. Installed piping systems must be temporarily plugged at the end of each day's work, or other interruption of progress on a given line. Plugging shall be installed in a manner satisfactory to the Town, and it shall be adequate to prevent entry of animals into the pipe or the entrance or insertion of deleterious materials.

H. Remove all debris and excess soil from all pipe installed under this Contract by flushing with clean water. It shall be the Contractor's responsibility to obtain necessary water and equipment to flush the pipes to the satisfaction of the Town.

3.02 Installation of Sewer Pipe – Restrained Joint PVC

A. PVC Pipe installed by open cut shall be joined at grade level and lowered into the trench using nylon slings to avoid damage to the pipe. Chains or cable type chokers shall not be used when lifting sections of pipe.

B. Horizontal directional drilling of PVC pipe shall be as specified in Section 02226 – Trenchless Excavation – Directional Drilling.

3.03 Installation of Sewer Pipe - PVC

A. Sewer pipe shall be laid progressively upgrade with bell upstream in a manner to form close, concentric joints with smooth bottom inverts.

B. After the main is installed, sufficient bedding material shall be placed along each side of the pipe to prevent conditions that might tend to move the pipe off line or grade. Bedding of #8 crushed stone must be provided from 4" below the pipe to 4" above the crown of the pipe. Install location material above force main between 18" and 24" deep.

-END-

SSECTION 02738A – POLYURETHANE MANHOLE LINING

PART 1 – GENERAL

1.01 Section Includes

A. Requirements for surface preparation, repairs and solvent-free coating application to specified surfaces.

1.02 References

A. ASTM C273 – Shear Properties of Sandwich Core Materials

B. ASTM D638 – Tensile Properties of Plastics

C. ASTM D695 - Compressive Properties of Rigid Plastics.

D. ASTM D1622 – Apparent Density of Rigid Cellular Plastics

E. ASTM D2240 - Durometer Hardness, Type D.

F. ASTM D4414 – Measurement of Wet Film Thickness of Organic Coatings by Notched Gages

G. ASTM - The published standards of the ASTM International, West Conshohocken, PA.

H. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

I. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

1.03 Submittals

A. Submit the following items:

1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
2. Material Safety Data Sheets (MSDS) for each product used.
3. Product Data – physical properties, surface preparation, application instructions, and curing instructions.
4. Project specific guidelines and recommendations.
5. Contractor Qualifications:
    a. Manufacturer certification Contractor has been trained and approved in the handling, mixing and application of the products to be used.
    b. Certification the equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Contractor personnel have been trained and certified for proper use of the equipment.
    c. Five (5) recent references of Contractor (projects similar size and scope) indicating successful application of epoxy manhole lining system.
    d. Proof of any necessary federal, state or local permits or licenses necessary for the project.
6. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

1.04 Quality Assurance

A. Contractor shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.

1.05 Delivery, Storage, and Handling

A. Store materials in accordance with manufacturer’s recommendations.

B. Protective coating materials shall be handled according to their material safety data sheets.

1.06 Site Conditions

A. Contractor shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA, IDEM, the EPA and any and all other applicable authorities.

1.07 Warranty

A. As outlined in the General Conditions for this Project.

B. In addition to the warranty and guarantee requirements as outlined in the General Conditions, the Certified Applicator shall warrant and guarantee all work against defects in materials and workmanship for a period of nine (9) years beyond the one year anniversary of the date of substantial completion. The Certified Applicator shall provide this written warranty to the Engineer with the Shop Drawing submittals. Certified Applicator shall, within 60 days after receipt of written notice thereof, make arrangements for the repair of defects in materials and/or workmanship which may develop during the said period, and any damage to other work caused by such defects or the repairing of the same, at his own expense and without cost to the Town.

If defects in the liner equal or exceed 10% of the surface area of the protective coating, the Contractor shall be responsible for the application of an additional epoxy liner matching the thickness specified herein with no additional charge to the Town. Defects will be deemed to have occurred if the liner fails to A) prevent active infiltration into the structure, B) prevent the internal damage or corrosion of the structure, or C) protect the substrate and environment from contamination by effluent.

PART 2 – PRODUCTS

2.01 Existing Products

A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Generally, 28 days is adequate cure time for standard Portland. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred.

B. Remove existing coatings prior to application of the new protective coating. Applicator shall maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.02 Manufacturers

A. Product shall be:

1. Spectrashield by Spectra-Tech L.L.C., Noblesville, Indiana. Phone (317) 770-7506 or FAX (317) 710-0690.

OR

2. Approved equal.

In the event the Contractor wishes to submit an alternate product for consideration by the Town, the Contractor shall submit to the Director of Public Services a complete technical proposal for the alternate system at least seven (7) days prior to construction. The Contractor shall also submit the following for the alternate system:

- Guarantee and Warranty
- List of Names of Applications, Names of Owner Personnel, Telephone Numbers and Addresses
- List of Existing Installations

If any of the above materials specified for the pre-qualifications proposal is not included in this submittal, the proposal may be considered non-responsive and incomplete and may be rejected by the Town.

2.03 Lining Materials

A. A sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment, is acceptable to these specifications (up to 200 mils in a single coat) or approved equal.

B. Liner

a.	Moisture Barrier	Modified Polymer
b.	Surfacer	Polyurethane/Polymeric blend foam
c.	Final Corrosion Barrier	Modified Polymer

Product type	Modified polymer epoxy lining system
Color	Flamingo Pink, tan
Solids, %	100
Viscosity, A Component	300-400, ASTM D-638
Viscosity, B Component	400-600, ASTM D-638

Volume Ratio A Component, B Component – 1:1

Tensile Strength, psi	>1,500
Elongation, %	>125
Tear Strength, psi	350
Shore D Hardness	55-65
100% Modulus, psi	>1,500
Core Density, lb/ft^3	4-10, ASTM D-1622
Compression Strength	ASTM D-1622
Closed Cell Content, %	>90
Shear Strength, psi	225-250, ASTM C-273
Reaction Gel Time, seconds	1-2
Tack Free Time, seconds	15
Cream Time, seconds	1-4
Rise Time, seconds	6-10
Cure Time, seconds	30
Total Thickness of liner	min. 500 mils

2.04 Protective Coating Application Equipment

A. As recommended by manufacturer.

PART 3 – EXECUTION

3.01 Acceptable Applicators

A. Protective coating must be applied by a Certified Applicator of the protective coating manufacturer and according to manufacturer specifications.

3.02 Examination

A. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

B. Contractor shall bear all costs and responsibilities associated with bypass pumping and flow control as needed. Any active flows shall be dammed, plugged or diverted as required to ensure the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert. All extraneous flows into the manhole at or above the area coated shall be plugged and/or diverted until the epoxy has set hard to the touch. As an option, the Contractor may add hot air to the manhole to accelerate set time of the coating.

C. Installation of the protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.

D. Examine surfaces to receive restoration mortar. Notify the Engineer in writing if surfaces are not acceptable. Surface preparation or application shall not commence until unacceptable conditions have been corrected.

E. Provide the Director of Public Services with a minimum of three (3) days advance notice of completion of surface preparation and start of application.

F. Before application of each material, surfaces to be lined shall be inspected by the Town or their designated representative. Any deficiencies identified by those listed above shall be corrected by the Contractor prior to the application of subsequent material.

G. Inspection by the Town or their their representative or the waiver of inspection of any portion of the work shall not relieve the Contractor of responsibility to perform the work as specified.

3.03 Surface Preparation

A. Contractor shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Contractor shall notify Town of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

B. Remove all contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants.

C. All concrete or mortar not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.

D. Surface preparation method(s) shall be based upon the conditions of the substrate, service environment and the requirements of the epoxy protective coating to be applied. Surface preparation methods shall also be in accordance with the manufacturer's instructions.

E. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with a pressure water cleaning. Other methods such as high pressure water jetting (refer to NACE Standard No. 5/SSPC-SP12), abrasive blasting, shotblasting, grinding, scarifying or acid etching may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface not excessively damaged. Contractor shall be responsible for the removal and disposal of all debris from cleaning and surface preparation.

F. Infiltration shall be stopped by using a material compatible with the specified repair mortar and suitable for topcoating with the specified epoxy protective coating.

G. Test prepared surfaces after cleaning, but prior to application of the epoxy coating, to determine if a specific pH or moisture content of the concrete is required according to manufacturer's recommendations.

H. The final product of surface preparation shall be a clean, dry manhole.

3.04 Application of Protective Coating

A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

B. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

C. The protective coating material must be spray applied by a Certified Applicator of the protective coating manufacturer.

D. Specified surfaces shall be coated to a wet film thickness no less than 500 mils.

E. A permanent identification number and date of work performed shall be affixed to the structure in a readily visible location.

3.05 Surfaces for Protective Coating

A. Structures to be coated are those indicated on the Drawings. The interior manhole surfaces to be coated shall include the bench and walls and shall be coated from the bench/channel point of union to approximately 2" above the bottom of the manhole frame.

3.06 Testing and Inspection

A. All testing equipment shall be provided by the Contractor. All tests shall be performed by the Contractor in the presence of the Town.

B. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 shall be used to ensure a monolithic coating and uniform thickness during application.

C. After the protective coating has set hard to the touch it shall be inspected with high-voltage Holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

D. A visual post-rehabilitation inspection shall be made by the Town and Contractor at the conclusion of the said work. On a date not before eleven (11) months from the date of substantial completion, a final 1-year visual inspection may be requested by the Town and shall be made by the Town, Contractor and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired by the Contractor according to the procedures set forth herein at no additonal cost to the Town

E. Town may conduct biannual inspections of sealed manholes beginning two years from the date of final acceptance and extending throughout the ten-year warranty period as described in Section 1.07 of this Specification.

F. The municipal sewer system may be put back into non-severe operational service as soon as the post-construction inspection has taken place. However, for severe corrosion duty such as high concentrations of acids, bases or solvents, 3 to 7 days and/or force cure by heat induction to the coated surfaces may be necessary prior to returning to service. Consult coating manufacturer for further details.

G. If the inspections indicate a failure of 10% or greater surface area of the protective coating, the Contractor shall be responsible for the application of an additional protective coating layer matching the thickness specified herein with no additional charge to the Town. Failure will be deemed to have occurred if the protective coating fails to A) prevent active infiltration into the structure, B) prevent the internal damage or corrosion of the structure, or C) protect the substrate and environment from contamination by effluent.

-END-

SECTION 02738B – EPOXY MANHOLE LINING

PART 1 – GENERAL

1.01 Section Includes

A. This specification covers the work necessary to furnish and install a complete lining or rehabilitation system for sanitary sewer structures, as specified herein. Work includes, but is not limited to, the following:

1. Stopping Leaks by repair and sealing of the concrete and/or masonry bench, channel, invert, pipe inlets, walls, cone, chimney and frame of all structures to include removal of unsound materials, preparation, chemical grouting, structural lining, patching, plugging and sealing compounds.

2. Surface preparation, and installation of Structural Lining, Corrosion Protection Lining, High Build Corrosion Protection Lining, High Strength Corrosion Protection Lining, Corrosion Protection Mortar, High Build Corrosion Protection Mortar, Flexible Corrosion Protection Lining and/or Flexible Chimney Seal to include protection of surfaces not to be treated, touch-up, clean-up, and appurtenant work all in accordance with the requirements of the Contract Documents and this Specification.

1.02 References

A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent the requirements therein are not in conflict with the provisions of this Section. All references and standards listed shall be the latest revisions. Joint and individual documents are referenced.

1. SSPC – The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4643
(412) 281-2331

2. NACE – National Association of Corrosion Engineers
P.O. Box 218340
Houston, TX 77218-8340
(281) 492-0535

a. SSPC-SP 13/NACE No. 6 Surface Preparation of Concrete
b. SSPC-TU 2/NACE 6G197 Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment
c. SSPC-SP 5/NACE No. 1, White Metal Blast Cleaning
d. SSPC-SP10/NACE No. 2, Near White Metal Blast Cleaning
e. SSPC-SP 6/NACE No. 3,Commercial Blast Cleaning
f. NACE RP0892 “Linings over Concrete for Immersion Service”
g. NACE Standard RP0591 “Coatings for Concrete Surfaces in Non-Immersion and Atmospheric Service”
h. NACE SP0188 “Discontinuity Holiday Testing of Protective Coatings”.
i. NACE RP 6F-164 “Curing of Interior Tank Linings”.
j. NACE RP 6F-166 “Recommended Practice for Inspection of Linings on Steel and Concrete”

3. ICRI – International Concrete Repair Institute
3166 S. River Rd., Suite 132
DesPlaines, Il 60018
(847) 827-0830

a. Technical Guideline No.03372, “Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays”
b. Technical Guideline No. 03731, “Guide for Selecting Application Methods for the Repair of Concrete Surfaces”
c. Technical Guideline No. 03730, “Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion”

4. ASTM – American Society for Testing and Materials
100 Barr Harbor Drive

West Conshohocken, PA 19428-2959
(610) 832-9585

a. ASTM E-337: Test Method for Measuring Humidity with a Psychrometer
b. ASTM D 4258 “Practice for Surface Cleaning Concrete for Coating”
c. ASTM D 4261 “Practice for Surface Cleaning Unit Masonry for Coating”
d. ASTM D 4262 “Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces”
e. ASTM D 4414 “Standard Practice for Measurement of Wet Film Thickness by Notch Gages”
f. ASTM D 4787 “Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates”

5. ACI – American Concrete Institute
Box 19150, Redford Station
Detroit, Michigan 48219
(248) 848-3700

a. ACI 350-01 “Code Requirements for Environmental Engineering Concrete Structures”
b. ACI 350.1 “Testing of Reinforced Concrete Structures for Water Tightness”
c. ACI 350.2 “Concrete Structures for Containment of Hazardous Material”
f. ACI 503 “Use of Epoxy Compounds with Concrete”
g. ACI 504 “Guide to Sealing Joints in Concrete Structures”

1.03 Submittals

A. Submit product data for each component specified including data substantiating the proposed materials comply with specified requirements, and recommendations by the manufacturer covering all materials.

B. Samples of the cured system as described in Part 3.03.D to include the following

1. Finish texture as determined by the Town or Town’s authorized representative.

2. Stepped samples showing stages of multi-layer applications.

1.04 Quality Assurance

A. Acceptable Manufacturers: The manufacturer of the specified products shall have in existence, for a minimum of three (3) years, a program of training, and technically supporting a nationally organized Approved Contractor Program. Manufacturer must provide five (5) project histories with names, dates, addresses, and phone numbers of contact persons for projects of similar scope, which have been completed at least three (3) or more years ago.

1. Submit manufacturer’s representative name, address and telephone number who will be available to provide information and suggestions on the proper use of the products.

B. Single Source Supply: All products described in Part 2.01 shall be manufactured by or approved for use by the manufacturer of the sanitary sewer infrastructure linings or rehabilitation system specified herein.

C. Installer Qualifications: Engage only factory trained, approved applicators have successfully completed applications using specified materials on projects of similar size and scope.

1. Provide (3) three references with name, address, and telephone number.

2. Provide written approval from the material manufacturer.

3. All of the contractor’s jobsite personnel must be trained in the hazards associated with confined space entry. All personnel entering a confine space shall be certified for confined space entry.

D. Equipment Requirements

1. Application equipment must be approved in writing by Sherwin-Williams Technical Service Group

E. Substitutions

1. Manufacturers seeking approval of products other than the specified system must supply cured samples, full product information, project histories and references, technical data with specifications, MSDS and certifications regarding conformity of performance properties from an independent testing laboratory. The product being submitted for approval must meet all requirements of the performance properties specified within this specification. Compliance with the above quality assurances must be provided in written form at least fourteen (14) days before bids are received. Omission or non-conformance of any item will result in rejection of the request.

F. Pre-Installation Conference

1. The contractor, the installation sub-contractor, and the sanitary sewer infrastructure lining and rehabilitation system manufacturer's representative shall meet on site with the Town's representative. Particular emphasis shall be placed on these specifications, safety, weather conditions, surface preparation, material application, and inspection.

2. The contractor shall submit to the Town's representative any revisions or changes agreed upon, reasons thereof, and parties agreeing or disagreeing with them.

G. Substrate Conditions: Do not proceed with work until substrate preparation and tolerances have been approved by the Town's representative, sanitary sewer infrastructure lining and rehabilitation system manufacturer's representative, the approved installation sub-contractor, and the contractor.

1.05 Delivery, Storage, and Handling

A. Deliver products to the job site in manufacturer's original, unopened containers bearing manufacturer's name and label and the following information

1. Product name
2. Product description (generic product classification)
3. Manufacturer's lot number
4. Color

B. Store materials in sealed original manufacturer's containers. Store materials in a protected area out of direct sunlight. Keep containers clean and undamaged. Adhere to manufacturer's published storage temperature and shelf life recommendations. Protect all materials from freezing.

1.06 Warranty

A. In addition to the warranty and guarantee requirements as outlined in the General Conditions, the Certified Applicator shall warrant and guarantee all work against defects in materials and workmanship for a period of nine (9) years beyond the one year anniversary of the date of substantial completion. The Certified Applicator shall provide this written warranty to the Engineer with the Shop Drawing submittals. Certified Applicator shall, within 60 days after receipt of written notice thereof, make arrangements for the repair of defects in materials and/or workmanship which may develop during the said period, and any damage to other work caused by such defects or the repairing of the same, at his own expense and without cost to the Town.

If defects in the liner equal or exceed 10% of the surface area of the protective coating, the Contractor shall be responsible for the application of an additional epoxy liner matching the thickness specified herein with no additional charge to the Town. Defects will be deemed to have occurred if the liner fails to A) prevent active infiltration into the structure, B) prevent the internal damage or corrosion of the structure, or C) protect the substrate and environment from contamination by effluent.

PART 2 – PRODUCTS

2.01 Acceptable Manufacturers and Materials

A. The Sanitary Sewer Infrastructure Lining or Rehabilitation System as manufactured by Sherwin-Williams will consist of, one or more systems for Stopping Leaks, Structural Lining, Corrosion Protection Lining, High Build Corrosion Protection Lining, High Strength Corrosion Protection Lining, Corrosion Protection Mortar, High Build Corrosion Protection Mortar, Flexible Corrosion Protection Lining or Flexible Chimney Seal where specified. All products are specified as the minimum standard of quality, and are manufactured or distributed by The Sherwin-Williams Company, Cleveland, Ohio (800-331-7979). Additional products may consist of one or more systems for

infiltration leak stoppage and concrete repair.

1. Stopping Leaks - Infiltration leakage of all concrete and brick structures shall be stopped by trenchless technology method of chemical grouting with polyurethane grouts. Products shall be manufactured by Avanti Grouts and shall be classified as “Hydrophobic Foam”, “Hydrophilic Gel” or “Hydrophilic Foam” grouting compounds or a combination of these materials and methods as recommended by the manufacturer.

    a. Hydrophobic Polyurethane Grouts are hydrophobic polyurethanes that when mixed and makes contact with the water, is designed to fill large voids in rock fissures, gravel layers, and cracks in concrete structures and for the cut-off of gushing water.

        Option # 1 – Avanti Grouts AV-280 Hydrofoam with AV-281 Hydrocel

    b. Hydrophilic Polyurethane Gels are hydrophilic polyurethanes designed to react with water and form a water impermeable gel mass. When they come into contact with water, the grout begins to foam and gel, and depending on the temperature and amount of water present, quickly cure to a flexible, impermeable foam or gel mass unaffected by mildly corrosive environments.

        Option # 2 – Avanti Grouts AV-202 Multi-Grout

    c. Hydrophilic Polyurethane Foams are designed to form a flexible gaskets or plug in joints and cracks in concrete. When it comes into contact with water, the grout expands quickly and cures to tough. Flexible, adhesive, closed-cell, foam essentially unaffected by mildly corrosive environments.

        Option # 3 – Avanti Goruts AV-202 Multi-Grout

    d. Hydrophobic Polyurethane Grouts designed to form flexible gasket or plugs in very tight joints and hairline cracks. When they come into contact with water the grout expands and depending on temperature and the amount of accelerator used quickly cures to a tough, flexible closed cell polyurethane foam essentially unaffected by corrosive environments.
        Option # 4 – Avanti Goruts AV-248 Flexseal LV with AV-249 Catalyst LV

2. Resurfacing Materials – Designated structures shall receive an application of resurfacing compounds/repair mortar. The resurfacing compounds/repair mortars are classified as Hydraulic Cements, Waterbased Epoxy Cement, Microsilica Repair Mortars or Calcium Aluminate Repair Mortars. Waterbased Epoxy Cement and Microsilica Repair Mortars shall be designated for areas of Mild H2s content or areas to be topcoated with a corrosion resistant coating or lining as shown on the drawings. Calcium Aluminate Repair Mortars shall be designated for areas of moderate H2S content or areas to be topcoated with corrosion resistant coating or lining as shown on the drawings. Thickness shall be sufficient to replace lost cross section and fill voids.

    a. Hydraulic Cements shall be cement based, quick setting, hydraulic cement compound which instantly stops weeping water through concrete or masonry walls and floors. They will become harder and more resistant when subjected to constant water pressure. (Used primarily for filling large voids and stopping minor weeping water leaks)

        A.W. Cook Cement, CEMTEC Hydraulic Cement
        PART 1 - Physical Properties (28 day cure)

Compressive Strength ASTM C-109	5,500 psi
Tensile Strength ASTM C-496	650 psi
Bond Strength ASTM C-882 (Modified)	880 psi
Setting Times (Gilmore) “Hot Mix”	65 seconds

    b. Waterbased Epoxy Cement Resurfacer shall be a three component, epoxy modified, cementitious resurfacer contianing Portland cement, hydrophobic thixotropes, fiber-reinforcement, graded silica sand and other abrasion resistant aggregates. These will be used for resurfacing, patching and filling bug voids in concrete and masonry surfaces.

        Sherwin-Williams Corobond 300, Epoxy Modified Cementitious Resurfacer
        Physical Properties (28 days cure)

Compressive Strength ASTM D7234	750 psi
Bond Strength ASTM C882	2,280 psi
Compressive Strength ASTM C109	5,500 psi
Flexural Strength ASTM C580	1,617 psi
Splitting Tensile Strength ASTM C496	874 psi

c. Rapid Cure Vertical Grade repair mortars shall be a one part, polymer modified, fast setting, silica fume, fiber reinforced mortar designed for vertical and overhead repairs from ¼" to 2" in one lift. The product may be applied by hand trowel or sprayed with a low-pressure pump. (Used to hand place large voids, bench repair, or hand troweled structural wall linings)

A.W. Cook Cement, CEMTEC Silatec Rapid Cure Vertical Grade
Physical Properties (28 day cure)

Compressive Strength ASTM C-109	6,800 psi
Flexural Strength ASTM C-293	990 psi
Bond Strength ASTM C-882 (Modified)	1,600 psi
Shrinkage ASTM C-596	0.07%
Abrasion Resistance – ¼" APCI	1
Setting Times @ 77°F	
Initial Set – 35 min	
Final Set – 50 min	

d. Microsilica repair mortars shall be a blend of Portland cement, graded silica sand, fibers and silica fume. The mortar may be hand troweled or spray applied, usually from ½" to 1" in depth. Uses include repairing concrete walls, ceilings, lining brick or concrete manholes and lift stations, etc. Microsilica repair mortar provides an extremely dense matrix and will accept coatings at earlier ages than typical Portland cement repair products. (Used primarily for structural wall linings)

A.W. Cook Cement, CEMTEC Silatec MSM
Physical Properties (28 days cure)

Compressive Strength ASTM C-109	10,400 psi
Flexural Strength ASTM C-293	1,695 psi
Shrinkage ASTM C-596	0.00%
Freeze/Thaw ASTM C-666 100 cycles	No Effect
Bond Strength ASTM C-882 (Modified)	1,695 psi
Modulus of Elasticity ASTM C-469	4,533,333 psi
Tensile Strength ASTM C-496	750 psi

e. Calcium Aluminate repair mortars shall be a blend of quartz silica, fibers and calcium aluminate cement. They can be hand troweled or spray applied, usually from ½" to 1" in depth. Uses include repairing concrete wall and ceilings, lining brick or concrete manholes, lift stations, etc. They can be especially useful when coatings are required at early stages of cure. (Consult with coating manufacturer for specific times) (Used primarily for structural wall linings)
Option # 1 – A.W. Cook Cement, CEMTEC Silatec CAM
Physical Performance (28 day cure)

Compressive Strength ASTM C-109	12,800 psi
Flexural Strength ASTM C-293	1,360 psi
Shrinkage ASTM C-596	0.03%
Tensile Strength ASTM C-496	650 psi
Freeze/Thaw, 300 cycles ASTM C-666	No Effect
Bond Strength ASTM C-882 (Modified)	1,765 psi

2.02 Performance Criteria

A. The Corrosion Protection Lining System shall consist of Sherwin-Williams Dura-Plate 5800 Epoxy (Formerly known as Cor-Cote SC "Sewer-Cote"). This is a ultra high solids, amine cured epoxy designed for the protection of concrete and steel in highly corrosive hydrogen sulfide (microbial induced) environments associated with wastewater applications including lift stations, digesters, aeration basins, manholes and wet wells. The application thickness shall be 40 – 60

mils DFT, when applied to concrete, masonry or structural lining surfaces. The specified film thickness shall be applied via spray application in a single coat with multiple passes.

Physical Properties:

Adhesion – ASTM D4541 - >300 psi, Concrete Failure
Abrasion Resistance – ASTM D4060, 1,000 g, 1000 cycles, CS-17 Wheel – 71 mg loss
Coefficient of Linear Thermal Expansion – ASTM C531 (in/in/ºF) – 13 X 10(-6)
Compressive Strength – ASTM D695 – 3,070 psi
Durometer Hardness – ASTM D2240 - Shore D –60
Flexural Modulus – ASTM D790 – 101,000 psi
Flexural Strength – ASTM D790 – 2,670 psi
Tensile Elongation – ASTM D638 – 11.2%
Tensile Strength – ASTM D638 – 3,024 psi
Chemical Resistance to Sulfuric Acid - 20% Concentration – No Effect

B. The High Build Corrosion Protection Lining System shall consist of Sherwin-Williams Dura-Plate 5900 Epoxy (Formerly know as Cor-Cote SC “Sewer-Cote” Plus). This is a ultra high solids, high build, amine cured epoxy designed for the protection of concrete and steel in highly corrosive hydrogen sulfide (microbial induced) environments associated with wastewater applications including lift stations, digesters, aeration basins, manholes and wet wells. The application thickness shall be 80 – 125 mils DFT, when applied to concrete, masonry or structural lining surfaces. The specified film thickness shall be applied via spray application in a single coat with multiple passes.

Physical Properties:

Adhesion – ASTM D4541 - >300 psi, Concrete Failure
Abrasion Resistance – ASTM D4060, 1,000 g, 1000 cycles, CS-17 Wheel – 80 mg loss
Coefficient of Linear Thermal Expansion – ASTM C531 (in/in/ºF) – 13 X 10(-6)
Compressive Strength – ASTM D695 – 7,500 psi
Durometer Hardness – ASTM D2240 - Shore D –64
Flexural Modulus – ASTM D790 – 87,570 psi
Flexural Strength – ASTM D790 – 1,950 psi
Tensile Elongation – ASTM D638 – 19.4%
Tensile Strength – ASTM D638 – 842 psi
Chemical Resistance to Sulfuric Acid - 20% Concentration – No Effect

C. The High Strength Corrosion Protection Lining System shall consist of Sherwin-Williams Dura-Plate 6100 High Physical Strength Epoxy. This is a 100%, high build, high strength, amine cured epoxy designed for the protection of concrete and steel in highly corrosive hydrogen sulfide (microbial induced) environments associated with wastewater applications including lift stations, digesters, aeration basins, manholes and wet wells. The application thickness shall be 80 – 125 mils DFT, when applied to concrete, masonry or structural lining surfaces. The specified film thickness shall be applied via heated, plural component, spray application in a single coat with multiple passes.

Physical Properties:

Adhesion – ASTM D7234 - >2,000 psi, Concrete Failure
Abrasion Resistance – ASTM D4060, 1,000 g, 1000 cycles, CS-17 Wheel – <90 mg loss
Compressive Strength – ASTM D695 – 15,000 psi
Dry Heat Resistance – ASTM D2485 – 300°F
Elongation Percent – ASTM D638 – 4.8%
Flexural Modulus – ASTM D790 – 590,000 psi
Flexural Strength – ASTM D790 – 11,000 psi
Hardness, Shore D – ASTM D2240 – 83
Impact Resistance – ASTM D2794 – 30 in. lbs.
Tensile Strength – ASTM D638 – 5,600 psi
Water Absorption – ASTM D570 – 0.15%
Water Vapor Transmission – ASTM D1653 – 3.0/gms/m² (24 hrs)
Chemical Resistance at 120°F
- 5% Acetic Acid
- 5% Ammonium Hydroxide
- Diesel

1% Ferric Chloride
Gasoline
10% Hydrochloric Acid
Kerosene
10% Nitric Acid
10% Sodium Chloride
25% Sodium Hydroxide
1% Sodium Hypochlorite
20% Sulfuric Acid

D. The Corrosion Protection Mortar shall consist of Sherwin-Williams Dura-Plate 5800 Epoxy (Formerly known as Cor-Cote SC "Sewer-Cote" Epoxy) blended with 28 lbs of Type SC Aggregate per 1.5-gallon mix of resin. This is a ultra high solids, amine cured epoxy mortar formulated for use in highly corrosive hydrogen sulfide (microbial induced) environments where quick turn around and resurfacing of concrete are required. The application thickness shall be 100 –125 mils DFT. The specified film thickness shall be applied via hand trowel or spray application with a back trowel.

Physical Performance;
Adhesion – ASTM D4541 - >300 psi, Concrete Failure
Abrasion Resistance – ASTM D4060, 1,000 g, 1000 cycles, CS-17 Wheel – 80 mg loss
Coefficient of Linear Thermal Expansion – ASTM C531 (in/in/ºF) – 9.38 x 10(-5)
Compressive Strength – ASTM D695 – 4,030 psi
Durometer Hardness – ASTM D2240 - Shore D – 60
Flexural Strength – ASTM D790 – 3,050 psi
Moisture Absorption – ASTM C413 - <0.33%
Modulus of Elasticity – ASTM C580 – 3.49 x 10(5)
Tensile Strength – ASTM D638 – 3,024 psi
Chemical Resistance to Sulfuric Acid - 20% Concentration – No Effect

E. The High Build Corrosion Protection Mortar shall consist of Sherwin-Williams Dura-Plate 5900 Epoxy (Formerly known as Cor-Cote SC "Sewer-Cote" Plus) blended with 28 lbs of Type SC Aggregate per 2-gallon mix of resin. This is a ultra high solids, high build, amine cured epoxy mortar formulated for use in highly corrosive hydrogen sulfide (microbial induced) environments where quick turn around and resurfacing of concrete are required. The application thickness shall be 125 –250 mils DFT. The specified film thickness shall be applied via hand trowel or spray application with a back trowel.

Physical Performance;
Adhesion – ASTM D4541 - >300 psi, Concrete Failure
Abrasion Resistance – ASTM D4060, 1,000 g, 1000 cycles, CS-17 Wheel – 80 mg loss
Compressive Strength – ASTM D695 – 7,050 psi
Durometer Hardness – ASTM D2240 - Shore D – 73
Flexural Strength – ASTM C580 – 675 psi
Moisture Absorption – ASTM C413 - <0.03%
Modulus of Elasticity – ASTM C580 – 15,040 psi
Tensile Strength – ASTM C307 – 1,980 psi
Chemical Resistance to Sulfuric Acid - 20% Concentration – No Effect

F. The Flexible Corrosion Protection Lining shall consist of Sherwin-Williams SherFlex Polyurethane Elastomer and an approved primer for the environment. This is a 100% Volume Solids, High Build, Aromatic, Polyurethane Elastomer formulated for use in highly corrosive hydrogen sulfide (microbial induced corrosion) environments where a tough, flexible, impact resistant, waterproof, quick turn around protective lining is required. The application thickness shall be 80 –125 mils DFT over an approved primer for the environment.

Physical Performance:

Abrasion Resistance – ASTM D4060, 1kg, 1000 cycles, CS-17 Wheel – 106 mg loss
Adhesion – ASTM D4541 – 300 psi, Concrete Failure
Dielectric Strength – ASTM D149-92a, method A – 430 volts/mil
Direct Impact – ASTM D2794 on steel pipe – 160 in./lb, no failures
Durometer Hardness – ASTM D2240 – Shore D 43
Elongation – ASTM D638 – Recoverable 47% at 77ºF
Flexibility – ASTM D 1737 – No effect bending 0.5 mm plate coated with 20 mils over mandrel of 8 mm diameter
Permeability – ASTM E-96 – 0.189 grains/ hr ft2 Hg U.S. Perms
Thermal Conductivity – ASTM C-177 – 0.133 BTU/HR.ft.ºF per ft at 77ºF

Tensile Strength – ASTM D638 – 1988 psi at 77ºF

G. The Flexible Chimney Seal shall consist of Sherwin-Williams Envirolastic AR530 Chimney Seal Cartridge System. This is a 100% Volume Solids, High Build, Aromatic, Polyurea formulated for use in highly corrosive hydrogen sulfide (microbial induced corrosion) environments where a tough, flexible, impact resistant, waterproof, quick turn around chimney seal is required. The application thickness shall be 60 –125 mils DFT.

Physical Performance:

Abrasion Resistance – ASTM D4060, 1kg, 1000 cycles, CS-17 Wheel – 5 mg loss
Adhesion – ASTM D4541 – 350 psi, Concrete Failure
Coefficient of Linear Thermal Expansion – ASTM C531(in/in/°F) – 4 X 10(-5)
Impact – ASTM D2794 on steel panels – >160 in./lb, direct and indirect
Durometer Hardness – ASTM D2240 – Shore D 50
Elongation – ASTM D638 – 530%
Mandrel Bend – ASTM D522 – Pass
Tear Strength – ASTM D624 – 525 pli
Tensile Modulus – ASTM D638 – 100% Modulus – 1,400 psi; 300% Modulus – 1,800 psi
Tensile Strength – ASTM D638 – 2440 psi

PART 3 – EXECUTION

3.01 Surface Preparation

A. Inflow and Infiltrations

1. Active leakage of all concrete and brick structures shall be stopped by trenchless technology method of chemical grouting with polyurethane grouts. Grouts shall be installed per manufacturers directions and could include any of the hydrophilic or hydrophobic products listed or combination there of.

B. Concrete

1. The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated in and made part of this specification. All references to SSPC SP-13/NACE No 6 designate the definitions and other requirements in these documents. The International Concrete Repair Institute (ICRI) Technical Guideline 310.2, Guide to Surface Preparation of Concrete to Receive Sealers, Coatings and Polymer Overlays shall be used to visually evaluate the concrete surface profile. Refer to Sherwin-Williams' Concrete Surface Preparation Guide.

2. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 310.2 to achieve profile CSP-3 to CSP-5

3. Concrete surface defects, such as deteriorated concrete or masonry, hollow areas, bugholes, honeycombs, cracks and voids shall be filled flush and true with the specified structural lining compound in accordance with ICRI Technical Guide No 03730 "Guide for Selecting Application Methods for the Repair of Concrete Surfaces". Fins, trowel marks, and all protrusions or rough edges shall be removed. All active water leaks shall be stopped by use of polyurethane chemical grouting compounds.

4. Concrete Surface Repair: Surface voids and defects

a. Areas less than 1/2" deep shall be repaired with Rapid Cure Vertical Grade repair mortars or Hydraulic Cement.

b. Areas greater than 1/2" deep shall be repaired with specified structural lining repair mortar.

5. Provide a clean, saturated surface dry (SSD) concrete surface with no free standing or moving water, with a minimum surface profile as defined above. All substrates are to be vacuumed, swept and blown down with clean, dry air to remove spent abrasive, dust and other foreign material that might interfere with the adhesion of the primer and lining.

6. Debris resulting from surface preparation and cleaning shall not be allowed to enter any water streams and shall be removed form the structure.

C. Miscellaneous Metals

1. The NACE / SSPC Joint Surface Preparation Standards for abrasive blasting are incorporated in and made a part of this specification. All references to SSPC-SP6 / NACE No. 3 and SSPC-SP10 / NACE No. 2 designate the definitions and other requirements in these documents. SSPC VIS 1 Visual Standard for Abrasive Blast Cleaned steel shall be used to visually evaluate the blast cleanliness.

2. Remove all oil and grease form surface by solvent cleaning per SSPC-SP1. Minimum surface preparation is SSPC-SP10 / NACE No. 2, Near White Metal Blast Cleaning. Abrasive blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2-3 mils). Prime any bare steel the same day as it is cleaned and before flash rusting occurs. Refer to Sherwin-Williams Guidelines Procedures for Surface Preparation of Metals.

   a. Inspect the surfaces to be lined. All holes in the steel surfaces or pits greater than 1/8 inch shall be repaired in accordance with the Town's's repair procedures.

   b. All substrates are to be vacuumed, swept and blown down with clean, dry air to remove spent abrasive, dust and other foreign material that might interfere with the adhesion of the primer or basecoat.

   c. The maximum allowable residual salt contamination, as measured with a KTA Scat Kit or equivalent field test method, immediately prior to the application of the first coat is as follows:
   - 5 micrograms per square centimeter (50mg/m^2) most commodities up to 120^{o}F

   d. Corrosion pits in the blasted steel shall be filled flush with the substrate with Steel-Seam FT 910 patching and surfacing compound or FOX Industries FX-472 Epoxy Resurfacer.

   e. Projections and lap joints on welded plates and on riveted plates to be coated shall be filled with Steel-Seam FT 910 patching and surfacing compound or FOX Industries FX-472 Epoxy Resurfacer in order to smooth out the surface and provide for a smooth transition of the lining over the substrate.

3.02 Application

A. The contractor shall at all times maintain traffic control measures in cooperation with local police details, property owners and the municipality.

B. The contractor shall maintain sewer flows in accordance with the contract documents. Diversion of the flow or plugging the flow of sewerage for the purposes of affecting repairs to the structure shall be coordinated at direction of the Town.

C. Comply with manufacturers written installation procedures and individual product data sheet application bulletins.

D. Apply materials in accordance with the following material coverage:

Option # 1: Corrosion Protection Lining System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Not Required	
Corrosion Protection Coating	
CorCote SC SewerCote	40.0-60.0
Total Targeted Thickness	40.0-60.0

Option # 2: High Build Corrosion Protection Lining System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Not Required	
Corrosion Protection Coating	
CorCote SC SewerCote	80.0-125.0
Total Targeted Thickness	80.0-125.0

Option # 3: High Strength Corrosion Protection Lining System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/ Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Not Required	
Corrosion Protection Coating	
Dura-Plate 6100 Epoxy	80.0-125.0
Total Targeted Thickness	80.0-125.0

Option # 4: Corrosion Protection Mortar System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Not Required	
Corrosion Protection Coating	
CorCote SC SewerCote w/SC aggregate	100.0-125.0
Total Targeted Thickness	100.0-125.0

Option # 5: High Build Corrosion Protection Mortar System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Not Required	
Corrosion Protection Coating	
CorCote SC SewerCote Plus	125.0-250.0
Total Targeted Thickness	125.0-250.0

Option # 6: Flexible Corrosion Protection Lining System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Primer	
Dura-Plate 235 Multi-Purpose Epoxy	3.0-5.0
Corrosion Protection Coating	
SHERFLEX Polyurethane Elastomer	80.0-125.0
Total Targeted Thickness	83.0-130.0

Option # 7: Flexible Chimney Seal System

Products	Thickness (mils dft)
Repair/Patching and Structural Linings	
Epoxy Repair/Resurfacer (Steel)/Resurfacer/Repair Mortars (Concrete)	As Needed
Stopping Leaks	As Needed
Corrosion Protection Coating	
Envirolastic AR530 Chimney Seal	60.0-125.0
Total Targeted Thickness	60.0-125.0

3.03. Inspection and Testing

A. The Town or Town's authorized representative may require the services of an independent testing laboratory to test the installed system.

B. If test results indicate noncompliance with the specification, the following corrective action may be required of the Contractor:

1. Remove non-compliant systems or components.
2. Replace system or components in (1)
3. Assume the testing expenses.

C. Minimum requirements of the corrosion protection coatings and/or lining system are that it be free of the following:

1. Uncured material
2. Inadequate thickness
3. Pinholes
4. Blisters
5. Delamination
6. Foreign matter
7. Unspecified materials

3.04. Protection

A. The corrosion protection coatings and/or lining system shall be protected from damage or detrimental elements during cure and until the time of final acceptance.

-END-

SECTION 02830 - CHAIN-LINK FENCE AND GATES

PART 1 – GENERAL

1.01 Scope

A. Contractor shall provide all labor, materials, tools and equipment necessary to install new chain link fencing and gates for this project including fabric, framework, posts, hardware, braces and fittings, safety devices, concrete footings, and accessories. The Contractor shall perform all work as shown and specified, and all additional work as necessary to produce a complete, finished job.

B. All fencing materials shall be the product of one manufacturer, unless otherwise approved by the Town.

1.02 Related Work Specified Elsewhere

A. Section 02200 – Earthwork

1.03 Submittals

A. Submit shop drawings showing fence height, size of posts, sizes of gates as applicable, size of rails, braces, and accessories.

1.04 Product Delivery, Storage, and Handling

A. Deliver all materials in manufacturer's packaging with all tags and labels intact and legible.

B. Handle and store materials as to prevent damage.

1.05 Domestic Product Requirements

All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States.

PART 2 – PRODUCTS

2.01 Fence Materials

A. All fabric, gates as applicable, posts, rails, braces and accessories shall be color coated, final color shall be black.

1. Before color coating is applied, all steel materials shall be galvanized using zinc metal conforming to ASTM B6.
2. Fence and gate fabric – the galvanized 9-gauge core wire shall have a fused and adhered polyvinyl (PVC) coating and shall meet the requirements of ASTM F668, Class 2b, with a core wire zinc coating weight of 0.3 oz/ft^2 and a PVC coating thickness of 0.006 to 0.010 inches. The PVC coating shall be applied by the fusion method after first applying a thermoset bonding agent to the galvanized core wire.
3. Fence fittings - shall be color coated to match the fence fabric. Fittings shall be coated with a polymer coating of thickness 0.006 to 0.015 inches or by an electrostatically applied polyester powder coating system. Painted fittings are not acceptable.

2.02 Fabric

A. PVC color coated galvanized fabric, 9 gauge wire woven in two (2) inch diamond mesh.

B. Top selvage shall be twisted and barbed, the bottom selvage shall be knuckled.

C. Splicing of fabric between posts is not acceptable.

2.03 Line Posts

A. Line posts shall be 2 3/8 inches outside diameter (OD) Standard Schedule 40 galvanized pipe conforming to ASTM F1043-Group 1A. Length of line posts shall be approximately 3 feet longer than the height of the fabric. Line posts shall not exceed a maximum spacing of ten feet.

B. Minimum weight shall be 3.65 pounds per linear foot. Tubing, conduit or open seam material is not permitted. Line posts shall meet the requirements of ASTM F1083 for materials.

2.04 Terminal Posts

A. All end, corner, and pull posts shall be 2 7/8 inches OD Standard Schedule 40 galvanized pipe conforming to ASTM F1043-Group 1A. Posts shall not exceed a maximum spacing of 100 feet.

B. Length of terminal posts and pull posts shall be approximately 3 feet 6 inches longer than the height of fabric. Minimum weight shall be 5.79 pounds per foot. Tubing, conduit and open seam material is not permitted. Terminal posts shall meet the requirements of ASTM F1083 for materials.

2.05 Extension Arms

A. The Contractor shall provide vinyl coated galvanized press steel or aluminum extension arms to accommodate 3 strands of barbwire at 45 degree overhang, facing outward.

B. Top strand of barbed wire shall be approximately 12 inches above the fabric.

2.06 Barbed Wire

A. Zinc-coated barbed wire shall be two-strand twisted 12 ½ gauge wire with 4 point barbs at 5" spacing. Coating shall consist of a minimum of 0.80 ounces of zinc per square foot of wire surface conforming to ASTM A-121.

2.07 Top and Brace Rails

A. Top rail and brace rails shall be 1 5/8 inch OD Standard Schedule 40 galvanized pipe conforming to ASTM F1043-Group 1A. Minimum weight shall be 2.27 pounds per foot. Tubing, conduit and open seam material is not permitted. Top rail pipes shall meet the requirements of ASTM F1083 for materials.

2.08 Fittings

A. The Contractor shall supply hot dipped galvanized steel, aluminum or non-metallic moldings of sufficient strength to ensure the integrity of the fence.

2.09 Tension Wire

A. Zinc-coated tension wire shall be 7 gauge steel wire with minimum coating of 0.40 oz. per square foot. Wire shall be stretched taut.

2.10 Tie Wire

A. Tie wires shall be 9 gauge galvanized steel, with PVC color coating. Color shall match other fence materials.

2.11 Concrete

A. Concrete for post embedment shall have two to four inches slump, and shall have a 28-day compressive strength of 3,500 psi.

2.12 Gates, General

A. All gates shall be hot-dipped, galvanized conforming to ASTM A392.

2.13 Swing Gates

A. Gate frame assembly shall be fabricated in accordance with ASTM F900, 1.90" OD Standard Schedule 40 galvanized pipe with welded joints. Minimum weight shall be 2.28 pounds per foot. Weld areas shall be repaired with zinc-rich coating applied per manufacturer's instructions. Fabric shall match fence.

B. The Contractor shall ensure the gates are complete with galvanized malleable iron hinges, latch and latch catch, center rests and iron bolt for closed position and chain hold for open position. Center stop shall be of the type: round disc with groove and shall rest in concrete anchor when in closed position, with PVC color coating. Color shall match other fence materials.

C. Frames shall be electrically welded at all joints.

D. Provide suitable gate latches for a padlock which may be attached and operated from either side of gate.

E. Hinges must permit gate to swing back 180 degrees. Gate braces shall be 1 5/8 inch, OD galvanized steel pipe.

F. Gate opening shall be as shown on the Drawings for:
Single or double leaf as applicable
Length

G. Gate opening: Single or Double, 6 feet to 12 feet each leaf. Gate posts shall be minimum 4” OD standard weight pipe with minimum weight of 9.11 pounds per linear foot.

PART 3 – EXECUTION

3.01 Fence and Gates

A. The Contractor shall install the fence and gates in a workmanlike manner utilizing the following construction practices.

1. For the top rail, use galvanized couplings of the outside sleeve type at a minimum 7 inches in length to join the top rail. Pass the top rail through the line post top to form a continuous brace for each stretch of fence. Secure the top rail to each terminal post with receptacle fitting.
2. Bottom of fence fabric should be installed within two inches of finished grade, but in no case shall exceed being within four inches of finished grade.
3. Space horizontal braces midway between the top rail and the bottom of the fence and extend from the terminal post to the first adjacent line post. End and gate posts shall have 1 brace; corner and straining posts shall have 2 braces.
4. Fasten the fabric to the top rail and braces with suitable tie wire at approximately 18 inch intervals between the line posts. Secure the fabric to line posts at approximately 12 inch centers.
5. Space the line posts no further apart than 10 linear feet per post. Terminal posts shall be spaced not to exceed 100 feet. Pour concrete into holes 3 feet 6 inches deep for line posts and 4 feet deep for terminal posts. Concrete shall extend a minimum of three inches below the bottom of fence post.
6. Stretch the tension wire taut along the bottom of the fabric and fasten at intervals of 18 inch centers.
7. Install gates level and secure to hang plumb and travel straight for full opening without sagging or interference.
8. Ground fence in accordance with the electrical details shown on Drawings, at 50 foot intervals and at all gate and corner posts.

-END-

DIVISION 9
FINISHES

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SECTION 09900 – PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and apply coatings and do related work necessary to complete work shown or specified.

B. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.

C. Definitions

1. Abbreviations
   a. ASTM – ASTM International
   b. OSHA - Occupational Safety & Health Administration
   c. SSPC - Steel Structures Painting Council
   d. TNE - Tnemec Company, Inc.
   e. DFT - Dry film thickness
   f. DMT - Dry mill thickness
   g. NFPA - National Fire Protection Association
   h. NACE - National Association of Corrosion Engineers
2. Coating: The term coating includes emulsions, enamels, paints, stains, varnishes, sealers, emulsion filler, and other coating materials whether used as prime, intermediate, or finish coats.
3. Spatter: Drops and droplets of coating and spilled or splashed coatings on surfaces not specified to be coated or surfaces previously finish coated.

1.02 Quality Assurance

A. All coating and surface preparation shall be completed by a qualified painting contractor who shall have a minimum of five (5) years experience in applying protective coatings to industrial and municipal water and wastewater treatment facilities.

1.03 Submittals

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Technical product data sheets for all products used.
2. Manufacturer’s application instructions.

1.04 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged or deteriorated products from the job site, including products which have exceeded their shelf life. Replace damaged products with undamaged and un-deteriorated products at no additional cost to the Town.

C. All coating materials stored on the job site shall be stored in a location consistent with the manufacturer’s storage requirements. The Contractor shall take all safety precautions in accordance with NFPA Bulletin No. 101.

1.05 Job Conditions

A. Environmental Requirements

1. Perform coating work in strict conformance with manufacturer’s printed recommendations as to environmental conditions under which coating and coating systems can be applied.
2. Do not apply finish in areas where dust is being generated.

3. During the course of the coating work, adequately ventilate the coated spaces to ensure there will be no concentration of noxious odors, hazardous fumes, or flammable vapors.
4. Unless otherwise noted, do not apply coatings in damp weather or when the temperature is below 50°F or above 95°F.
5. Provide heating and enclosure when necessary to maintain specified temperature during application and curing of coatings.
6. Provide forced air circulation in enclosed areas during the application and curing period.
7. All costs associated with providing and/or maintaining the required environmental conditions shall be borne by the Contractor or coating subcontractor.

B. Protection

1. Protect all finish work of other trades and surfaces not being coated. Furnish suitable coverings as required. Remove coating spatter from all finished surfaces, and restore finishes of affected items to their original conditions at no additional cost to the Owner.
2. Post “Wet Paint” notices, as required, to protect newly coated surfaces.
3. Keep oily rags and waste in Underwriters’ Laboratories labeled metal containers. Do not allow oily rags and waste to accumulate in structures.
4. Protection of Adjacent Surfaces – Cover or otherwise protect all finished work or other trades and surfaces not being painted.

C. Job Site Conference: The Contractor shall arrange and conduct a job site conference between the coating manufacturer’s representative, the Town’s representative, and the personnel assigned this work prior to any field surface preparation or coating application.

PART 2 - PRODUCTS

2.01 Manufacturers

A. Except as otherwise specified, materials shall be the products of the following manufacturers or approved equal:

1. Tnemec Company, Inc. (TNE)

B. Equivalent materials of other manufacturers may be substituted only on written approval of the Town. Requests for substitution shall include manufacturer’s literature for each product giving the name, generic type, and descriptive information. Submittals shall include the following performance data as certified by a qualified testing laboratory:

1.	ASTM D 4541	Adhesion
2.	ASTM B 117	Salt Spray
3.	ASTM D 1653	Permeability
4.	ASTM D 4060	Abrasion
5.	ASTM D 4585	Humidity
6.	Galvanic Protection	Conductivity

C. Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise acceptable to the Town.

2.02 Materials

A. All field applied primers shall be provided to ensure compatibility of total coating systems and of the same manufacturer as the finish coats for each system as specified hereafter. Provide barrier coats over incompatible primers or remove and reprime as required. No thinner or solvents other than those approved by the Coating Manufacturer shall be used.

B. All materials shall herein be assigned a designation number for ease of reference. The minimum material requirements shall be as listed.

2.03 Coating Systems

All surfaces to be coated shall be cleaned of all dirt, oil, grease, salts, mill scale and other foreign matter prior to the surface preparation and coating applications described below.

A. SYSTEM 1 - Non-Submerged Interior or Exterior Metals, Piping, & Machinery

1. Surface preparation: Commercial blast, per SSPC-SP6, achieve 1.0-2.0 mil profile
2. Prime Coat (shop coated or field coated): Organic Zinc-Rich Urethane, 1 coat, 2.5-3.5 mils DFT
   a. TNE: Tneme-Zinc, Series 90-97
   b. Approved equal
3. Finish Coat: Aliphatic Acrylic Polyurethane, 2 coats, 2.0-5.0 mils DFT
   a. TNE: Endura-Shield, Series 74
   b. Approved equal
4. Minimum of 3 coats and a minimum total finished DMT of 6.5

B. SYSTEM 2 - Submerged Metals, Piping, & Machinery (Note 2)

1. Surface preparation: Near-white metal blast, per SSPC-SP-10, achieve 1.0-2.0 mil profile
2. Prime Coat (Shop Coated or Field Coated):
   a. Sanitary, 1 coat, 3.0-5.0 mils DFT
      (1) TNE: 66 Rust Inhibitive Primer
      (2) Approved equal
3. Finish Coat: Modified Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
   a. Sanitary:
      (1) TNE: 66 Hi-Bond Epoxoline II
      (2) Approved equal
4. Minimum of 3 coats and a minimum total finished DMT of 11.0

C. Notes:

1. The total finish dry mil thickness shall be in accordance with the manufacturer's coating system's requirements.
2. The term submerged applies to water and wastewater. Special consideration shall be given to applications where acids or other highly corrosive materials will be present.
3. Minimum total dry film thickness excludes the primer.

2.04 Colors

A. Comply with OSHA requirements concerning color coding and safety marking.

B. Color code exposed piping. Color code equipment associated with piping, unless otherwise shown or specified.

C. Color coding shall be generally as follows. Specific colors for each type of service will be selected by the Town after submittal of color charts:

Application	Color
Dangerous Machine Parts & Energized Equipment	Safety Orange
Sanitary (Sewer and Force Main)	Dark Gray
Other Items	To Be Determined in Field

2.05 Mixing and Tinting

A. Coatings, except two part epoxies, shall be delivered to the job site premixed.

B. Job tinting will not be acceptable, except as approved by the Town.

C. All mixing shall be done in mixing pails placed in suitably sized non-ferrous or oxide resistant metal pans.

PART 3 - EXECUTION

3.01 Inspection

A. Inspect all surfaces on which paint is to be applied, and notify the Town of any defects considered detrimental to the application of materials specified.

B. If any dirty, rusty, scaly, greasy, damp, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film are painted over, both the removal of paint and repainting the affected area shall be done by the Contractor without cost to the Town.

C. Provide all staging, and other temporary facilities required for the proper execution of the work.

D. The Contractor shall furnish the following for the Town's use during the project:

1. A low voltage wet sponge instrument for checking film continuity.
2. A dry mil thickness gauge for checking film thickness.

3.02 Surface Preparation

A. General

1. All surfaces to be coated shall be prepared in a workman-like manner with the objective of obtaining a clean and dry surface. No coating shall be applied before the prepared surfaces are approved by the Engineer.
2. All preparation and cleaning procedures shall be in strict accordance with the coating manufacturer's printed instructions and as specified in this Section for each particular substrate condition.
3. Remove or otherwise protect hardware, hardware accessories, machined surfaces, plates, and similar items in place and not to be painted prior to surface preparation and painting operations.
4. Clean surfaces to be coated before applying coating or surface treatments. Remove oil and grease with clean cloths and cleaning solvents in accordance with SSPC SP-1 prior to mechanical cleaning. Clean surfaces of galvanized metals with water soluble detergents prior to etching. Cleaning solvents shall be low toxicity and shall have a flash point in excess of 115°F. Program cleaning and painting so dust and other contaminants from the cleaning process do not fall in wet, newly coated surfaces.

B. Metals

1. All ferrous metal to be primed in the shop shall have all rust, dust, and scale, as well as all other foreign substances, removed by sandblasting in accordance with SSPC SP-6 or SP-10 and achieve a profile ranging from 1.0 to 3.0 mils DFT as recommended by manufacturer. Immersion (submerged metals) exposure shall receive surface preparation SSPC SP10 near-white blast. Non-immersion (non-submerged metals) exposure shall receive surface preparation SSPC SP-6 commercial blast. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Abraded or corroded spots on shop coated surfaces shall be wire brushed and touched up with primer specified in this Section. Remove all surface imperfections that will induce premature coating system failure. Chip or scrape off weld splatter and weld slag. Grind down sharp and rough edges of weld seams to create a smooth transition. Surface cleanliness shall be verified in accordance with SSPC-VIS1.
2. Store shop coated ferrous surfaces out of contact with the ground in such manner and location as will minimize the formation of water-holding pockets, soiling, contamination, and deterioration of the coating film.
3. All ferrous metals not primed in the shop shall be sand-blasted in the field prior to application of the primer pretreatment in accordance with criteria specified above.
4. All non-ferrous metals and galvanized surfaces, whether to be shop or field primed, shall be solvent cleaned per SSPC SP-l prior to the application of a vinyl-phosphoric wash and/or primer.
5. Any piping scheduled for a coating which is supplied with a bituminous coating shall receive two coats of titanium pigmented alcohol-soluble resin before applying primer and colored finished coat.
6. All new exterior and interior metal electrical conduits shall be coated per specification.
7. All existing coated metals and previously shop coated metals shall be free of all foreign substances and cleaned according to manufacturer's recommendations prior to application of primer and finish coats.
8. All non-submerged existing pipe, pipe supports, metal structural members, and miscellaneous metal items to remain which are to be recoated shall have all loose and poorly adhered existing coating removed with hand tool cleaning to provide a surface preparation SSPC SP-2 (hand tool cleaning) or SP-3 (power tool cleaning). All submerged existing metal items to remain and to be recoated shall have SSPC SP 10 (near white blast cleaning) or SP-11 (near white power tool cleaning) surface preparation to remove existing coating to bare metal. All rust, dust scale, and other foreign substances shall be removed. Bare metal exposed after cleaning

shall be immediately primed to prevent new rusting. Prior to applying new coating, clean existing metals and piping with water-soluble degreasers or solvent per SSPC SP-1.

3.03 Application

A. Coating Thickness

1. Each coat of material shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness specified. Dry film thickness shall be verified in accordance with SSPC-PA2. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of unthinned material as originally furnished by the manufacturer must not cover a greater square foot area when applied by spray gun than when applied unthinned by brush. Coatings in submersible applications shall be pinhole-free.
2. Deficiencies or excesses in film thickness shall be corrected by the application or removal of an additional coat(s) of material.

B. Drying Time: Drying time shall be construed to mean “under normal conditions.” Where conditions are other than normal because of the weather or because coating must be done in confined spaces, longer drying times will be necessary. Additional coats of material shall not be applied, nor shall units be returned to service until coatings are thoroughly dry.

3.04 Protective Coating of Non-Ferrous and Galvanized Metals

A. Where non-ferrous metals such as aluminum, copper, and galvanized metal come in contact with concrete or dissimilar metals, a protective coating must be applied. In the case of galvanize, obtain recommendation from coating supplier.

B. A vinyl gasket may be used in lieu of the protective coating.

C. After erection and alignment, openings between non-ferrous metal surfaces and the concrete shall be sealed in a watertight manner with the proper caulking compound, relative to and in accordance with the opening width demand.

3.05 Cleaning

A. Touch-up coatings and restore finish where damaged or defaced by construction activities.

B. Remove coating spatter from all finished surfaces and restore affected finishes.

C. Remove excess materials, scaffolding, staging, drop cloths, equipment, and rubbish from the job site.

3.06 Coating List

A. New Lift Station – Wet well and Valve vault

1. All valves and piping coming into contact with sewage or connected to the pump or valve chambers
2. Exposed steel electrical conduit

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DIVISION 11
EQUIPMENT

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SECTION 11200 - SUBMERSIBLE LIFT STATION

PART 1 - GENERAL

1.01 Description

A. Work under this section includes, but is not limited to, the provision and installation of Submersible Non-Clog Centrifugal Pumps; including pumps, motors, base elbows, concrete wet wells and valve vaults, hatches and other appurtenances as described herein and as required for a completely operational pumping system.

B. The pumping equipment shall be Flygt brand manufactured by Xylem, Inc.

C. Related work specified elsewhere includes but is not limited to, the following:

1. Site Work - Division 2
2. Protective Coatings – Section 09900
3. Electrical - Division 16

1.02 Quality Assurance

A. Standardization - All equipment shall be of the latest and most modern design. All similar components shall be manufactured and furnished by one manufacturer unless specifically otherwise allowed in writing by the Town.

B. Provide manufacturer's warranty as specified in this Section.

C. Provide field test results in Start-Up Certification Report as specified in this section.

D. The pumping equipment and accessories shall be an integral package supplied by the pump manufacturer with local representation to provide undivided responsibility.

E. The pump supplier shall have full-time service personnel and repair facilities at his place of business.

1.03 Submittals

A. Submit the following:

1. Pump capacity in gallons per minute
2. Total dynamic head (TDH) and Operating RPM
3. Motor Horsepower
4. Motor RPM
5. Motor voltage, phase, and cycle
6. Make and model number of the pump
7. Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards.
8. Certified copies of pump curves.
9. Copy of manufacturer's standard warranty for each type of equipment provided.
10. Shop drawings with performance, descriptive literature, weights and dimensions, and other physical characteristics verifying compliance with this section; including certified pump curves, motor starting and full-load amps, motor horse power, and motor data. When numerous options and sizes are shown, the shop drawings shall be marked to clearly indicate the size and type specific to this section and project.
11. Manufacturer's installation instructions and recommended testing procedures.
12. Manufacturer's operation and maintenance (O & M) manuals and materials. When numerous types and sizes are shown, the manuals shall be marked to clearly indicate the sizes and types specific to this project.
13. Start-Up Certification Report specified in this section.
14. Electrical:
    a. Submit all electrical requirements for each piece of equipment including voltage, phase, and load data.
    b. Provide wiring diagrams for each piece of equipment. For example, submitting one diagram for all centrifugal pumps is not acceptable.
    c. "Typical" diagrams are not acceptable. Manufacturer's standard diagrams may be submitted if they are made specific for this project by:
        1) Showing all included options, special items, etc.

2) Unused options or features shall be crossed out or deleted.
3) Identify the drawing with project name, equipment name, and tag number, e.g., “Chandler Lift Station No. ___, Pump No. 1, Tag No. XX-12345".

1.04 Warranty

A. Equipment and installation shall be covered by maintenance bond as specified in Section 01010 General Items, Part 2.04-C, Posting of Bond.

B. The manufacturer of the equipment furnished under this Section shall be responsible for the proper operation of the system when installed according to his instructions.

C. Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the Town against defects in workmanship and materials for a period of five years prorated under normal use, operation, and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the shop drawings.

1.05 Spare Parts and Special Tools

A. The manufacturer shall furnish one set of all special tools necessary for normal operation, maintenance, and calibration.

B. Provide all manufacturer's recommended spare parts for each unit, as well as any spare parts identified in this specification section or the special requirements. As a minimum, a spare O-Ring Kit package shall be supplied with each pump.

1.06 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of the products. Store the products in accordance with the manufacturer's recommended procedures.

B. Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop the products. Do not skid or roll the products on or against other products. Attach slings and hooks in such a manner to prevent damage to the products.

C. The pumps furnished shall be packaged in such a manner as to provide ample protection from damage during handling, shipment, and outdoor storage at the construction site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.

D. Promptly remove damaged products from the job site. Replace damaged products with undamaged products at no cost to the Town.

PART 2 - PRODUCTS

2.01 General

All components of the lift station exposed to weather shall be constructed of material resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, and ultraviolet stabilized PVC.

2.02 Submersible Non-Clog Pumps

A. Requirements

1. Furnish and install submersible non-clog wastewater pumps. The pumps shall meet the requirements of HI Standards.
2. The pumps shall be equipped with submersible cable (SUBCAB) suitable for submersible pump applications. The SUBCAB shall be of sufficient length to reach from the pump in place in the wet well to its local control panel, with enough slack to aid in pump removal for service. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA approval.
3. The pumps shall be supplied with mating cast iron discharge connections.

B. Pump Design

1. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well.
2. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring, or profile gasket is not acceptable. No portion of the pump shall bear directly on the sump floor.

C. Pump Construction

1. Major pump components shall be gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blowholes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel.
2. All metal surfaces coming into contact with the pumps, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
3. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings shall be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
4. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

D. Pump Shaft

Pump and motor shaft shall be the same unit. The pump shaft shall be an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T.

The use of stainless steel sleeves will not be considered equal to stainless steel shafts.

E. Impeller

The impellers shall be gray cast iron, Class 35B, dynamically balanced, double shrouded non-clogging design having a long throughlet without acute turns. The impellers shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impellers shall be keyed to the shaft, retained with an Allen head bolt and shall be capable of passing a minimum 3-inch diameter solid. All impellers shall be coated with an acrylic dispersion zinc phosphate primer.

F. Volute

Pump volute(s) shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

G. Bearings

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

H. Mechanical Seal

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

I. Cooling System

Motors are sufficiently cooled by the surrounding environment or pumped media (if required by manufacturer). A water jacket is not required.

J. Motor

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

The motor shall be rated for a Class 1, Division 1 area.

K. Cable Entry Seal

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

L. Protection

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.

A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

M. Stainless Steel Nameplates

Nameplates shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed, and all other pertinent data. The nameplates shall be stainless steel.

2.03 Accessories

A. Concrete Wet Well and Valve Vault

1. The Contractor shall furnish and install a monolithic concrete or precast manhole type wet well. Pump and related equipment shall be installed and/or mounted as shown.
2. A concrete vault shall be furnished and installed to house the valves and appurtenances. Provide an aluminum access ladder in the valve vault as shown on the drawings.
3. Precast manhole sections shall conform to requirements of ASTM Specification C478. Wet well shall be constructed same as described for manholes in Specification Section 02730. Square valve vaults shall meet the requirements of ASTM C913.
4. All pre-cast concrete shall contain waterproofing additive Xypex or approved equal.
5. All pre-cast concrete shall contain anti-corrosion additive, Conshield or approved equal.
6. Wet well and valve vault shall have a field-applied bituminous coating to make them watertight.

B. Access Hatches and Safety Grating

1. Wet Well Access Hatch

The pump supplier shall provide a recessed aluminum hatch frame and door assembly to be installed in the concrete wet well top. This door assembly shall provide access for removal of the pumps and shall support the guide rails. Frames shall be ¼ inch extruded aluminum with built-in neoprene cushion and with strap anchors bolted to the exterior. The cover leaf shall be ¼ inch aluminum reinforced with aluminum stiffeners as required. Stainless steel hinges shall be bolted to the underside and pivot. All stainless steel bolts and hardware shall be used. The cover shall open to 90° and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand. Covers shall be built to withstand a live load of 300 pounds per square foot, and equipped with a snap lock, removable handle. When closed, the covers shall not protrude above the operating surface in which they are installed. Factory finish shall be aluminum lacquer. All surfaces contacting concrete shall have a bituminous coating. Covers shall be diamond pattern plate. The wet well access hatch shall be of the minimum size recommended by the pump manufacturer for use with the particular pumps and configuration of each wet well.

2. Valve Vault Access Hatch

A recessed aluminum single door access hatch and door assembly similar to the one described above for the wet well shall be provided for use as entry to the valve pit. Minimum opening for the valve vault entry shall be 30" x 36" unless a larger opening is required to allow operation of plug valves with a T-handle wrench from the surface while leaving the area directly above the "quick disconnect" hose fitting to allow for bypass connection without kinking of hose. The cover shall be water tight with a drain system. The cover shall be built to withstand a live load of 300 lbs/ft^2.

3. Safety Grating

a. The wet well access hatch shall be equipped with aluminum safety grating. The safety grate shall be made of 6061-T6 aluminum and designed per the most current edition of the "Specifications for Aluminum

Structures", by the Aluminum Association, Inc. The grating shall be designed to withstand a minimum live load of 300 psf using 17,300 psi as the design stress for the aluminum. The deflection shall not exceed 1/150 of the span.

b. Grate openings shall be 5" x 5" to allow for visual inspection, limited maintenance, and float adjustments while the safety grate is closed. The design of the hatch must assure the grate is closed prior to the hatch doors being closed.
c. Each grate shall be provided with a permanent hinging system, which will lock the grate in the 90° position once opened. The grate shall be coated with an OSHA type safety orange color powder coating system applied by electrostatic spray process.
d. The safety grating shall be furnished by the same manufacturer as the aluminum hatch to assure compatibility and shall be "Safe Hatch" by ITT Flygt, or approved equal.

C. Slide Rail System

1. A rail system shall be provided for easy removal of the pump and motor assembly for inspection and service. The system shall not require a man to enter the wet well to remove the pump and motor assembly.
2. Two rails of two inch stainless steel pipe shall be provided for each pump. The guide rails shall be positioned and supported by the pump mounting base. The guide rails shall be aligned vertically and supported at the top by attachment to the access hatch frame.
3. Intermediate guide rail support shall be required for stainless steel pipe as recommended by the manufacturer.
4. The pumps shall be equipped with sliding brackets or rail guides. To insure easy removal of the pumps, the rail guides attached to each pump shall not encircle the rails.
5. A stainless steel lifting chain of adequate length for the basin depth shall be provided for each pump. Each pump shall be equipped with a permanent, stainless steel, stationary lifting handle.
6. The rails and the rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. The rail system shall function to automatically align the pumping unit to the discharge connection by a simple downward movement of the pump. No twisting or angle approach will be considered acceptable.

E. Cable Holder

Provide and install a stainless steel cable and chain holder to be mounted inside the hatch opening of the top slab of the wet well to support the pump power and control cables and lifting cable.

F. Baffles

Stainless steel inlet baffles shall be installed in wet wells as directed by the Town.

G. Piping and Valves

1. Wet Well and Valve Vault Piping

a. Piping in the wet well through the valve vault to the connection to the force main shall be ductile iron. Ductile iron pipe shall meet the requirements of ANSI A21.51/AWWA C151 and shall be designed and manufactured for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2. Minimum pressure class shall be 150.
b. Gaskets for flange joints on exposed pipe shall meet ANSI/AWWA C110, full face rubber or other material approved by the Town, and must have a minimum 1/8 inch thickness. Nuts and bolts shall conform to ANSI/AWWA C110 and be stainless steel.
c. Pipe joints for buried piping shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.2/C111. Restrained joints shall be wedge-action retainers for mechanical joint fittings or field-lock wedge-action gaskets for push-on joints.
d. Fittings shall be ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi. Fittings shall have mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.1/C111. Thrust blocking or restrained joints are required at fitting locations.
e. All wet well and valve vault piping shall be coated as specified in Section 09900 – Protective Coatings.

2. Check Valves

a. Lever and weight swing check valves shall be constructed of a heavy cast iron body with a bronze seat ring. Check valves shall be APCO Series 6000LW Convertible Swing Check Valve as manufactured by Valve &

Primer Corporation or Horizontal Swing Check Valve Style 106LW as manufactured by Clow Valve Company or approved equal..

b. The swing check valve shall prevent the backflow of the media on pump shut-off or power failure and be tight seating.
c. All internals shall be replaceable in the field without removing the main valve from the pipeline.
d. Valve exterior shall be painted with Red Oxide Phenolic Primer paint, as accepted by the FDA for use on contact with potable water. Valve shall also be coated with the field coatings specified for the wet well and valve vault piping.

2.04 Level/Pump Control System

Four sealed float type mechanical micro switches shall be supplied for the lift station control sump level and alarm signal. The mechanical micro switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have a heavy Neoprene jacket and a weight shall be attached to the cord above the float to hold the float in place in the sump. The floats shall also be capable of supporting themselves from a wiring channel support bar or capable of being attached to a stainless steel chain or cable with a weight at the bottom of the chain.

Refer to Section 16481 for a description of the Pump Control Panel.

PART 3 - EXECUTION

3.01 Operation of the System

There are four levels within the wet well for normal operation of the system. The first level is all pumps off. The second level is lead pump start. Third level is lag pump start. The two pumps shall alternate between lead and lag. Pumps will operate until the off float is activated. If the lead pump is unable to keep up, the lag pump will activate; both pumps are to remain activate until the all pumps off float is achieved. The fourth level is shall alert the Operator the wet well is at a high-water level and shall active the alarm strobe.

3.02 Installation

A. All equipment shall be installed in accordance with the manufacturer's published instructions, and in accordance with all state and local codes, ordinances and regulations.

B. The Contractor shall adjust, lubricate and leave the pumping system in proper working condition.

C. Contractor shall provide spare parts to the Town as described herein.

3.03 Cleaning Up

Upon completion of work, the Contractor shall remove all construction equipment and temporary materials, and dispose of all rubbish and other unsightly debris caused by operations and shall leave the premises in as good or better condition than found.

3.04 Field Testing

A. The manufacturer's representative shall perform a pumping test of each new pump as soon as practical after the pumping equipment is installed. The Contractor is responsible for coordinating the testing of the pumps. The pumping test shall determine the capacity, discharge pressure, horsepower draw, and efficiency of each pumping unit under actual operating conditions. The duration of each pump test shall be at least ten (10) minutes of continuous operation. Include all as-installed test data and pump curves in Start-Up Certification Report.

B. Flow meters and pressure gauges installed as a part of the project shall be used to determine the pumping rates and pressures. The Contractor will not be required to install temporary flow meters and gauges for pump testing. Where flow meters are not provided, a wet-well draw down test shall be performed to verify pump performance.

C. Any defects in the new equipment or failure to meet the specified performance shall be corrected by the Contractor. The Town reserves the right to reject the pump if the Contractor fails or refuses to make the corrections required to meet the specified performance; or the improved pumping units, when tested, fail to meet the specified performance.

3.05 Manufacturer's Service and Start-Up Certification Report

A. The Contractor shall provide the services of a qualified representative of the pump manufacturer for a minimum of one day per pump station to perform the following tasks:

1. Inspect the installation of the equipment.
2. Place the equipment in operation and make any necessary adjustments.
3. Perform Field Tests specified above.
4. Perform tests specified in this Section and recommended by the equipment manufacturer.
5. Instruct Town's personnel in the proper operation and maintenance (O & M) of the equipment (training).

B. If equipment is not completed for proper start-up and training procedures, the representative shall reschedule another visit at no additional cost to the Town. Training will not be permitted without proper start-up and testing tasks. An abstract or outline of the start-up, testing, and training procedures shall be provided to the Town at least five days prior to the scheduled visit. Manufacturer's operation and maintenance manuals and materials and audio-video cassette, when included under submittal requirements, shall be incorporated in the training procedures, with emphasis on items or materials of greatest importance.

C. A typed, bound report covering the manufacturer's representative's findings shall be submitted to the Town for review and approval. The report shall (1) describe the start-up procedures taken; (2) include any inspections performed; (3) outline in detail any deficiencies observed along with the corrective measures taken; and (4) include the results of all field tests, including necessary graphs, charts, tables, etc., specified in this Section or required by the referenced standards. The report shall certify the equipment is properly installed and functioning for the purpose intended.

D. The Contractor shall bear all expenses associated with the start-up, testing, and training procedures and report described above, including labor, transportation, lodging, and material costs.

3.06 Access and Fencing

A. The Contractor shall provide an access roadway to the lift station from nearest public roadway. Access shall be paved the full extent with asphalt or concrete. Town may approve on a case-by-case basis the entrance after leaving public roadway and entrance to the lift station are the only two portions to be paved. The Town may approve the length of roadway in between these two points to be gravel.

B. Fencing around the lift station shall be in accordance with Section 02830 Chain Link Fence.

-END-

DIVISION 16
ELECTRICAL

TABLE OF CONTENTS

SECTION 16000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 The Requirement

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. Where the word "Contractor" appears in these Technical Specifications it shall be construed to mean the Electrical Contractor.

C. The Contractor shall be responsible for all interconnecting devices, conduit, wire, and appurtenances not furnished by others but required for the operation of equipment as described in the functional descriptions whether specifically shown on the Drawings or not.

D. The scope of work for this project primarily includes, but is not limited to, the following:

1. Furnish and install electrical equipment as specified and shown on the Contract Documents including power system and conduit and wire systems.
2. Coordinate with local power utility company for providing service to the new lift station control panels. Contractor is responsible for meeting all utility requirements and providing all materials as required by the utilities at no cost to the Town.
3. Other electrical work as specified herein and indicated on the Drawings.

E. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation.

F. All electrical equipment shall conform to the applicable NEMA specifications. All electrical equipment shall be properly identified in accordance with these Specifications and Contract Drawings. Nameplates shall be engraved high pressure plastic laminate, black with white lettering for 120/208 or 120/240V equipment, and red with white lettering for 277/480 or 480V equipment. The nameplates shall be attached to the equipment cabinets with two (2) stainless steel sheet metal screws for nameplates up to 2-inch wide. For nameplates over 2-inch wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. All panelboards, starters, control panels, cabinet enclosures, and equipment switches shall be labeled in the manner described, or in an equally approved manner.

G. All materials, equipment, sizes and capacities of electrical equipment incorporated in the project shall conform to the latest requirements of the current National Electric Code, the National Electrical Manufacturer's Association, the State and local electrical codes, and to applicable rules and regulations of the local electrical utility serving the project.

H. All material and equipment must be the product of an established and reputable manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Town.

I. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Town shall be furnished and installed at no cost to the Town.

J. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Town.

K. Furnish and install controls for each piece of equipment requiring controls. The controls shall be the size and type recommended by the manufacturer for the application and as otherwise specified or indicted on the Drawings. Refer to Divisions 1 and 16 of the Specifications for control, connection and coordination descriptions and requirements.

L. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished, or equipment otherwise specified or indicated on the Drawings.

1.02 Drawings

A. The Contractor shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for the complete lighting, power, and other electrical systems. Additional conduits and the required wiring shall be installed by the Contractor for wherever needed to complete the installation of the specific equipment furnished, at no cost to the Town.

1.03 Equipment Location

A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to insure that proposed equipment will fit properly in spaces indicated.

1.04 Local Conditions

A. The Contractor shall examine the site and become familiar with conditions affecting the work. He shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. Costs for connecting electrical service include meter base, CT cabinet, underground duct bank, etc. Coordination with the serving utility is required prior to the bid to ensure these items have been adequately accounted for in the bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

1.05 Submittals

A. The Contractor shall submit to the Town Shop Drawings of all electrical materials, apparatus, appliances, equipment and miscellaneous devices shown or specified and shall be in accordance with the requirements of the General Conditions and Section 01300, Submittals.

B. Shop Drawings shall be sufficiently complete in detail to enable the Town to determine compliance with Contract requirements. Details and information shown shall include but are not necessarily limited to the following:

1. Performance characteristics.
2. Physical sizes.
3. Material and equipment specifications, and construction and methods of fabrication details.
4. Compliance with standards (e.g. UL, NEMA), rules, regulations, and codes.
5. Accessories.
6. Complete wiring diagrams showing circuit designations as shown on the Drawings. A complete wiring diagram shall be submitted for each controller furnished.
7. Complete product data sheets for all components of the specified equipment.
8. Electrical ratings (voltage, current, KVA, phase, etc.)
9. Weights of components parts and assembled unit weights.
10. Complete assembly, layout, and installation drawings with clearly marked dimensions.

C. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

D. Shop Drawings will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components for which Contractor has provided no information.

E. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's specification section.

F. Each submittal shall be identified by the applicable specification section.

1.06 Applicable Codes and Requirements

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, the serving electrical utility company, the latest edition of the National Electrical Code (NEC), the National Electric Manufacturers Association (NEMA), the Institute of Electrical and Electronic Engineers (IEEE), the Insulated Power Cable Engineers Association (IPCEA), the American Society of Testing Materials (ASTM), the American National Standards Institute (ANSI), the requirements of the Occupational Safety Hazards Act (OSHA), and all other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.
3. All work shall be in accordance with local codes.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Town does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted, or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Town.

1.07 Permits and Inspections

A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.08 Temporary Lighting and Power

A. The Contractor shall reference the General Conditions.

1.09 Tests

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance overloads, and short circuits. Tests shall be made with and to the satisfaction of the Town.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Town. The Contractor shall show by demonstration in service all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.

C. The grounding system shall be tested to assure continuity and compliance with the requirement that ground resistances do not exceed 5 ohms when measured by a megohmeter or equivalent device. Ground resistance measurements of each grounding electrode shall be taken and certified by the Contractor. Upon completion, the Contractor shall submit to the Town the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground under test isolated from other grounds. Ground resistance shall

also be measured from each piece of equipment to the grounding electrode. Reference Section 16170, Grounding and Bonding, for additional requirements.

D. Each lighting and power distribution panelboard shall be tested with main circuit breaker disconnected from the feeder, branches connected, branch circuit breakers closed, all fixtures in place and permanently connected, lamps removed or omitted from the fixtures, and all wall switches closed.

E. Testing (Insulation Resistance Test) of all incoming and outgoing cables for switchgears, distribution and power panels, motor control centers, and similar equipment shall be done after the cables are in place and just prior to final terminations. All data shall be recorded, as per Exhibit "A", attached to the end of this Section.

F. The Contractor shall furnish all equipment and personnel as required.

G. Feeder circuits shall be tested with the feeder conductors disconnected from the supplied equipment. Each individual power circuit shall be tested at the panel or motor control center with the power equipment connected for proper operation.

H. Megohmmeter tests of the insulation resistance of rotating machines and power feeders shall be conducted. The results will be accepted when the megger shows the insulation resistance to be not less than one megohm per 100 volts at 10°C using a 1,000-volt megger.

I. All transformers shall be Megohmmeter tested in accordance with the manufacturer's recommendations.

1.10 Documentation

A. Required Documentation

The work requirement of this Section is in addition to and does not supersede testing and adjusting specified in other portions of the Contract Documents. The Contractor shall submit to the Town test records and reports for all testing.

1.11 Field Test of Equipment

A. The equipment to be tested shall include, but not be limited to, the following:

- Conduit System
- Cable and Wire
- Grounding System
- Lighting Fixtures (Outdoor)

B. Refer to each specific specification section for detailed field tests.

1.12 Final Field Test of System

A. The Contractor shall complete the installation and testing of the electrical installation at least one (1) week prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

B. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Town. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

C. The Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment. The infrared inspection shall apply to existing and new equipment.

1.13 Schedules and Plant Operations

A. Since the testing required in 1.12 above shall require certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Town for review and approval one month prior to any work beginning. When testing has been scheduled, the Town must be notified forty-eight hours prior to any work to

allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of plant equipment must be coordinated with the Town so as not to affect proper plant operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the Town, the equipment shall be placed back in service immediately and turned over to plant personnel.

C. In the event of accidental shutdown of plant equipment, the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

1.14 Materials Handling

A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt, and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material shall be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Town.

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conduc-tors	Size:	AMG MCM Shld:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____Pothead _____Terminal					Location: Indoors_____ Outdoors_____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT B)
TEST DATA - MEGOHMS
TEST NO. ____

Part Tested: Test Made:_____
Hours/Days:_____
After Shutdown:_____

Grounding Time: Dry Bulb Temperature:_____
Wet Bulb Temperature:_____

Test Voltage:

Equipment Temperature: _____
How Obtained: _____
Relative Humidity: _____
Absolute Humidity: _____
Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date_____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
□ Minute				5 Minutes			
□ Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			

Remarks:

PART 2 -- PRODUCTS

2.01 Product Requirements

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof, if requested by the Town, the materials, appliances, equipment, or devices he provides under this Contract meet the requirements of Underwriters Laboratories, Inc., regarding fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming with this requirement.

2.02 Substitutions

A. Any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition.

2.03 Concrete

A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified, and in complete conformance with the applicable requirements of Division 3 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on floors or slabs that are existing or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, etc. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings. Pads shall be reinforced with steel wire mesh and shall have dowel rods inserted into the floor for anchorage.

C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs are not existing or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, etc. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

D. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.

PART 3 -- EXECUTION

3.01 Cutting and Patching

A. Coordination

1. The work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Town's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

3.02 Excavation and Backfilling

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 Corrosion Protection

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

-END-

SECTION 16111 - CONDUIT

PART 1 - GENERAL

1.01 Requirements

A. Under this Section, the Contractor shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.

B. The Drawings indicate the general location of conduits both exposed and concealed; however, the Contractor shall install these conduits in such a manner to avoid all interferences.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.
   b. All conduit shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of suitable pulling tape.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Drawings.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to equipment specifications and product data sheets identifying all materials used and methods of fabrication.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein.

2.02 Conduits

A. Unless specified otherwise herein, all conduits shall be rigid, hot-dipped galvanized steel. Minimum size conduit shall be 3/4 inch unless specifically indicated otherwise. Unless specified otherwise herein, all encased conduits shall be PVC Schedule 40, minimum size 1 inch. The Contractor, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.

All components of the conduit system shall be of the same material of construction. Rigid galvanized steel conduit systems shall include fittings, couplings, connectors, and other components compatible with and approved for such

systems. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.

Reference the "Conduit Uses" portion of this specification for additional information regarding conduit.

B. Rigid Steel Conduit

1. Steel conduits shall be rigid type, heavy wall, hot-dipped galvanized inside and outside and as manufactured by Allied Tube and Conduit Corporation, Wheatland Tube Company, Jones & Laughlin Steel Company, or equal.
2. Each length of conduit shall be shipped with a coupling on one end and a color coded thread protector at the other end.

C. Flexible Metal Conduit

1. Flexible metal conduit (FMC) shall be galvanized steel, single strip. FMC shall be UL listed. FMC shall be used to connect all indoor vibrating equipment, installed in dry locations, above reflected ceilings to lighting fixtures, and other applications as accepted by the Town. FMC shall be as manufactured by Electri-Flex, Alflex Corporation, Anaconda or equal.

D. Liquid-Tight Flexible Metal Conduit

1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Liquatite Type "LA" as manufactured by Electri-Flex, "Ultratite" Type UL"Ultralite" as manufactured by Alflex Corporation, Type "A" as manufactured by Anaconda, or equal.
2. Watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the Town.

E. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or equal.

F. Conduit Fittings

1. Fittings for rigid metal conduit, rigid nonmetallic conduit, flexible metal conduit, liquid-tight flexible metal conduit, and electrical metallic tubing shall conform to UL 467 and UL 514 as applicable.
2. Fittings for electrical metallic tubing shall be rain-tight and concrete-tight, conform to UL 467 and UL 514, as applicable, and shall be plated steel hexagonal threaded compression type.
3. Set screw or indentor type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
4. Fittings or bushings shall be installed in easily accessible locations.
5. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, or equal, watertight, permit a movement up to 4 inches, and shall be equipped with approved bonding jumpers around or through each fitting. Bonding jumpers shall be Appleton, Crouse-Hinds, OZ/Gedney, or equal.
   Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of ¾-inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, or equal.
   Where embedded conduits pass through structural expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of ¾-inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, or equal.
6. Conduit fittings ("condulets") shall be used on exposed conduit work for lighting and power outlets, convenience outlets, changes in direction of conduit runs and breaking around beams. "Condulets" shall be cast ferrous alloy, galvanized or cadmium plated, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or equal. Coated fittings and boxes shall be used with coated conduit in all chemically aggressive areas or where called for on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers accessible.

Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.

7. Conduit fittings shall be cast type of non-ferrous metal or malleable iron thoroughly coated inside and outside with metallic zinc or cadmium after all machining has been completed. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type. Where cast fittings are used to house wiring devices such as receptacles and switches, they shall be of the "deep" type.
8. Coated fittings shall be used with coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.
9. Conduit seals shall be Type EYS as manufactured by Crouse-Hinds, Appleton equivalent, OZ/Gedney equivalent, or equal.

PART 3 - EXECUTION

3.01 Conduit and Fittings

A. Unless otherwise specified herein, the minimum size conduit shall be 3/4 inch for exposed work and 1 inch for conduit encased in concrete or mortar.

B. Conduit home runs for some lighting circuits are not necessarily indicated on the Drawings; however, the circuit numbers are shown. Conduit shall be furnished and installed for these lighting circuits and shall be installed as required to suit field conditions, subject to review and acceptance by the Town.

C. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the Town.

D. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.

E. For floor mounted equipment, conduit may be run overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions.

F. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull wires installed. The pull wire shall be No. 14 AWG zinc-coated steel, or of plastic material, having not less than 200-pound tensile strength. Not less than 12 inches of slack shall be left at each end of the pull wire.

G. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of sealing compound applied to threads. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. In exposed work only, where standard coupling cannot be used, only Erickson couplings are permitted, or as otherwise acceptable to the Town.

H. Conduit threaded in the field shall be of standard sizes and lengths.

I. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.

The equivalent number of 90° bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet: 0
2. Runs of 300 feet to 201 feet: 1

3. Runs of 200 feet to 101 feet: 2
4. Runs of 100 feet and less: 3

J. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. All fasteners, clamps, straps, and anchors shall be stainless steel. The use of perforated strap hangers or Mineralac conduit hangers are prohibited. Perforated strap hangers shall not be used. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Explosive-drive equipment may be used to make connections where the use of this equipment complies with safety regulations. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.

K. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Spring steel fasteners may only be used to support lighting branch circuit conduits to structural steel members. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to insure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.

L. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable watertight expansion fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs.

M. Install polyvinyl chloride (PVC) coated steel conduits when entering or exiting concrete except under electrical equipment where the conduit is not subject to physical abuse. Extend stub-ups at least 12 inches above and below grade or finish floor. Conduits extending through the concrete floor shall be installed using straight runs (for vertical penetrations) or factory elbows (for conduits installed within the slab) of PVC coated rigid steel conduit.

N. All conduit extending through the floor behind panels or into control centers or similar equipment may be PVC Schedule 40 and shall extend a minimum of 6 inches above the floor elevations, where practicable, with no couplings at floor elevations.

O. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to metal conduit occurring inside the concrete encasement.

P. No more than three (3) 90-degree bends will be allowed in any one conduit run. Where more bends are necessary, a condulet or pull box shall be installed. All bends in 1/2-inch and 3/4-inch conduit shall be made with a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.

Q. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid metal conduit to equipment except that, where required, flexible metal conduit

may be used 6 inches above the floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.

R. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the Town.

S. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.

T. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.

U. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Flexible metal conduit and liquid-tight flexible metal conduit length shall be five feet (5 feet), maximum.

V. Flexible metal conduit or liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running through flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal.

W. All threaded ends of conduits shall be coated with an approved conducting compound as manufactured by Thomas & Betts, or equal prior to making up the joint.

X. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.

Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall.

Conduits passing through sleeves in interior walls and floors shall be tightly caulked.

Y. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required.

Z. The use of two (2) locknuts and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.

1. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
2. Install non-metallic conduits in accordance with manufacturer's instructions where specified herein or indicated on the Drawings.

3. Join non-metallic conduit using cement as recommended by the manufacturer. Clean and wipe non-metallic conduit dry before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes (minimum).
4. Use proper installation tools approved for the purpose to assemble coated conduit systems to prevent damage to the covering and maintain the corrosion-resistant integrity of the conduit system. No damage to the covering is permitted. Use “touch-up” compounds to repair minor damage to the interior or exterior coatings. Painting shall be as specified in Section 09900, Protective Coatings.

3.02 Conduit Uses and Applications

A. No PVC conduit shall be installed exposed unless specifically accepted in writing by the Town. Where PVC conduit is allowed to be installed exposed, the conduit shall be Schedule 80 as required by the NEC. Reference Article 300-5(d) of the NEC.

B. PVC Schedule 40 conduit shall be furnished and installed in concrete slabs (for slab-on-grade construction) and in walls when the conduit is shown to be encased. Rigid steel conduit shall be installed in all elevated slabs when the conduits are shown to be encased.

C. PVC coated conduits shall be installed as specified in 3.01 M.

D. Other conduit uses not specifically listed above shall be brought to the attention of Town for a decision.

-END-

SECTION 16123 - BUILDING WIRE AND CABLE

PART 1 -- GENERAL

1.01 The Requirement

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the Contractor.

B. The Contractor shall submit Shop Drawings and other material required to substantiate conformance with the requirements set forth on the Drawings and in Section 16000, Basic Electrical Requirements, and Section 01300, Submittals. Shop drawings shall include, but not be limited to, detailed specifications and product data sheets for the power, control, and instrumentation cable required for this project.

C. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years.

D. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witness Shop Tests
   a. Not required.
2. Shop Test
   a. Prior to the first shipment of each size of power, control, and instrumentation cable to be furnished and installed under this Contract, samples of each size of cable shall be subjected to complete physical and electrical factory production tests at the manufacturer's plant. Other cable and wiring shall be tested in accordance with the applicable ICEA Standards. Six copies of certified test data sheets shall be submitted to the Town for approval prior to installation at the site. Subsequent shipment of each size of wire shall be covered by certificates of compliance which shall list Contractor's name, point of delivery, reel numbers, size of wire, length of wire, and date of shipment. Certificates shall attest the wires and cables comply with specification requirements and wires and cables are equal in every respect to wires and cables which have been successfully tested.
   b. All test data or certificates shall be submitted.

3. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.
   b. After installation, all wires and cables shall be tested for insulation levels and continuity. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
      1) For 600V power and control cable, apply 1,000 VDC from a Megaohmeter for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Testing for continuity shall be "test light" or "buzzer".
      2) 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.

B. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.

C. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.

D. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Town, without cost to the Town.

E. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.

1.03 Submittals

A. The Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings
2. Reports of Certified Shop and Field Tests
3. Wiring Identification Methods

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Cable pulling calculations.
3. Wiring identification methods and materials.

1.05 Identification

A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.06 Cable Pulling Lubricants

A. The Contractor shall submit a list with a minimum of four manufacturer’s standard lubricants which may be used interchangeably for each type of lubricant required. Lubricant shall be non-hardening type.

1.07 Cable Pull Calculations

A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of North Carolina, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 -- PRODUCTS

2.01 Manufacturers

A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance as manufactured by the Okonite Company, Rome Cable Corporation, Southwire Company, or equal. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings. Only one manufacturer for each wire and cable type shall be permitted.

2.02 600 Volt Power Wire and Cable

A. 600 volt cable and wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.

B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Town.

D. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.03 600 Volt Control Cable

A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations. The individual conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Table K-1. Cables shall meet requirements of IEEE-383.

B. Conductors shall be tin or alloy coated (if available) stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Town.

D. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.04 Lighting and Receptacle Wire and Cable

A. The lighting and receptacle branch circuit wire shall consist of stranded, copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.

B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Town.

D. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.05 Instrumentation Cable

A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.

B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.

C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

PART 3 -- EXECUTION

3.01 600V Cable Installation

A. The cable and wires shall be installed as specified herein and shown on the Drawings.

B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.

D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Town prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) for power or control wiring will only be permitted if specifically accepted by the Town.

E. Wire and Cable Sizes

1. The sizes of wire and cable shall be as shown on the Drawings, or if not shown, as approved by the Town. If required due to field routing, the size of conductors and respective conduit shall be increased so the voltage drop does not exceed 2-1/2%.
2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.

F. Number of Wires

1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no cost to the Town. The addition of conductors shall be coordinated with and approved by the Town to avoid violations of the NEC regarding conduit fill.
3. All spare field conductors shall be terminated on the terminal blocks mounted within the equipment.

G. Wiring Identification

1. All wiring shall be identified at each termination, shall have a unique wire number, and shall be labeled at both ends. Wire numbers shall correspond with the equipment terminal wire numbers as indicated in the accepted Shop Drawings. Where no wire numbers are indicated, the Contractor shall advise the Town in writing prior to assigning wire numbers. Wire numbers shall not be duplicated.
2. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.
3. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.
4. For instrumentation wiring, the Contractor shall provide, on the Shop Drawings, a schedule indicating the wire number, color code, if applicable, origin and destination devices, and terminals.
5. Wire identification shall be accomplished through the use of a portable printer and white, polyolefin wire marking sleeves. The wire identification system shall be a "Bradymarker" XC Plus Printer with "Bradysleeve" wire marking sleeves, Panduit equivalent, Seton equivalent, or equal.
6. The Contractor shall submit a written description outlining his intended method of wiring identification and supporting information (i.e., product data sheets, etc.) identifying the materials to be used. The Contractor shall meet with the Town to come to an agreement regarding wire identification prior to the installation of any wiring.

H. Cable Identification Tags

1. The Contractor shall furnish all labor and materials and affix in a permanent way to each cable in manholes, cable compartments and vaults, junction boxes, pull boxes and points of termination, a bronze metal tag, 1/2-inch in diameter, with a 1/8-inch diameter hole, with copper wire through the hole, the cable identification number approved by the Town. The tag shall be attached to the cable by twisting the ends of the copper wires. All cables shall be tagged with its full ID number immediately after it has been pulled.

I. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be run in conduit.

J. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Town shall be used.

2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

K. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so the cable can be trained and racked in an approved manner. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. All manhole cables shall be arc and fire-proofed. The training shall be done in such a manner as to minimize chaffing.

L. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size and complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

M. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the insulation or of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature within a three day period prior to pulling of 40°F or lower, cable reels shall be stored during the three day period prior to pulling in a protected storage area with an ambient temperature not lower than 55°F and pulling shall be completed during the work day for which the cable is removed from the protected storage.

N. Color Coding

1. Conductor insulation shall be color coded as follows:
   a. 480V AC Power
      Phase A - BROWN
      Phase B - ORANGE
      Phase C - YELLOW
      Neutral - WHITE
   b. 120/208V or 120/240V AC Power
      Phase A - BLACK
      Phase B - RED
      Phase C - BLUE
      Neutral - WHITE
   c. DC Power
      Positive Lead - RED
      Negative Lead - BLACK
   d. DC Control
      All wiring - BLUE
   e. 120VAC Control
      Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.
   f. 24VAC Control
      All wiring - ORANGE
   g. Equipment Grounding Conductor
      All wiring - GREEN

2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

3.02 Instrumentation Cable Installation

A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid galvanized steel or PVC coated rigid galvanized steel conduit. The use of asbestos cement or plastic conduit will not be permitted. Analog signal wires shall exclusively occupy these conduits. No other wiring for AC or digital DC circuits shall be installed in these conduits.

B. All shielding shall be continuous and shall be grounded in accordance with the instrumentation equipment manufacturer's recommendations, as approved.

C. A raceway containing instrumentation cable shall be installed to provide the following clearances:

1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.

D. Where practical, raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.

E. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

F. Grounding of cable shield shall be accomplished at one point only, unless otherwise required by instrumentation system's manufacturer.

G. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required for specifically directed by the Town, the Contractor shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.

H. Special instrument cable shall be as specified or recommended by the vendor of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.

I. All cable, insulation and jacket shall have adequate strength to allow for it to be pulled through the conduit systems. Sufficient conductors shall be installed to provide space and serve future equipment where shown and specified. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers at each end.

-END-

SECTION 16170 - GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered as a minimum requirement for compliance with this Specification.

B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Town.

C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:

D. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Reports of certified field tests.

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Drawings.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.
2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 Manufacturers

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 Ground Rods and Grid

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod.

B. The maximum resistance to ground of a driven ground rod shall not exceed 5 ohms under normally dry conditions. Where the resistance obtained with one (1) ground rod exceeds 5 ohms, additional ground rods shall be installed not less than 6 feet on centers. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.

C. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. If there is not suitable metallic water service to the facility, the ground connection shall be made to the driven ground rods on the exterior of the building.

D. Where ground fault protection is employed, care shall be taken so the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 Fittings

A. Grounding connections to equipment shall be bolted. Cable end connections may be made by use of the crucible weld process or bolted type connectors. Bolted type connectors for this application shall consist of corrosion resistant copper alloy with silicone bronze bolts, nuts and lock washers which are designed for this purpose.

2.04 Grounding Conductors

A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 Equipment Grounds

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

PART 3 -- EXECUTION

3.01 Installation

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods. The ground rods shall be driven deep enough to obtain a ground resistance of not more than 5 ohms and shall be interconnected by the use of copper cable bus, welded to the rods by the crucible weld process. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground system and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.
2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
4. Connections to ground rods shall be exposed to permit maintenance and inspection for continuity and effectiveness of grounding system.
5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

-END-

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 -- GENERAL

1.01 The Requirement

A. All electrical equipment shall be properly identified in accordance with these Specifications. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this section include, but are not limited to, the following:

1. Exposed conduit color banding.
2. Operational instructions and warnings.
3. Danger signs.
4. Equipment/system identification signs.
5. Nameplates.

1.02 Signs

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the electrical panels and disconnect switch.

1.03 Lettering and Graphics

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.

PART 2 -- PRODUCTS

2.01 Manufacturers

A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 Nameplates

A. Nameplates shall be engraved, high pressure plastic laminate, black with white lettering.

2.03 High Voltage Signs

A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate vision.

2.04 Conduit Markers

A. All conduits shall be labeled in accordance with the conduit and wire schedules. Color coded conduit markers shall be standard preprinted, flexible permanent, plastic sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive. Lettering shall indicate the conduit number as indicated in the conduit schedule. Provide 8 inch minimum length for 2 inch and smaller conduit and 12 inch length larger than 2 inch conduit.

PART 3 -- EXECUTION

3.01 Nameplates

A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 Conduit Identification

A. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on the electrical conduit in a manner similar to the piping identification. Except as otherwise indicated, use orange as the coded color for conduit marker backgrounds. Conduit identification shall be made after the conduit has been painted.

3.03 Operational Identification and Warnings

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.04 Power Source Identification

A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Town regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

-END-

SECTION 16440 - DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.

B. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Spare Parts List

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Drawings.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
3. Assembled weight of each unit.

D. The shop drawing information shall be complete and organized in such a way the Town can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 Tools, Supplies, and Spare Parts

A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment, and with all spare parts as recommended by the equipment manufacturer.

B. One complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Town at the time of final inspection.

C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.06 Identification

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 Manufacturers

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Switches shall be manufactured by Square D Company, Cutler-Hammer, General Electric Company, or equal.

2.02 Disconnect Switches

A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable in both on and off positions.

B. Switches shall be NEMA Type HD, single-throw, externally operated, fused or non-fused as required. Switches of the poles, voltage, and ampere ratings shown shall be furnished in NEMA 1A (gasketed) enclosures in indoor dry areas, and in NEMA 4X Type 304 stainless steel enclosures for damp/wet indoor process areas. Enclosures for outdoor applications shall be NEMA 4X Type 304 stainless steel. Switches located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.

C. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.

D. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.

PART 3 -- EXECUTION

3.01 Installation

A. All disconnect switches to be mounted five (5) feet above the floor, at the equipment height where appropriate, or where shown otherwise.

B. The Contractor shall furnish and install fuses of various types as required with the continuous ampere ratings as required or shown on the Drawings.

-END-

SECTION 16481 - PUMP CONTROL PANEL

PART 1 – GENERAL

1.01 Description

A. This specification along with the Drawings cover the technical requirements for the engineering, fabrication, wiring and installation for control panels and enclosures.

B. The Contractor shall be responsible for adjustments and commissioning of the control panel necessary to place the control panel into service, including proper pump protective device adjustments and programming.

C. The Contractor shall furnish and install new pump power and pump status cables to new pump motors. The Contractor shall provide new float switches and cables and connect to pump control panel.

D. In order to maintain unit responsibility and warranty on the pumping equipment and control center, each control center must be accepted in writing by the pump manufacturer and suitable operation with the pumping equipment.

E. The equipment furnished for this control panel shall meet the requirements of Division 16000, 16123, 16170, 16195, and 16902.

1.02 Industry Standards

A. Equipment specified herein shall meet applicable standards of the following agencies and associations:

1. Underwriters' Laboratories, UL.
2. National Electrical Manufacturers Association, NEMA.

1.03 Submittals

A. Furnish to the Town complete shop drawings for the following items.

1. All pump control panel components.
2. Pump control panel enclosure.
3. Level control float switches.
4. Pump motor power and control cables.
5. Mounting rack and installation details.

PART 2 – PRODUCTS

2.01 General

A. The instrument panels and enclosures shall be as follows:

1. Pump Control Panels enclosure shall be rated NEMA 4X, stainless steel, provided with accessories and components as shown on the drawings and detailed in the project specifications.

B. Provide water tight conduit hubs for all NEMA 4X enclosures, and conduit seals for explosion-proof wiring applications, and moisture seals for non-hazardous applications.

C. Enclosure shall be sized to accommodate future equipment not installed in this phase: PLC/RTU, power supply, UPS, radio modem, radio antenna.

D. The control panel for the Baugh City Pump Station No. 1 will have a 480VAC, single-phase power supply and utilize Variable Frequency Drives for voltage phase conversion to 480V, 3-phase and to control the pump motors. The control panel for Asbury Cemetery Pump Station No. 2 will have a 480VAC, 3-phase power supply and utilize Variable Frequency Drives to control the pump motors.

2.02 Panel Construction

A. General

1. Stiffening members shall be provided for strength and stiffness as required.
2. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
3. Lifting rings shall be provided.
4. Sub panels shall be provided as required, with mounting designed for easy removal. The subpanels shall be finished with 2 coats of white enamel paint.
5. Print pockets shall be attached to the interior side of each door.
6. Hinges shall be stainless steel piano continuous hinge type.

2.03 Panel Grounding

A. Provide an equipment grounding bus bar.

1. The ground busbars shall be of nickel-plated copper, rated for 200 amperes.
2. The bus bar shall be provided with two (2) screw clamp terminal blocks, which shall be capable of accepting conductors up to #1 AWG.
3. The bus bar shall be provided with a minimum of twenty (20) screw clamp terminal blocks, which shall be capable of accepting conductors up to #10 AWG.

2.04 Panel Wiring

A. Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.

B. Not more than two wires shall be terminated at any terminal.
C. Wiring splices and wire nuts will not be permitted within the enclosure.

D. Wiring within the enclosure shall be protected as follows:

1. In general, all wiring within the enclosure shall be put in plastic wiring ducts. Wiring ducts shall be sized to include 100% (percent) spare capacity.
2. Wiring outside of the ducts shall be restrained by means of plastic ties.
3. Wiring passing a door hinge shall be grouped and wrapped in a protective wire harness.
4. Provide abrasion protection for wire bundles passing through holes or across metal edges.

E. In general, wiring within the enclosure shall be as follows:

1. Control wiring within the enclosure shall be #14 or #16 AWG stranded, type MTW, 600V.
2. Wiring for 4-20 mA DC analog signals shall be #18 AWG twisted shielded pair.
   a. Cables shall meet the following criteria:
      1.) U.L. Listed Subject 1277
      2.) Pass IEEE 383 or UL 1581 Flame Test
      3.) OSHA Acceptable
      4.) Pall UL VW-1 Flame Test
      5.) #18 AWG conductors, 7 strand, bare copper
      6.) 100% aluminum/polyester foil shield
      7.) 600 volt 90º C rated insulation
      8.) Each conductor shall be numbered and color-coded.
      9.) Comply with NEC articles #318, #340 and #501, for power limited tray cable (PLTC)
      10.) Nominal 2” lay
      11.) PVC insulation, with ripcord and nylon jacket
      12.) Suitable for use in wet locations
   b. The manufacturer of the cables shall be an ISO 9001 certified facility.

F. In general, wiring within the enclosure shall follow the following color convention to comply with NFPA 79 (1994), part 16:

1. Neutral conductors shall be white.

2. Line, load and control conductors shall be black.
3. Grounding conductors shall be green.
4. Foreign voltage control conductors shall be yellow or orange.
5. Low voltage (below 50 volts) AC conductors shall be red.
6. Low voltage neutral (grounded) conductors shall be white with a red stripe.
7. DC control conductors shall be blue.
8. DC (+) power conductors shall be blue with a white stripe or purple.
9. DC (-) (grounded) power conductors shall be white with a blue stripe.
10. Wiring with multi-conductor cables shall be color-coded.

Note: Foreign voltage means all control circuits that may remain energized when the main disconnecting means is in the OFF position. Interlocking conductors shall be yellow or orange throughout the entire circuit, including wiring in the control panel and the external field wiring.

G. AC and DC wiring shall be separated from each other. Where AC and DC wire runs parallel, the minimum separation between them shall be four (4) inches. Where AC and DC wire runs cross, they shall cross at 90°. Provide separate wiring duct for AC and DC wiring.

H. Equipment and signal ground wiring, as well as Neutral wiring, shall not be daisy-chained; they shall each be terminated at isolated, bussed terminal blocks.

I. Each conductor end shall be terminated at a terminal block or at an equipment-wiring terminal. Each terminal block shall have a unique identification number. The terminal blocks shall be arranged and numbered in consecutive order, based on standard alphanumeric order.

J. Terminal blocks within enclosure shall be grouped as follows:

1. 120 Volts AC power.
2. 120 Volts AC control wiring.
3. AC isolated Neutral.
4. 24 Volts DC power.
5. 24 Volts DC control wiring for discrete signals
6. 24 Volts DC Common.
7. Analog signal wiring (for 4-20 mA DC signals).
8. Grounding.

K. Provide 25% spare terminal blocks (minimum of six) for each type used in each enclosure.

2.05 Terminal Blocks

A. Terminal blocks within enclosures shall be of the high density modular types, constructed of nylon material, suitable for mounting on standard DIN rails. Termination type shall be tubular screw with serrated pressure plate. The terminal block system shall be manufactured by Phoenix Contact, Weidmuller, or equal.

B. All current carrying parts (metal bodies) shall be made of nickel/tin-plated copper.

C. Ground terminals shall be color coded in accordance with international standard, which shall be yellow/green.

D. Matching jumper bridges shall be color coded to the wiring colors.

E. Panel power distribution fused terminal blocks shall be provided with disconnect lever puller mechanism and illuminated indication.

1. Fused shall be standard ¼" by 1-1/4", and shall be sized as shown on the drawings.
2. The terminal blocks shall be able to accept up to number 8 AWG conductor.
3. Terminal blocks shall be rated for 15 amps at 250 VAC.
4. Terminal blocks shall be Phoenix Contact type UK 6.3-HESiLA-250, Weidmuller type 6/2, or equal.

F. Terminal blocks for discrete inputs and outputs shall be two-level types:

1. Both levels shall be of the feed through types.
2. Terminals shall be rated for up to 20 amperes at 300 VAC, and shall be able to accept up to #12 stranded

conductors.
3. Terminal blocks shall be Phoenix Contact type UKKB-3, Weidmuller WDK 2.5, or equal.

G. Terminal blocks for analog inputs and outputs shall be three-level types:

1. The top and center terminations shall be feed through types.
2. The bottom termination shall be grounded through the railing.
3. The terminal blocks shall be rated for up to 10 amperes at 300 VAC, and shall be able to accept up to #12 AWG stranded conductors.
4. The terminal blocks shall be Phoenix Contact type SLKK-5, Weidmuller type DLD 2.5/PE or equal.

H. Terminal blocks for foreign voltage “hot” conductors shall be single level disconnecting type:

1. Blocks shall be orange or yellow to match control wiring per Part 2.04, F.
2. The terminal blocks shall be rated for 10 amperes at 300 VAC, and shall be able to accept #22 thru #12 AWG conductors.
3. The terminal blocks shall be lever type with clear indication of open/close status.
4. The terminal blocks shall be Weidmuller type WRT 2.5, Phoenix Contact or equal.

2.06 Panel Accessories

A. Provide (furnish and install) interposing relays to interface all field-mounted equipment with power limited electronic control and communication equipment including the wet well and dry well devices. Use intrinsically safe relays where devices are located in hazardous areas.

2.07 Panel Instruments

A. Provide all analog signal boosters and isolators necessary to interface all field mounted equipment with control system equipment.

B. Provide a flashing strobe light for visual indication of all alarms at the pump stations.

2.08 Pilot and Control Devices

A. Pilot Devices: Pushbuttons, selector switches, and indicating lights shall be 30.5 mm and rated heavy-duty, oil-tight or watertight and corrosion resistant as required. All units shall be furnished with standard size legend plates with legends as described on the project Drawings.

B. Selector switches shall have the number of positions, switching arrangement, number and type of contact blocks indicated on the project Drawings.

C. Contact blocks shall have a minimum continuous current rating of 10 amperes at 240 VAC. Contact blocks shall have screw type connection terminals.

D. Indicating lights shall be light emitting diode type 120VAC, color cap, and push-to-test feature. Provide flashing type lights where indicated.

E. Pilot device manufacturers shall be:

1. Allen-Bradley Bulletin 800H or 800T or equal by same manufacturer as motor starters.

F. Control relays shall be plug-in type with sockets and hold-in clips. Sockets shall have screw terminals. Contacts shall be silver-cadmium, rated 10 amperes at 240 VAC. Relays shall have three-pole, double throw contacts (3PDT). Relays shall have a manual operator and pilot light. Coil voltages shall be 120 VAC, or as noted on the project Drawings. Relays shall be as manufactured by Allen-Bradley Bulletin 700, Type HA or HB, or equal by same manufacturer as motor starters.

G. Reference Section 16902 for additional requirements.

2.09 Equipment Identification and Wire Tagging

A. All control wiring shall be identified by means of computer-generated, heat shrink type wire marker. Wire numbers shall be as shown on the drawings.

B. Each component mounted within the enclosure shall be provided with equipment identification. Equipment and device nameplates or identification shall be of engraved laminated plastic, with black lettering on white background. Nameplates shall be as listed herein or as shown on the project Drawings.

2.10 Regulated Power Supply

A. When DC power supply is required for controllers, and 2-wire analog loops, provide two redundant 24 V DC regulated power supplies.

B. The contractor shall be responsible for providing and sizing all instrument loop power supplies. The instrument loop power supplies shall be sized to include at least 100% spare capacity. Submit power supply load calculations with the panel shop drawings.

C. The power supply shall be sized to include 100% spare capacity.

D. Acceptable power supply manufacturers:
   1. Phoenix Contact
   2. SOLA
   3. Or equal

2.11 Accessory Circuit Breakers

A. Accessory circuit breakers shall have terminal lug wire size #14 - #2 AWG Cu or Al. Reversible line and load lugs for flush mount wiring. DIN mounted (symmetrical rail 35 x 7.5 DIN/EN 50 022). UL Listed as HACR type from 15 A to 70 A. Field installable quick connectors. Single handle with internal common trip. UL Listed 120/240VAC (10,000 AIC).

B. Accessory circuit breakers shall be thermal magnetic type.

C. Accessory circuit breakers shall be supplied with reversible lugs. Mounting brackets shall be provided for flush installation.

D. Accessory circuit breakers shall be Square D Class 860, Multi 9 miniature circuit breakers, or equal.

2.12 Motor Branch-Circuit Breakers

A. Motor branch-circuit breakers shall be motor circuit protector type with adjustable instantaneous trip.

B. Motor branch-circuit breakers shall be provided by manufacturer/supplier of solid-state motor controllers.

2.13 Accessory and Control Power Transformer

A. Accessory and control power transformer primary shall be as specified on the drawings, dry type, rated 480 volt primary, 120 volt secondary, 60HZ, single phase, with two 5% FCBN taps, 115 degrees C temperature rise.

B. Accessory and control power transformer shall be Acme #TA-2-81220 and TA-2-81323 or equal.

2.14 Contactors and Relays

A. These units shall be type and size with the number of poles and accessories as indicated on the Drawings.

B. Unless indicated otherwise, these units shall be by the same manufacturer as the magnetic motor starters.

C. Control relays shall be plug-in “ice-cube style” with screw terminal base and hold-in clips.

2.15 Full Voltage Non-Reversing Motor Starters

A. The Asbury Cemetery Lift Station No. 2 shall operate on a full voltage non-reversing across the line motor starter. The motor starter shall be NEMA rated. IEC rated motor starters will not be acceptable.

B. Motor starter shall be sized to operate a 15HP motor at 480VAC, 3-phase.

2.16 Variable Frequency Drive

A. The Baugh City Lift Station No. 1 Variable Speed Drive shall be able to operate 5HP, 3-phase, 460VAC motors on a single-phase, 480VAC input. The use of a single phase input shall not void any warranties on the drive unit. The supplier or manufacturer shall submit in writing the drive is warranted for use in this application.

Variable speed drives shall be adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 460 volt AC NEMA Design B induction motors. Variable frequency drives for other than NEMA Design B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.

Drive units shall perform continuous self diagnostics as well as load and drive self check on startup.

B. All drives shall have permanently mounted programming and display modules. These modules shall provide programming access to all drive parameters, display all fault codes to assist with diagnostics and provide a display of output speed in percent or load.

C. This specification describes variable speed motor control which includes the design, fabrication, testing, installation and support requirements for variable frequency drive systems for 3-phase, squirrel cage rotor, induction motors driving pumps.

D. Each variable frequency drive to be a complete alternating current electric drive system including hardware, software, technical data, and spare parts necessary to accomplish variable speed operation of an induction motor and load combination in accordance with the requirements as indicated on the Drawings and as described in these Specifications.

E. Variable frequency drive system manufacturer shall be responsible for the design and performance of the entire drive system and shall either manufacture all items of equipment or supply them using coordinated specifications furnished to the original equipment manufacturers to insure compatibility and performance in accordance with this Specification. Variable frequency drive manufacturer shall coordinate with suppliers of the drive motors and driven equipment.

F. Variable frequency drive system shall be suitable for operation as part of a 480VAC, 1-phase, 60 Hertz power distribution system. The complete variable frequency drive system shall withstand the mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 22,000 amperes symmetrical at rated voltage.

G. The variable frequency drive system shall be suitable to operate, at times, on a limited power source engine-generator set. The system shall be provided with equipment and devices to prevent waveform distortion as specified herein.

H. Provide control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed so the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks.

I. Design each variable frequency drive motor drive speed control system so through simple programming by either factory engineers or Owner's trained operating personnel, specific control and protection functions can be attained.

J. Each variable frequency drive system shall meet the requirements of this Specification without derating any of the induction motor operating parameters including service factor and nameplate horsepower. The variable frequency drive system manufacturer shall specifically identify special requirements or restrictions of the motor-load combination may result from operation on the variable frequency drive system.

K. The variable frequency drive shall consist of a 6 pulse diode semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and

frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.

L. Variable frequency drive shall operate from fixed frequency power supply and convert this input power into variable speed induction motor shaft power as required by this Specification. Provide each variable frequency drive with a motor circuit protector as indicated on the Drawings which shall be padlockable. Provide each variable frequency drive with 3% line reactors at the input. Include the necessary drive controllers and output contactors to accomplish the intended control of the variable frequency drive system.

M. The drive shall operate the motor and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the variable frequency drive.

N. Variable frequency drive shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed (revolutions per minute). The variable frequency drive shall be provided with maximum and minimum frequency limits.

O. Variable frequency drive system to maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 Hertz for a 24 hour period.

P. Variable frequency drive to have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The variable frequency drive shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

Variable frequency drive shall be furnished with programmable electronic overload and torque limits.

Q. Drive system shall achieve a desired output frequency (setpoint) with a repeatability of 0.1 percent of rated frequency of 60 Hertz.

R. Drive system to be capable of operating the specified load continuously at any speed within the operating speed range of 10 percent to 100 percent of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.

S. Drive system controls to be microprocessor-based and have controlled linear acceleration capability to ramp up the speed, revolutions per minute, of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Provide two (2) field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.

T. Voltage or current unbalance between phases of the variable frequency drive output voltage shall not exceed 3 percent of the instantaneous values. The variable frequency drive system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.

U. Variable frequency drive system to operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip and remove supply voltage from the drive system. Variable frequency drive output voltage regulation shall be plus or minus 2 percent.

The variable frequency drive system shall be furnished with line surge protection.

V. The Contractor shall size variable frequency drive system and components to provide, indefinitely, motor load current equal to 110 percent of the motor nameplate full load current.

W. Operating Conditions

1. Humidity: 0-95 percent.

2. Ambient Temperature: Minus 20 degrees Celsius to plus 50 degrees Celsius.
3. Altitude: up to 3,300 feet
4. Power Supply: 460 volts, 1-phase, 60 Hertz.
5. Available Short Circuit Duty: 22,000

X. Each VFD shall provide "potential-free" output contacts for the following conditions:

1. Drive running.
2. Drive in "Auto" and all trip conditions cleared.
3. Drive Fail.

Y. Variable frequency drive system shall provide a 4-20 mADC output signal proportional to the drive output frequency for use as speed feedback or control and remote speed indication.

Z. Variable frequency drive system shall accept a 4-20 mADC input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.

AA. When operating in the automatic mode, the variable frequency drive system shall shut down during a power outage. Upon restoration of normal power and after an adjustable time delay (0-2 minutes; motor has coasted to zero speed and there is no backspin), the variable frequency drive system shall automatically restart and then ramp up to speed as required by the control system. The process operator shall not be required to reset the system manually after a shutdown caused by a power outage.

AB. Variable frequency drive shall be furnished with a multiple attempt restart feature.

AC. Furnish a door mounted selector switch or other pilot device for those variable frequency drives where an additional speed reference signal (e.g., from a remote potentiometer, an analog output from a setpoint (PID) controller, an analog output from a programmable logic controller, or similar analog signal) is to be supplied to the variable frequency drive in addition to the door mounted manual speed control.

AD. Variable frequency drive design shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VAC suitable for interfacing with the control system.

1. Diagnostics shall operate a visual alarm indicator visible on the variable frequency drive equipment cabinets without opening the cabinet doors.
2. Diagnostics shall provide an easily readable output that will isolate a failure.
3. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.
4. Provide a normally open dry contact for each alarm function to enable remote indication. A communication port shall be provided for possible future link.

2.16 Accessory Devices

A. These devices shall be heavy duty type and shall mount in the starter/pump control panel enclosure on the swing out panel or panel door, as indicated.

B. Unless otherwise indicated, these devices shall be by the same manufacturer as the magnetic motor starters.

2.17 Pump Panel Enclosure

A. Provide stainless steel NEMA 4X enclosure, as indicated on the drawings, with interior painted steel back panel for mounting components, interior painted steel swingout panel for mounting control devices such as control switches and pilot lights, and exterior door with padlock hasp. Non-metallic swingout and non-metallic back panels are not acceptable. Hoffman, Weigman, or equal.

2.18 Transient Voltage Surge Suppression System

A. The SPD/Filter shall be constructed using multiple surge current diversion arrays of metal oxide varistors (MOV), matched to 1% variance. The array shall consist of multiple gap-less metal oxide varistors, with each MOV individually fused. The arrays shall be designed and constructed in a manner which ensures MOV surge current sharing. No gas tubes, silicon avalanche diodes or selenium plates/rectifiers shall be used. The status of each array shall be continuously monitored and a green LED shall be illuminated if the array is in full working order. All protection modes, including N-G, shall be monitored and internally fused. Summary alarm dry contacts shall be provided: phase loss, undervoltage, power loss, protection failure. Similar to Liebert Accuvar Series# ACV 240H 200 RK or equal.

2.19 Spare Parts

A. The following spare parts shall be furnished by the pump and panel supplier for each lift station. All spare parts shall be supplied in containers suitable for long term storage.

1. One (1) - Pump controlling, intrinsically safe relay, SymCom ISS105ISO Pump Saver, or model used in Panel construction.
2. One (1) - MiniCAS motor protection relay.

PART 3 – EXECUTION

3.01 System of Operations

A. Submersible Lift Stations

1. When the selector switch is in the “Hand” position, the respective pump shall run.
2. With the selector switch in the “Off” position, the respective pump shall not run.
3. When the pumps are in the automatic mode, the pumps shall alternate through a lead-lag sequence controlled by the float switches in the wet well. The “Pumps off” float switch shall stop all pumps. The “Lead Pump” float shall start the lead lump (the pumps shall alternate each time the lead pump is called to start). The “Lag Pump” float shall start the lag pump, and both pumps shall operate.
4. The station shall have a high level alarm float switch, seal fail, and over temperature sensor that will trigger an alarm at the control panel.
5. During a high level alarm, both pumps shall be activated if not running already.
6. During a seal fail or over temperature alarm, the alternate pump shall activate.
7. Each alarm shall activate the warning beacon light and shall remain flashing until the alarm is corrected.
8. Level alarms shall automatically reset after the condition is cleared.
9. Manual reset buttons shall be required for seal fail, and over temperature alarms.

3.02 Installation

A. Provide and install all necessary bracket mounting devices, structural pieces and anchors necessary for this purpose.

1. For this project, provide a heavy duty welded aluminum mounting frame, set in concrete. Provide corrosion protection coating for any portion of aluminum frame in direct contact with concrete.

B. General mounting heights for the various type devices shall be as follows, unless otherwise indicated.

1. Control Panel - 5'-6" to top.

C. All control devices, motor starters, and relays inside the pump control panel shall be identified with engraved laminate nameplate.

D. Pump control panel shall have engraved laminate nameplate on exterior.

E. Install and connect pump control cables furnished with each pump.

F. Install and connect pump seal and temperature sensor cables for each pump motor.

G. Furnish, install and connect control cables for each level float.

H. Furnish and install stainless steel strain relief mesh grips and anchors for each cable installed in the wet well as required.

3.02 Wiring

A. Provide wiring for all motors, starters and control equipment.

B. Connections shown to equipment are approximate and do not represent the actual point of connection. Verify actual location before roughing-in.

3.03 Start-Up and Commissioning

A. The manufacturer and/or contractor shall supply authorized personnel for start-up service as needed to ensure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Town during the warranty period.

B. Simulate the following failures/operations and detail how the operation/failure was simulated with the result. Submit the procedures for simulating the operation/failures to the Town during the submittal phase. The Town must approve the means and methods prior to performing the actual test. Include the final test results in the operation and maintenance manual.

1. Phase Failure
2. Simulate float operation
3. Simulate high level alarm
4. Simulate one pump fail.
5. Simulate two pump fail.

C. The above testing and commissioning may overlap with Town training.

3.04 Training

A. The system manufacturer shall supply authorized personnel to conduct a training session. The Town shall have the right to video tape the training for future reuse.

B. The initial training session shall be conducted during start-up as needed until the Town is satisfied the operators are comfortable with the operation and maintenance of the system. Training shall be done on site with the Town's personnel. Start-up and training personnel shall provide their full attention to this customer while on site.

C. For any system to work properly, good training is important. The contractor shall insure the training will be taken at the utmost importance and insure the client is comfortable with the system. Subsequent follow up with the Town at 6 months and 1 year will be performed to insure any questions are addresses.

3.05 Warranty

A. A 1 year warranty shall begin from the time of "substantial completion" as issued by the Town. This shall cover parts and labor due to faulty components and/or workmanship.

-END-

SECTION 16902 - ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 The Requirement

A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

C. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.

D. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.

E. The Contractor shall furnish and install, as specified herein and indicated on the Drawings, all motor control components and wiring for all motor-operated equipment furnished under this Section and all other Sections as indicated. The Contractor shall review the entire Contract Drawings to be totally familiar with his responsibilities.

F. The Contractor shall furnish and install all external power and control wiring to control panels of prewired packaged equipment, unless indicated otherwise.

G. Control wiring requirements are indicated in electrical schematics and descriptions on the Drawings, in control functional descriptions, and in equipment manufacturer's equipment data. The Contractor shall furnish and install all control wiring in accordance with these Contract Documents. The Contractor shall provide all control circuits and wiring for a particular item of equipment in accordance with requirements as set forth by the manufacturer of the particular item of equipment.

H. As specified herein and indicated on the Drawings, furnish and install instrumentation wiring and connections to instrumentation equipment furnished under all Contracts of this Specification. Unless indicated otherwise, motor control switches, pilot lights, relays, and other control equipment for mounting in instrumentation panels shall be furnished, installed, and wired by the Contractor.

I. Unless otherwise specified herein or indicated on the Drawings, motor controllers shall be wired to drop out and remain dropped out on loss of power to the line side of the controller. Operator action shall be required to restart the motor unless the motor is intended to automatically restart.

J. Motor control components and control wiring shall conform to NEMA Specifications ISC-1970 (Revised, 1975), Industrial Controls and Systems.

K. Where devices are installed on the doors of NEMA 4, 4X, or 3R enclosures, devices shall be selected and installed to maintain the NEMA rating of the enclosure.

L. Wiring in all starters, panels, junction boxes, and similar equipment shall be brought out to numbered terminal strips for interconnection. The Contractor shall be responsible for documenting terminal numbers for all starters, controls, panels, and similar equipment provided under the Contract. At the completion of the project, the Contractor shall submit a complete set of record drawings showing and/or listing all terminals in boxes, panels, starters, and similar equipment in a single, complete bound package for the equipment and control supplied under the Contract. Reference the General Conditions.

M. The Contractor is responsible for coordinating the electrical work under the Contract with all equipment starters, controls, and instruments provided by others. The Contractor shall verify and coordinate with process equipment power supply and voltage, process equipment control power supply and voltage, and details of installation and interconnection. Coordination shall include distribution of approved electrical shop drawings to the General Contractor’s equipment suppliers.

N. Electrical control schematic diagrams drawn using a ladder-type format in accordance with JIC standards shall be submitted for all electrical equipment which is being provided under the Contract.

O. Record drawings shall be provided in accordance with requirements in the General Conditions. One complete set of record wiring diagrams encased in plastic or plexiglass envelopes shall be provided for each starter, panel, and similar equipment. The diagrams shall include wire color codes showing connections from numbered terminal blocks to external equipment.

P. Where space or strip heaters are provided within the enclosures for electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and operated according to its intended use.

Q. Control stations shall be furnished and installed at each motor and at all other controlled devices (e.g. solenoid valves) as specified herein and indicated on the Drawings.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests: None required.
2. Field Tests: Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division I, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Spare Parts List.
3. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.

D. The shop drawing information shall be complete and organized in such a way the Town can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 Operation and Maintenance Manuals

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 Tools, Supplies, and Spare Parts

A. The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Town by the Contractor.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Town.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

PART 2 -- PRODUCTS

2.01 Control Components

A. Pushbuttons (PB) and selector switches (SS) shall be Type E34 as manufactured by Cutler-Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pushbuttons and selector switches shall be 30.5 mm, heavy-duty, oil tight NEMA 4X corrosion resistant with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Town. Legend plates shall be plastic, black field (background) with white lettering. Pushbuttons and selector switches shall be non-illuminated. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release.

B. Pushbuttons and selector switches for all electrical equipment shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

C. Pushbuttons, selector switches, and other pilot devices for pump control panels shall be as specified herein.

D. Engraved nameplates shall be securely fastened to the front of each pushbutton station, disconnect switch, and motor starter remotely located from the motor control center. If adequate space is not available, the nameplate shall be mounted below the push button station. Nameplates shall be as specified in Section 16195, Electrical Identification. Identify all switches, control stations, and motor controllers as to their respective equipment.

E. Pilot lights shall be Type E34 as manufactured by Cutler- Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pilot lights shall be of the proper control voltage, LED type, heavy-duty, corrosion-resistant NEMA 4X with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Town. Legend plates shall be plastic, black field (background) with white lettering. Pilot light lens colors shall be as follows:

Red	-	"Run", "On", “Open”
Green	-	"Off", “Closed”
Amber	-	"Alarm", "Fail"
White	-	“Control Power On”

F. Pilot lights for all electrical panels shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

G. Pilot lights for pump control panels shall be round with custom engraved legend plates for each pilot light.

H. Control Relays (CR) shall be Type D3 as manufactured by Cutler-Hammer, Potter-Brumfield equivalent, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Relays shall be general purpose plug-in type with coil voltage as shown on the Drawings and sealed 10 ampere contacts. All relays shall have three SPDT contacts rated 120/240 VAC and 28 VDC minimum. Machine tool relays shall be provided when the contact burden exceeds 10 amperes. Miniature type or "ice cube" relays are not acceptable.

I. Timing Relays (TR) shall be the general purpose plug-in type, Type TR as manufactured by Cutler-Hammer, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with two SPDT timed output contacts. Contact ratings shall be the same as for control relays as specified above.

J. Control Stations (CS) shall be as manufactured by Cutler-Hammer, General Electric Company, Siemens Energy and Automation Inc., or equal. Control stations shall be furnished and installed complete with pushbuttons, selector switches, and other pilot devices as specified herein or indicated on the Drawings. Stop pushbuttons shall be furnished with a lock-out device as specified herein and indicated on the Drawings.

Control station enclosures shall be cast aluminum with gasketed cover for all indoor dry areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all indoor damp/wet process areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all outdoor applications.

Control stations located in hazardous locations shall be suitable for the Class, Division, and Group to suit the application. The pilot devices shall be the factory sealed type mounted in enclosures as specified above.

K. Open type motor starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be able to withstand 20 million operations. Each starter shall be furnished with a minimum of two spare auxiliary contacts in addition to the hold-in contact.

The motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

Starters shall be furnished with manual reset overload relays in each phase sized in accordance with the NEC. Provide door mounted overload reset button with metal (not plastic) shaft. Starters shall be provided with coils for 120 VAC operation, unless otherwise indicated on the Drawings.

Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the Town. The Contractor shall furnish and install correctly sized overload heaters based on the rating of the motor installed.
Open type magnetic motor starters shall be Cutler-Hammer Type AN16 or AN56 using NEMA rated Freedom Series contactors, General Electric Company equivalents, Siemens Energy and Automation Inc. equivalents, or equal.

L. Selected motors are indicted as requiring elapsed time indicators. Provide Eagle Signal Type HK210A6, General Time Catalog #ED27NR, Allen-Bradley equivalent, or equal, elapsed time indicators for 120 VAC volt operation mounted flush in the respective motor starter compartment door. Where clearance is not obtainable for compartment door closing, mount timers in a separately mounted enclosure, with each timer nameplated. Wire elapsed time indicator to operate when the respective motor operates.

M. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or cabinet subpanel. Terminals shall be tubular screw type with pressure plate for wire size #22 - #8 AWG.

Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30A. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20A. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. There shall be a sufficient quantity of terminals for the termination of all spare field conductors.

Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Town, a vendor's pre-engineered and prefabricated wiring termination system may be acceptable.

The terminal blocks shall be as manufactured by Phoenix Contact, Inc., Wieland, Inc., or equal.

N. Alarm horns shall be as manufactured by Federal Signal Corporation, Edwards Signaling Company, EST (Edwards Systems Tech) or equal. Alarm horns shall be made for surface, flush, or semi-flush mounting on walls, panels, enclosures, or on square outlet boxes. Alarm horn sound output level shall be of 100 dB (nominal) at 10 feet.

PART 3 -- EXECUTION

3.01 Configuration of Controls and Equipment

A. All controls including wiring, control switches, pushbuttons, indicating lights, control interlocks and similar devices, shall be provided at the control voltages specified herein or indicated on the Drawings. Each motor starter shall be provided with a control power transformer mounted in the starter unit. Primary wiring to the control power transformer shall be tapped to two (2) poles on the load side of the circuit breaker or fusible switch. Both primary wires shall be fused with 10- ampere, slow-blow fuses. The fuse on the ungrounded secondary side shall be capable of handling 100 percent to 125 percent of the rated control transformer secondary current. Control power transformers shall be provided with volt-ampere (VA) ratings equal to a minimum of 125 percent of the volt-ampere (VA) load connected to the transformer.

B. All equipment, cabinets, and devices furnished under the Contract shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

C. All equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided.

D. All switches shall have double-pole, double-throw, contacts rated at a minimum of 600 VA, unless specifically noted otherwise.

E. Materials and equipment used shall bear a U.L. label wherever such labeling of equipment and materials are available.

F. Unless otherwise specified or indicated on the Drawings, all equipment shall be designed, furnished, and installed so in the event of a power interruption, the equipment must be restarted manually after a power failure.

G. All power terminals shall be insulated and identified.

H. All instruments shall operate at 10 to 125 degrees F unless otherwise specified.

I. Internal wiring within all starters, panels, instruments, junction boxes and similar equipment, shall be brought out to numbered terminal strips for interconnection and field wiring.

J. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and supplier's data.

K. Unless otherwise noted, the Contractor shall provide all interconnecting wiring and conduit for complete control systems. The Contractor shall make all connections to equipment devices, instruments, and all components requiring electrical connection.

L. The shield on each instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment. In no case shall more than one ground point be employed for each shield. All analog control functions shall utilize 4-20 mADC control signals, unless otherwise specified. All analog transmission shall take place within shielded twisted cables which are not susceptible to interference or noise.

M. Lightning/surge protection shall be provided to protect the instrumentation and control system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and shall be maintenance free and self-restoring. Equipment shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and, where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the enclosure or in a separate NEMA 4 junction box coupled to the enclosure.

3.02 Field Tests

A. The Contractor shall conduct field tests prior to operation of the equipment. The Town shall witness all field testing. Field testing shall be conducted at a time approved by the Town. Field tests shall be conducted for all hardware components and shall include a functional check of all items. Field tests shall include a functional check of all instruments and control equipment. All equipment shall be connected and fully operational for field testing. Field tests shall demonstrate the controls perform according to the Contract requirements and all equipment, valves, switches, controls, alarms, interlocks, indicating lights, and similar equipment function properly. Based on the results of field tests, the Contractor shall make any required corrections to equipment and controls and shall make any adjustments required to the control logic and control settings to achieve the specified operation or operation otherwise directed by the Town. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Town. The Contractor shall make modifications and adjustments to the controls as directed by the Town for optimizing operation of the overall system. All costs in connection with field tests of equipment provided under the Contract, shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of all motor starters and controls during the tests.

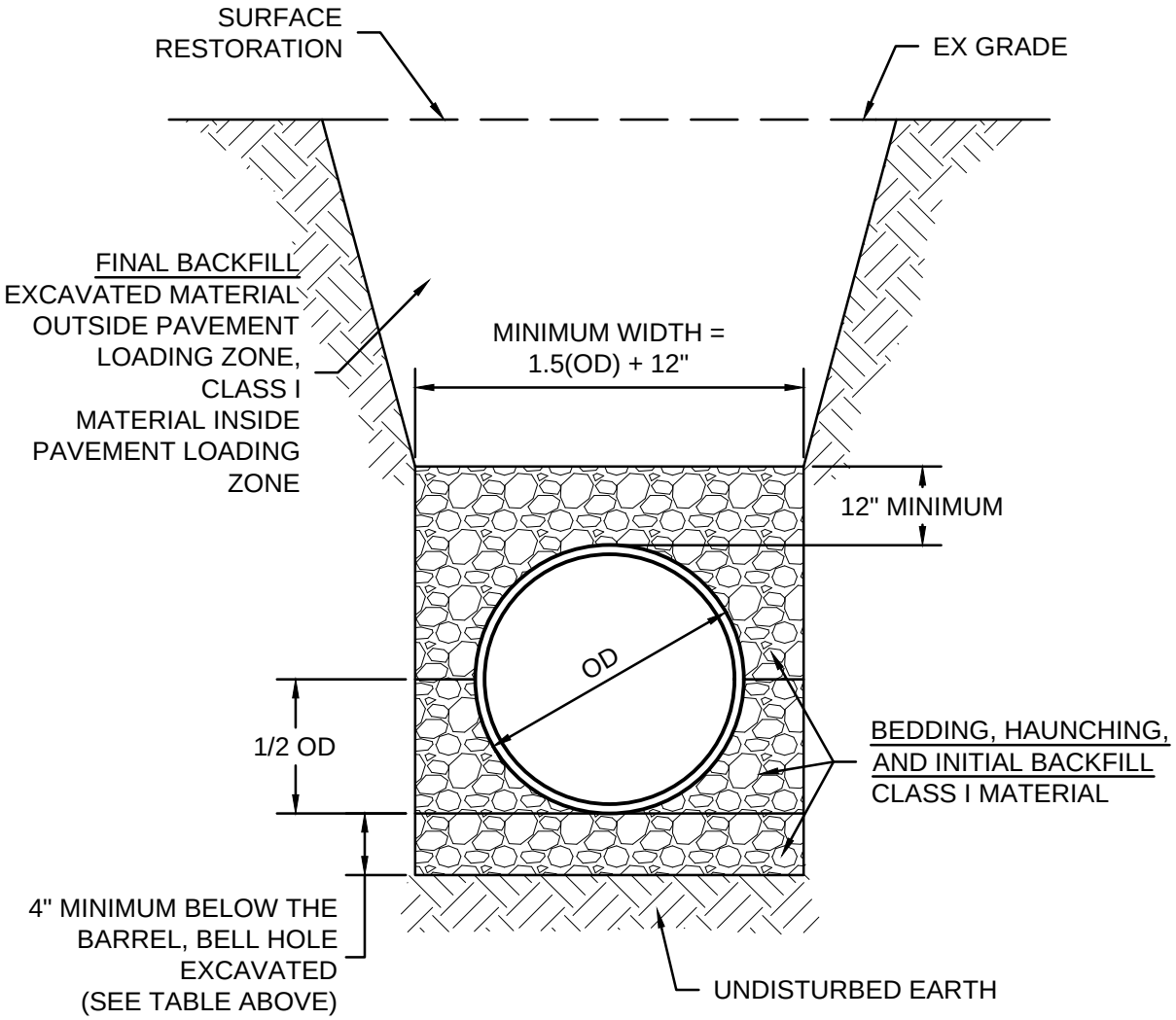
-END-

APPENDIX A

STANDARD DETAILS

FIGURE	DESCRIPTION
1	FLEXIBLE PIPE TRENCH (GRAVITY)
2	FLEXIBLE PIPE TRENCH (PRESSURE)
3	SEMI-RIDGID PIPE TRENCH (DUCTILE IRON)
4	STANDARD SANITARY SEWER MANHOLE
5	SANITARY MANHOLE OVER EXISTING SANITARY SEWER
6	TYPE 1 MANHOLE
7	FRAME AND COVER
8	STANDARD MANHOLE BENCHES
9	OUTSIDE DROP MANHOLE
10	CHIMNEY RECONSTRUCTION/FRAME
11	REDUCER CAP FOR PRECAST MANHOLE
12	COVER CAP FOR PRECAST MANHOLE
13	CONTROL/EXPANSION JOINTS
14	SANITARY LATERAL 15’ DEEP AND OVER
15	SANITARY LATERAL LESS THAN 15’ DEEP
16	NEW SERVICE CONNECTION
17	NOT USED
18	AIR/VACUUM RELEASE VALVE
19	FORCE MAIN CLEANOUT
20	FORCE MAIN CONNECTION AT MANHOLE
21	FORCE MAIN REACTION BLOCKING
22	MINIMUM CROSSOVER AND SEPARATION REQUIREMENTS FOR SEWER AND WATER MAINS
23	STREAM CROSSING
24	DITCH CROSSING
25	SANITARY SEWER REPAIR
26	CASING PIPE
27	NOT USED
28	TRACER WIRE INSTALLATION
29	CHAIN LINK FENCE
30	DRIVEWAY SWING GATE INSTALLATION
31	CONCRETE BOLLARD DETAIL
32	INCIDENTAL PAVEMENT

PIPE SIZE	8" TO 16"	18" TO 30"	33" AND OVER
BEDDING BELOW THE PIPE BARREL	4"	OD / 4	8"



FLEXIBLE PIPE TRENCH (GRAVITY)

SCALE: NONE

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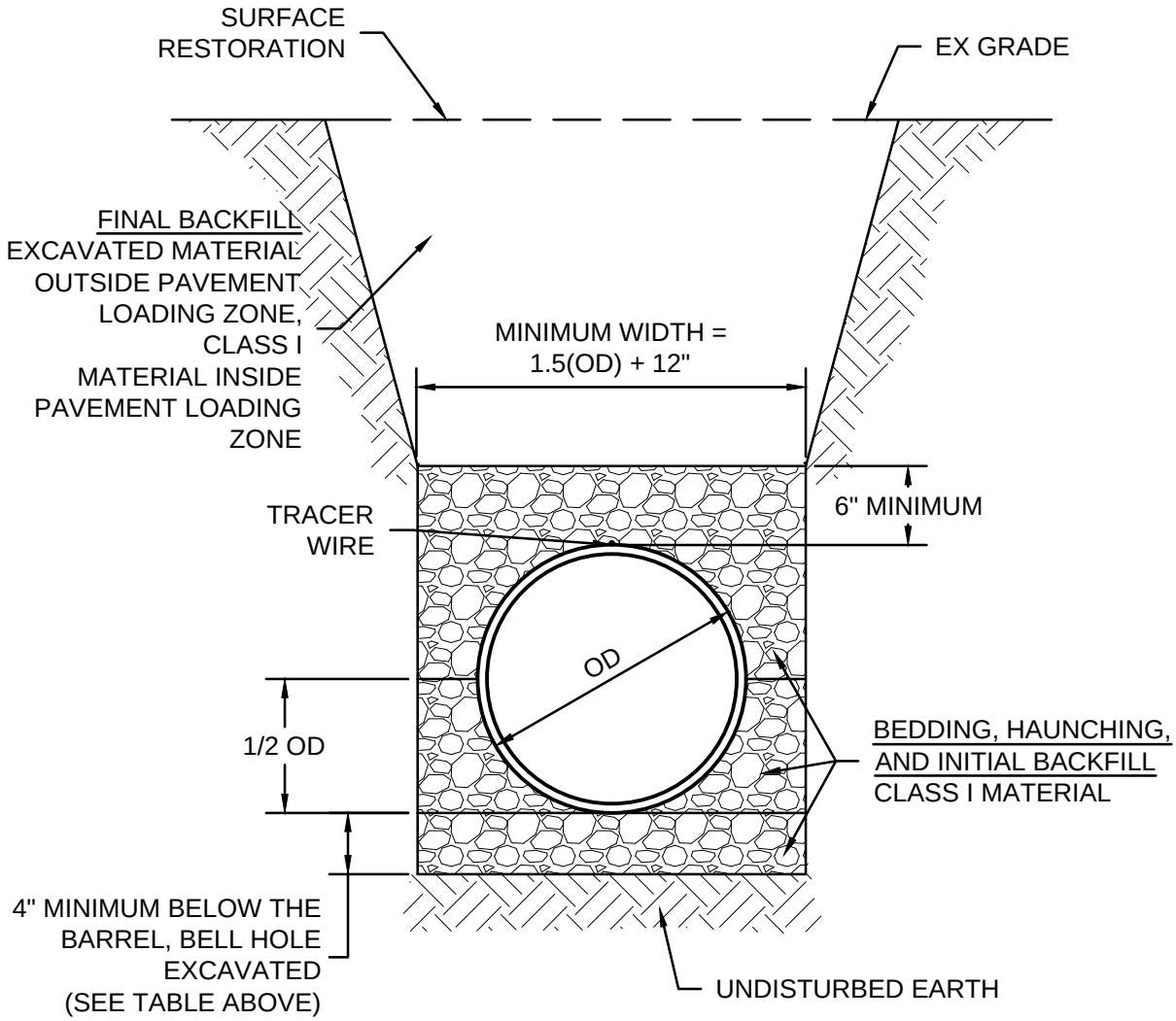
FLEXIBLE PIPE TRENCH (GRAVITY)

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.01

92104-MS.dwg

PIPE SIZE	3" TO 15"	18" TO 30"	33" AND OVER
BEDDING BELOW THE PIPE BARREL	4"	OD / 4	8"



FLEXIBLE PIPE TRENCH (PRESSURE)

SCALE: NONE

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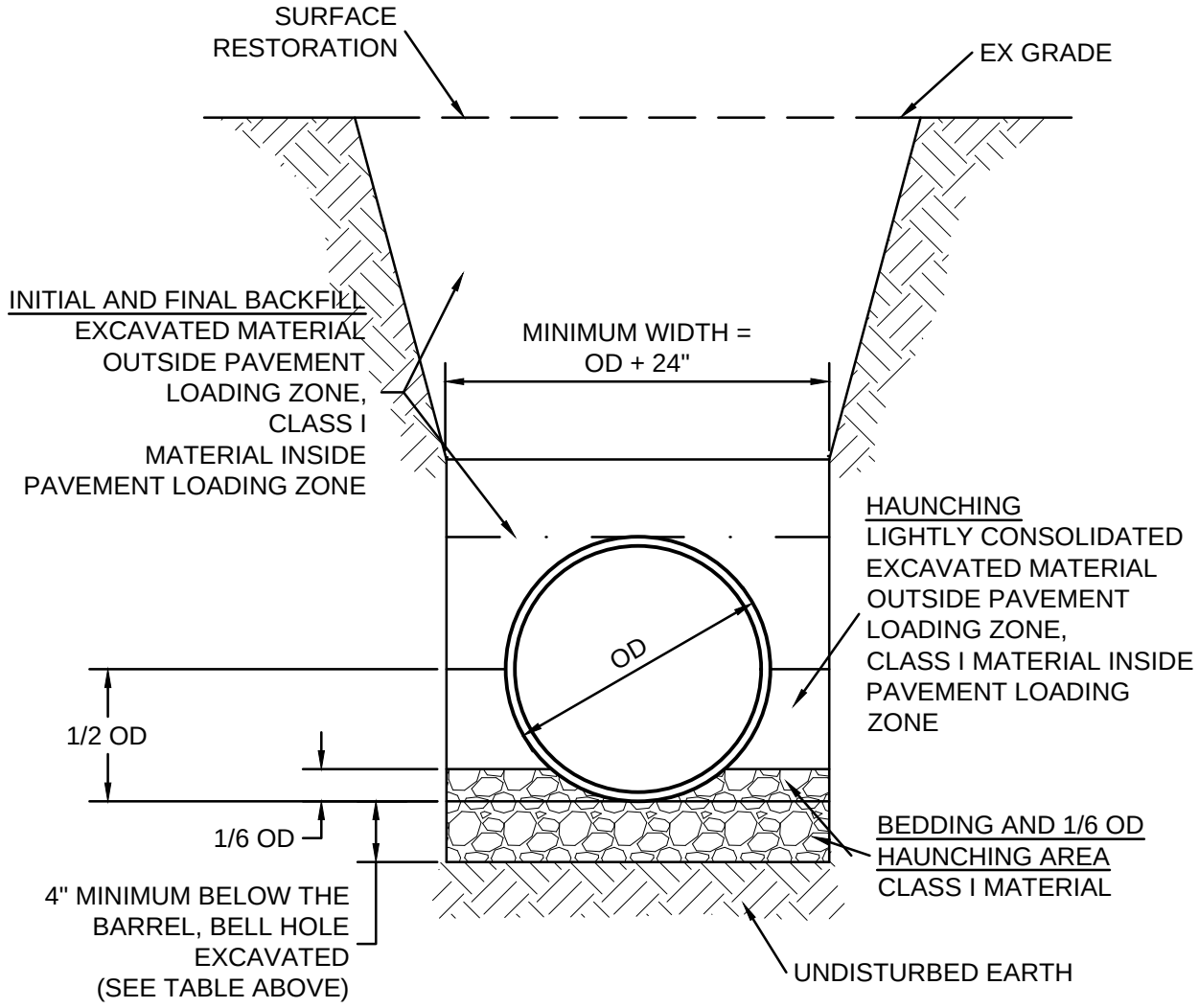
FLEXIBLE PIPE TRENCH (PRESSURE)

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.02

92104-MS.dwg

PIPE SIZE	3" TO 16"	18" TO 30"	32" AND OVER
BEDDING BELOW THE PIPE BARREL	4"	OD / 4	8"



SEMI - RIGID PIPE TRENCH (DUCTILE IRON)

SCALE: NONE

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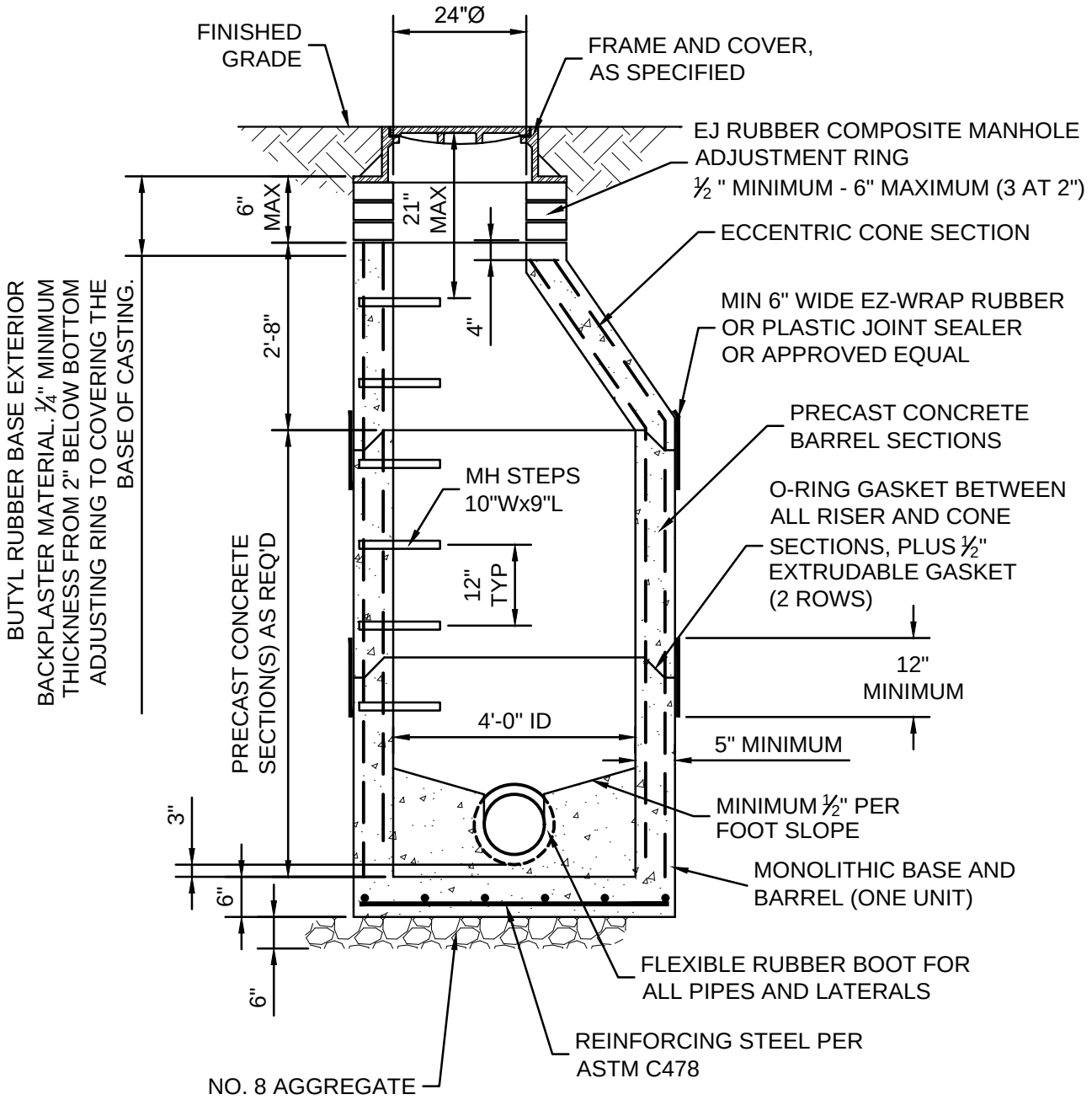
SEMI - RIGID PIPE TRENCH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.03

92104-MS.dwg



STANDARD SANITARY SEWER MH

SCALE: NONE

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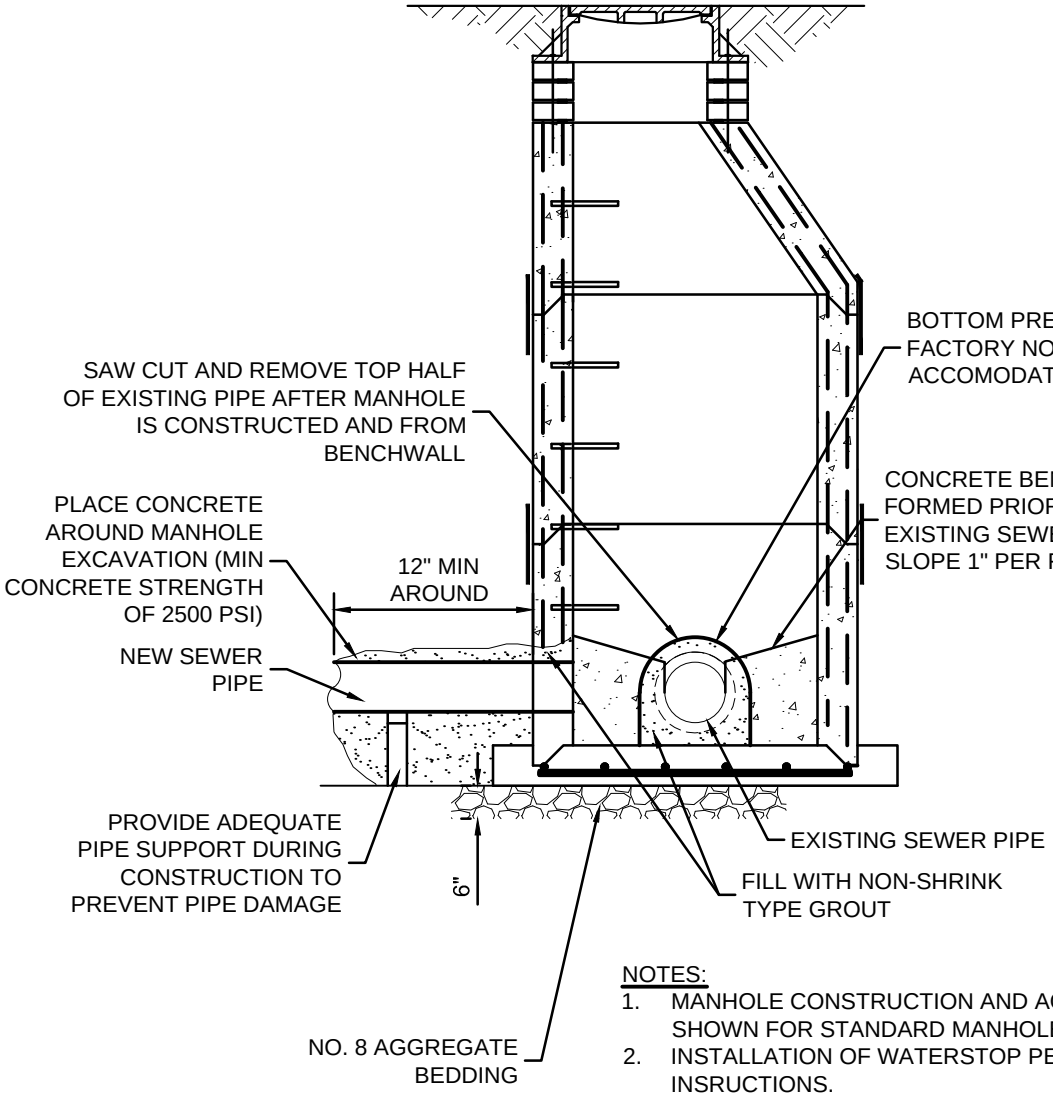
STANDARD SANITARY SEWER MH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.04

92104-MS.dwg



NOTES:

1. MANHOLE CONSTRUCTION AND ACCESSORIES SAME AS SHOWN FOR STANDARD MANHOLE.
2. INSTALLATION OF WATERSTOP PER MFR INSTALLATION INSRUCTIONS.
3. INSTALL WS-30 WATERSTOP GASKET CORP OR APPROVED EQUAL. PLACE CONCRETE OR NON-SHRINK GROUT AROUND PIPE AND WATERSTOP. THOROUGHLY VIBRATE ALL AROUND PIPE AND WATERSTOP TO COMPLETE COMPACTION AND TO RELEASE ANY TRAPPED AIR.

SAN MH OVER EX SAN SEWER

SCALE: NONE

WESSLER ENGINEERING

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SAN MH OVER EX SAN SEWER

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.05

92104-MS.dwg

92104-MS.dwg

WESSLER ENGINEERING
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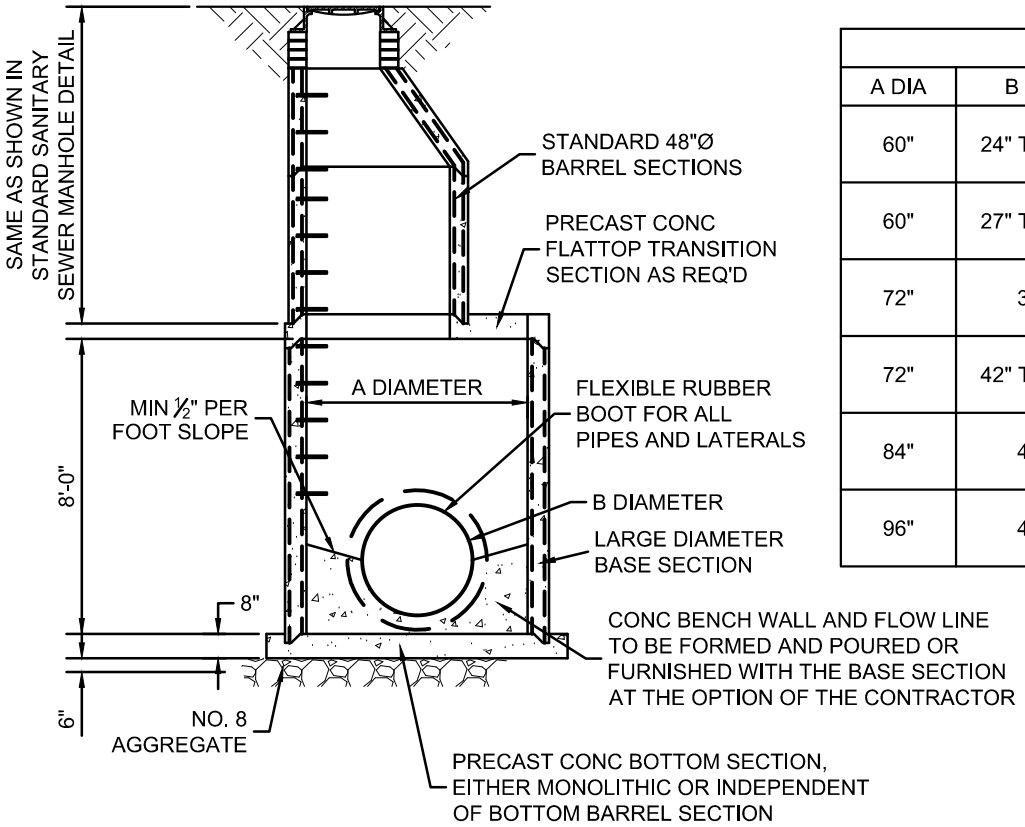
TYPE 1 MANHOLE

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

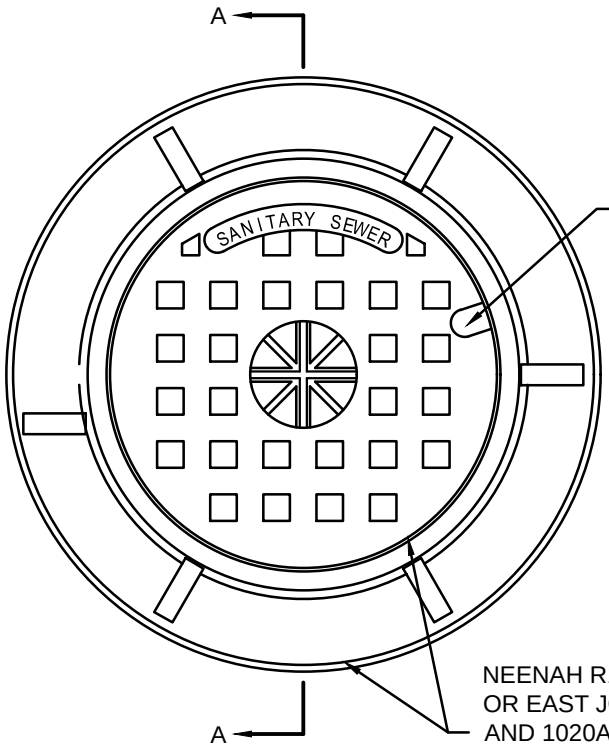
FIGURE NO.06



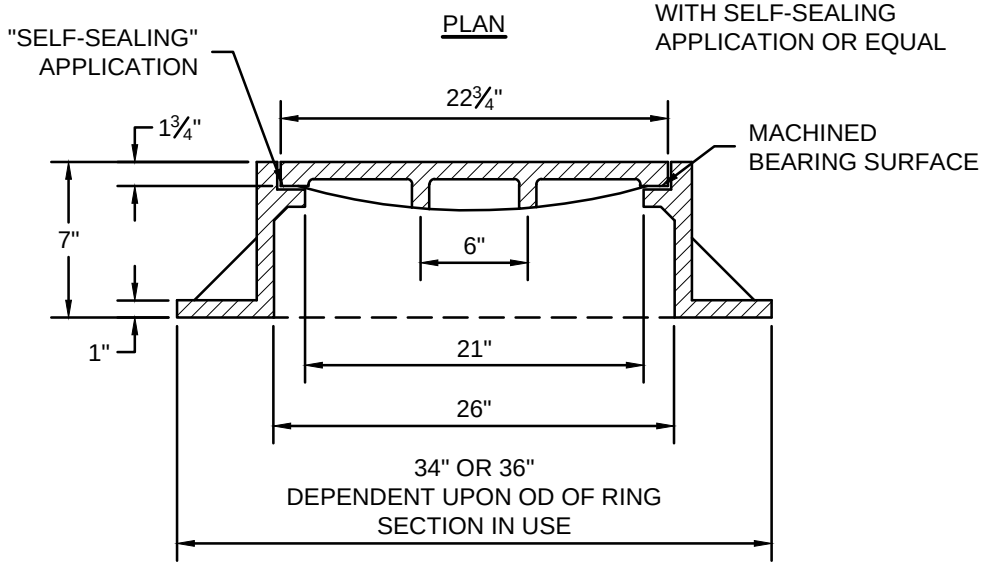
STRUCTURE DATA SCHEDULE		
A DIA	B DIA	APPLICATION
60"	24" TO 33"	HORIZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
60"	27" TO 36"	HORIZ PIPE DEFLECTION STRAIGHT THRU MANHOLE UP TO 45°
72"	36"	HORIZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
72"	42" TO 48"	HORIZ PIPE DEFLECTION STRAIGHT THRU MANHOLE UP TO 45°
84"	42"	HORIZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°
96"	48"	HORIZ PIPE DEFLECTION GREATER THAN 45° UP TO 90°

TYPE 1 MANHOLE

SCALE: NONE



PLAN



SECTION A-A

STANDARD SANITARY SEWER MANHOLE FRAME AND COVER

SCALE: NONE

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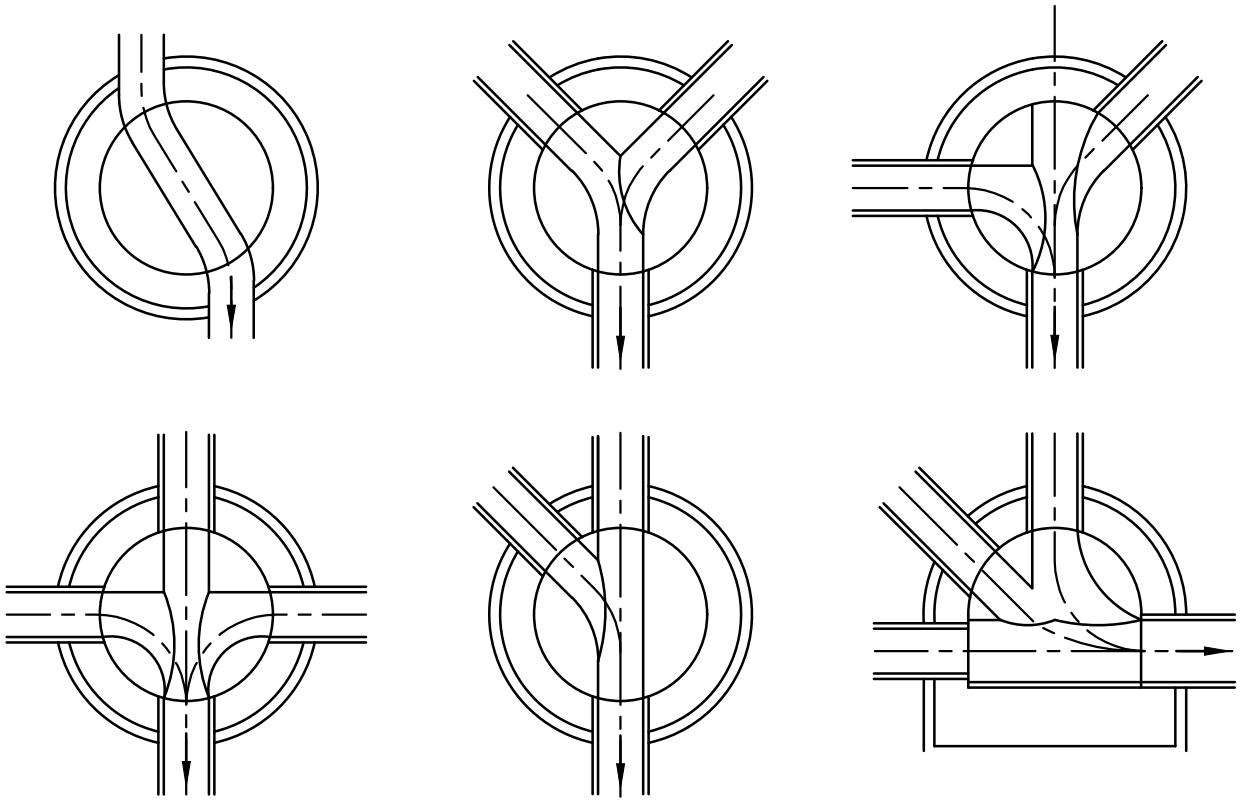
FRAME AND COVER

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.07

92104-MS.dwg



NOTES:

1. SANITARY SEWER BENCH SLOPE = ½" PER FOOT

STANDARD MANHOLE BENCHES

SCALE: NONE

WESSLER ENGINEERING

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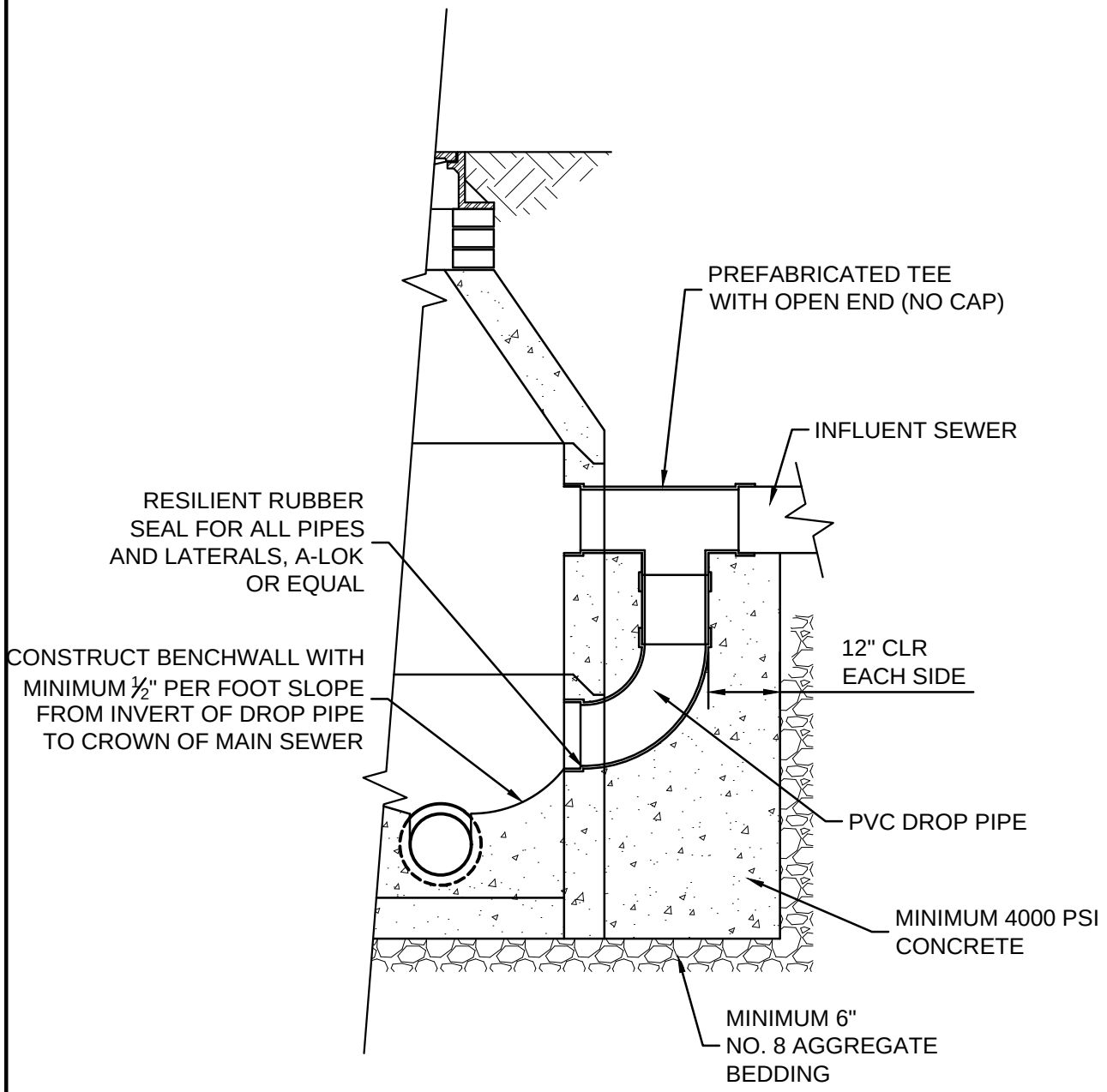
STANDARD MANHOLE BENCHES

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.08

92104-MS.dwg



NOTES:

1. MANHOLE CONSTRUCTION AND ACCESSORIES SAME AS SHOWN FOR STANDARD SANITARY SEWER MANHOLE.

OUTSIDE DROP MANHOLE

SCALE: NONE

WESSLER ENGINEERING

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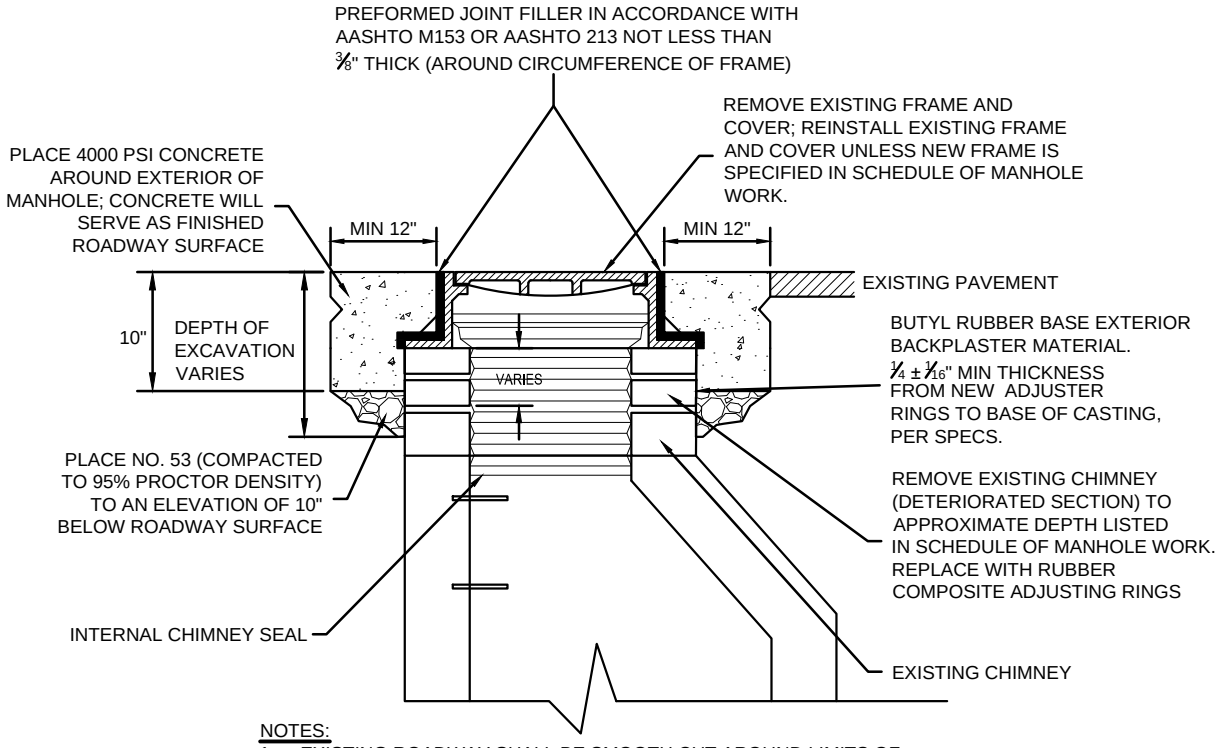
OUTSIDE DROP MANHOLE

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.09

92104-MS.dwg



NOTES:

1. EXISTING ROADWAY SHALL BE SMOOTH CUT AROUND LIMITS OF EXCAVATION.
2. TOP OF CASTING (FRAME/COVER) ELEVATION SHALL MATCH FINISHED GRADE WHEN MANHOLE IS LOCATED IN A PAVED AREA.
3. FOR CHIMNEY RECONSTRUCTION LESS THAN 2 INCHES, CONTRACTOR SHALL INSTALL HDPE ADJUSTING RINGS.
4. PREFORMED JOINT FILLER AND POURED CONCRETE EXTERIOR NOT REQUIRED WHEN STRUCTURE IS LOCATED OUTSIDE OF PAVEMENT.

CHIMNEY RECONSTRUCTION/FRAME AND COVER RESET OR REPLACEMENT

SCALE: NONE

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CHIMNEY RECONSTRUCTION / FRAME

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.10

92104-MS.dwg

SECTION DIA	D AND H
60"	6'-0"
72"	7'-2"

REDUCER CAP FOR PRE-CAST MANHOLE SECTIONS

SCALE: NONE

WESSLER ENGINEERING

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REDUCER CAP FOR PRE-CAST MH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.11

92104-MS.dwg

COVER CAP FOR PRE-CAST MANHOLE SECTIONS

SCALE: NONE

WESSLER ENGINEERING

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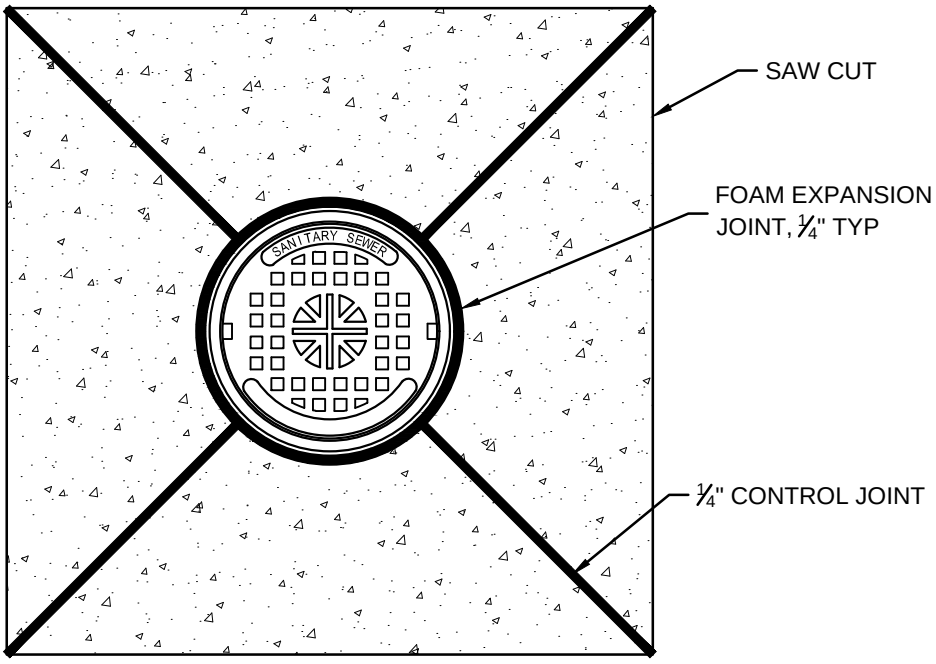
COVER CAP FOR PRE-CAST MH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.12

92104-MS.dwg



CONTROL/EXPANSION JOINTS FOR FRAME AND COVER IN CONCRETE

SCALE: NONE

WESSLER ENGINEERING
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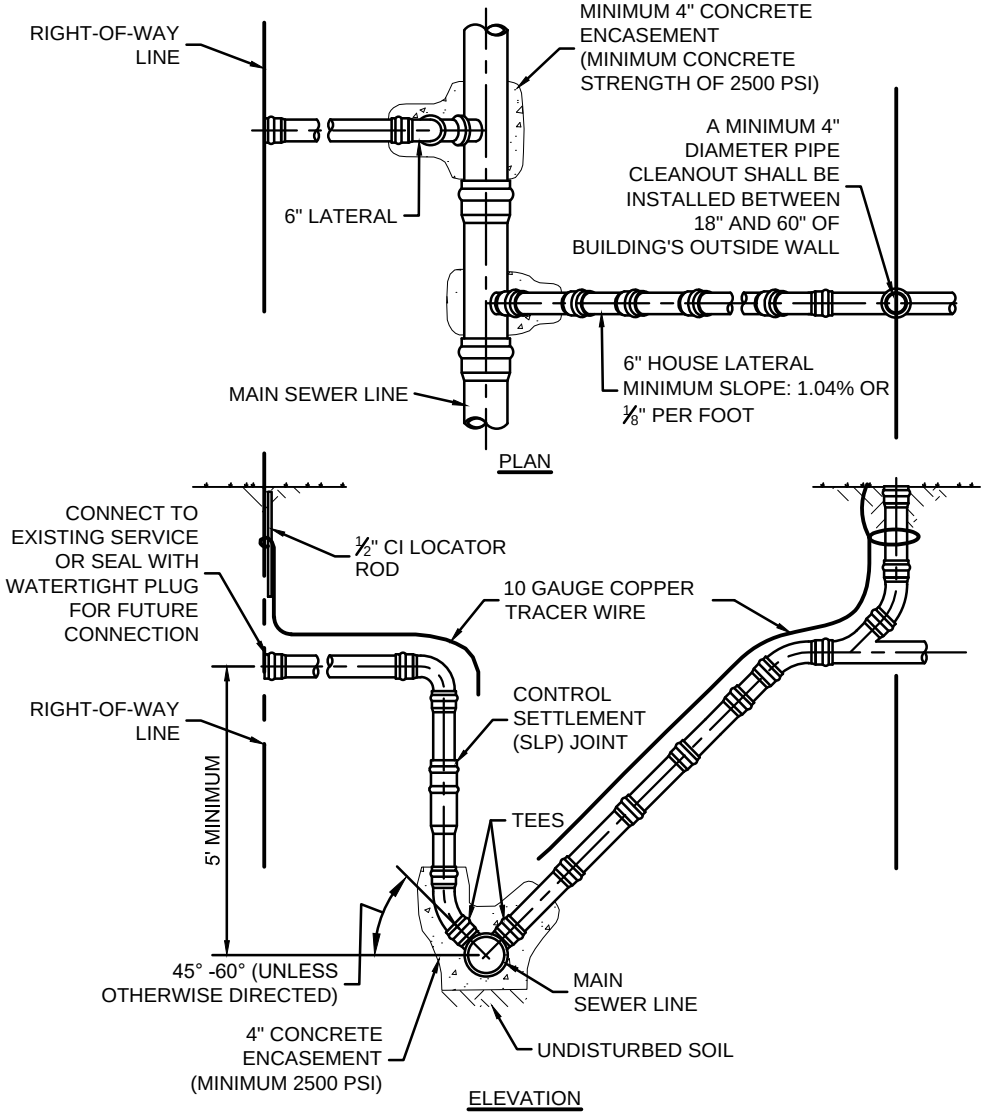
CONTROL / EXPANSION JOINTS

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.13

92104-MS.dwg



NOTES:

1. WYE BRANCHES SHALL BE INSTALLED WHERE INDICATED. THEY SHALL BE EXTENDED TO PROPERTY LINES OR TO DISTANCES AS SHOWN ON THE DRAWINGS, AND SHALL BE OF 6" PIPE UNLESS OTHERWISE SHOWN.
2. THE DEPTH OF THE LATERAL AT THE PROPERTY LINE SHALL BE APPROXIMATELY 8'-0" UNLESS SEWER DEPTH IS LESS, IN WHICH EVENT A MINIMUM SLOPE OF 1/8" PER 1'-0" SHALL BE USED.

SANITARY LATERAL FOR DEEP SEWERS (15' DEEP AND OVER)

SCALE: NONE

WESSLER ENGINEERING

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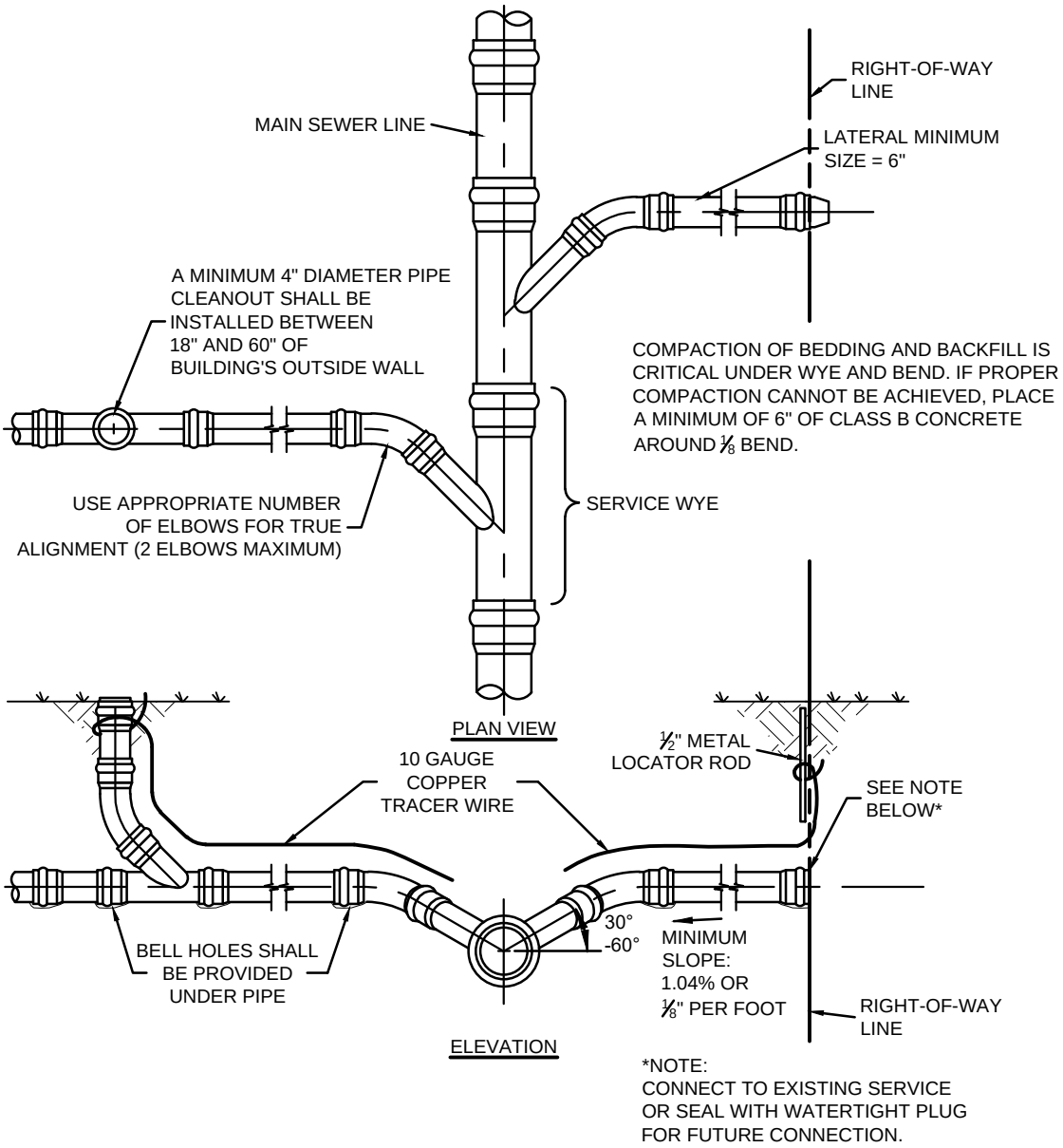
SAN LATERAL 15' DEEP AND OVER

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.14

92104-MS.dwg



NOTES:

1. WYE BRANCHES SHALL BE INSTALLED WHERE INDICATED. THEY SHALL BE EXTENDED TO PROPERTY LINES OR TO DISTANCES AS SHOWN ON THE DRAWINGS, AND SHALL BE OF 6" PIPE UNLESS OTHERWISE SHOWN.
2. THE DEPTH OF THE LATERAL AT THE PROPERTY LINE SHALL BE APPROXIMATELY 8'-0" UNLESS SEWER DEPTH IS LESS, IN WHICH EVENT A MINIMUM SLOPE OF 1/8" PER 1'-0" SHALL BE USED.

SANITARY LATERAL FOR SHALLOW SEWERS (LESS THAN 15' DEEP)

SCALE: NONE

WESSLER ENGINEERING
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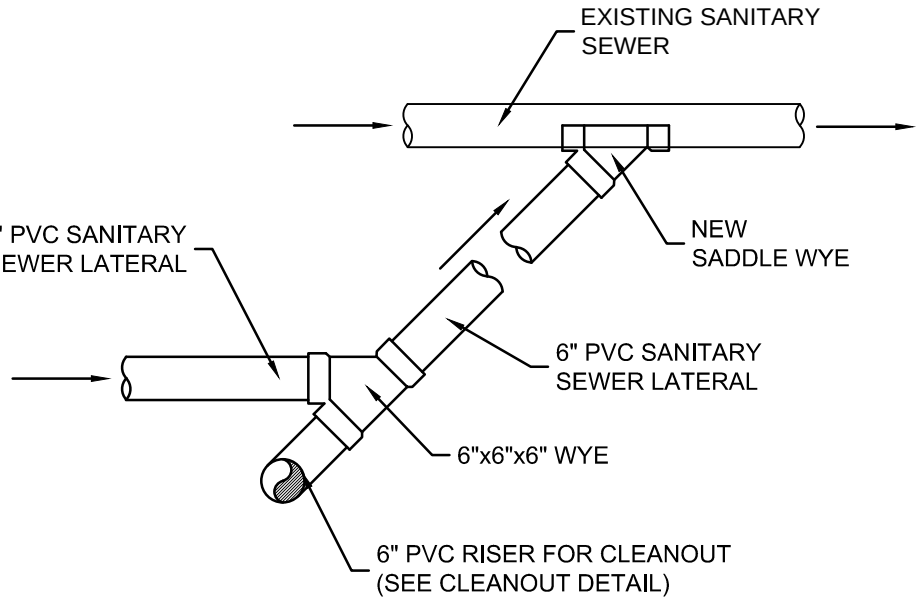
SAN LATERAL LESS THAN 15' DEEP

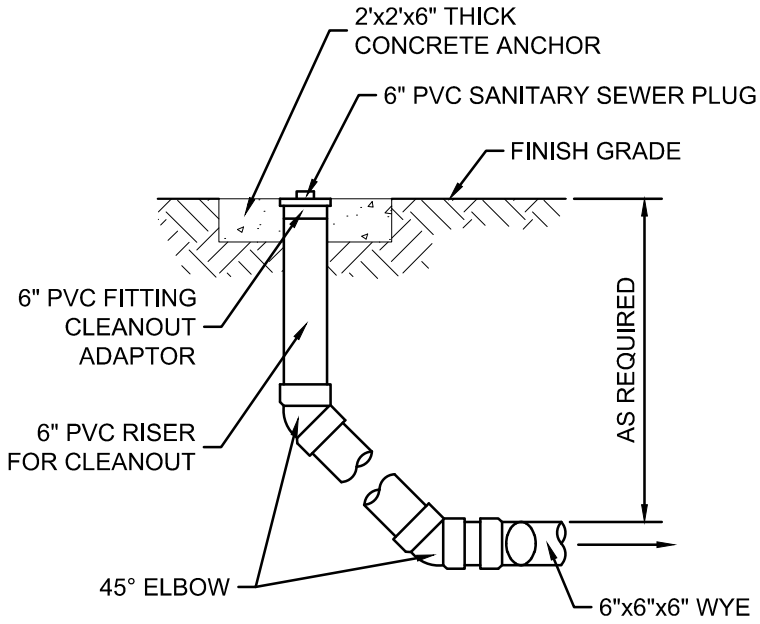
TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.15

92104-MS.dwg



PLAN VIEW



CLEANOUT

NEW SERVICE CONNECTION TO EXISTING SANITARY SEWER

SCALE: NONE

WESSLER ENGINEERING
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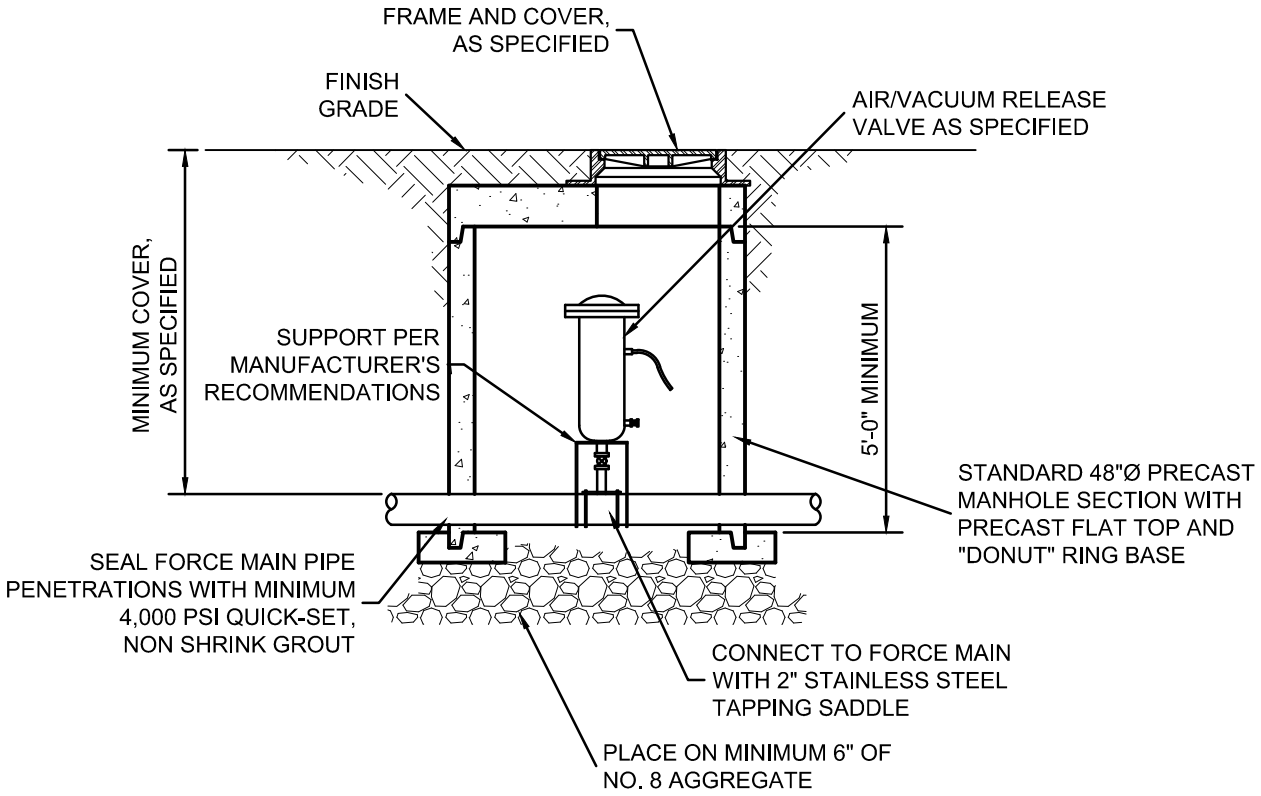
NEW SERVICE CONNECTION

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.16

92104-MS.dwg



NOTES:

1. THE CONTRACTOR SHALL DETERMINE THE REQUIRED FORCE MAIN DEPTH AT THE STRUCTURE TO ENSURE THAT THE VALVE VAULT STRUCTURE DOES NOT EXTEND ABOVE FINISHED GRADE.
2. LOCATION OF AIR/VACUUM RELEASE STRUCTURES ARE APPROXIMATE. THE FINAL LOCATION TO BE DETERMINED IN THE FIELD BY THE CONTRACTOR AT THE HIGH ELEVATION POINT OF THE FORCE MAIN.

AIR/VACUUM RELEASE VALVE AND VAULT

SCALE: NONE

WESSLER ENGINEERING

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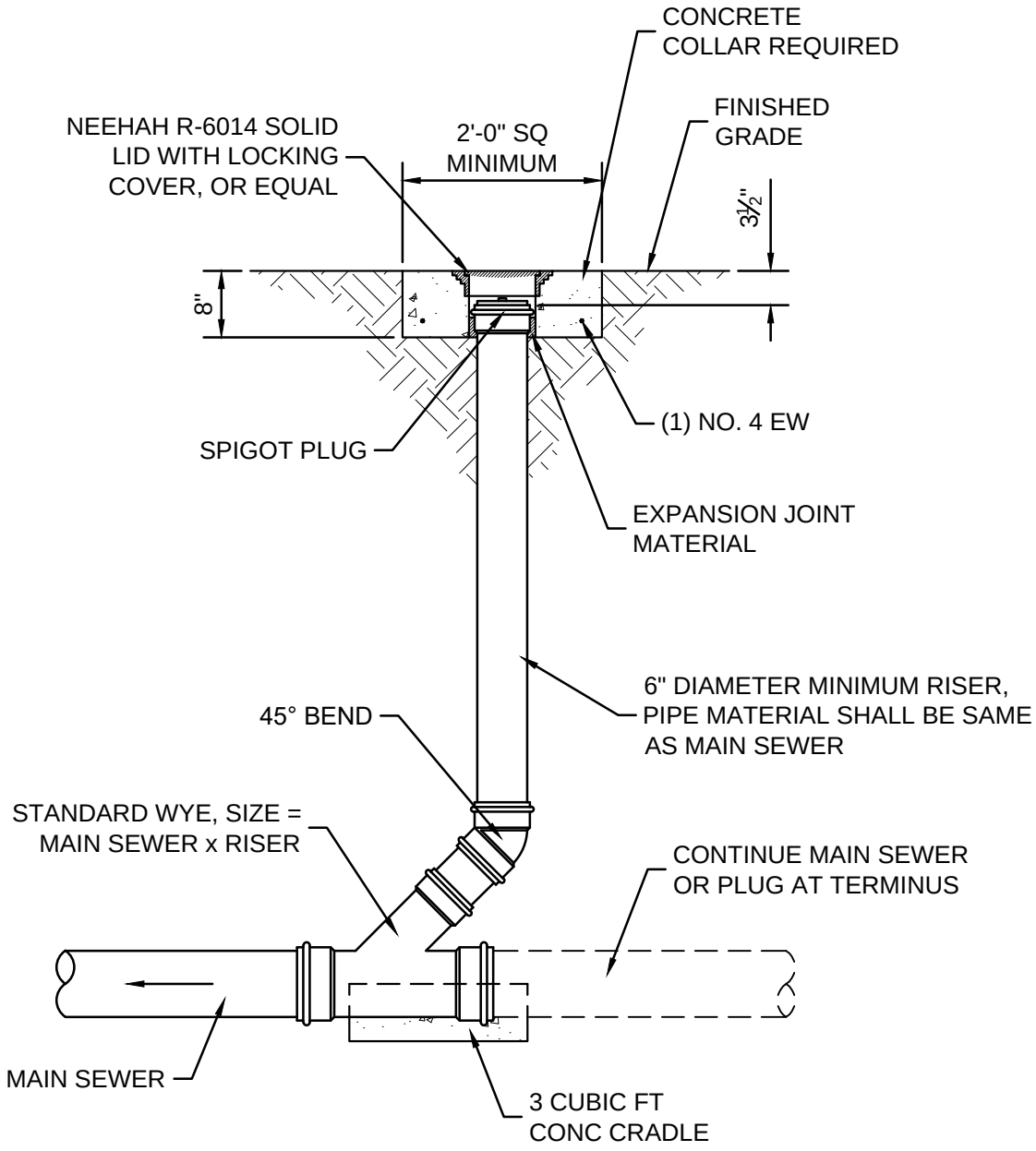
AIR/VACUUM RELEASE VALVE & VAULT

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.18

92104-MS.dwg



FORCE MAIN CLEANOUT

SCALE: NONE

WESSLER ENGINEERING
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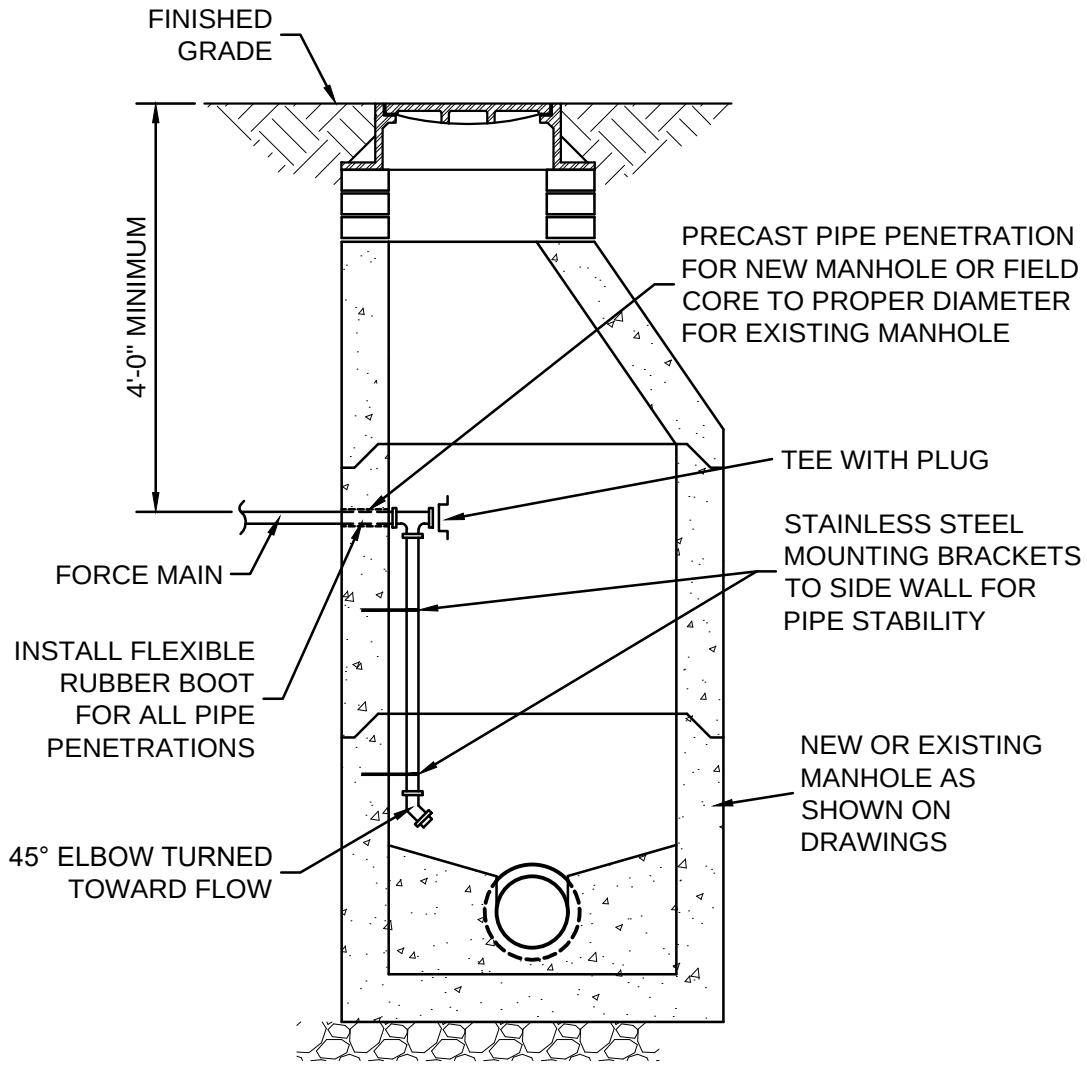
FORCE MAIN CLEANOUT

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.19

92104-MS.dwg



NOTES:

1. NEW MANHOLE CONSTRUCTION AND ACCESSORIES SAME AS SHOWN FOR STANDARD SANITARY SEWER MANHOLE.

FORCE MAIN CONNECTION AT MANHOLE

SCALE: NONE

WESSLER ENGINEERING

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FORCE MAIN CONNECTION AT MH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.20

92104-MS.dwg

92104-MS.dwg

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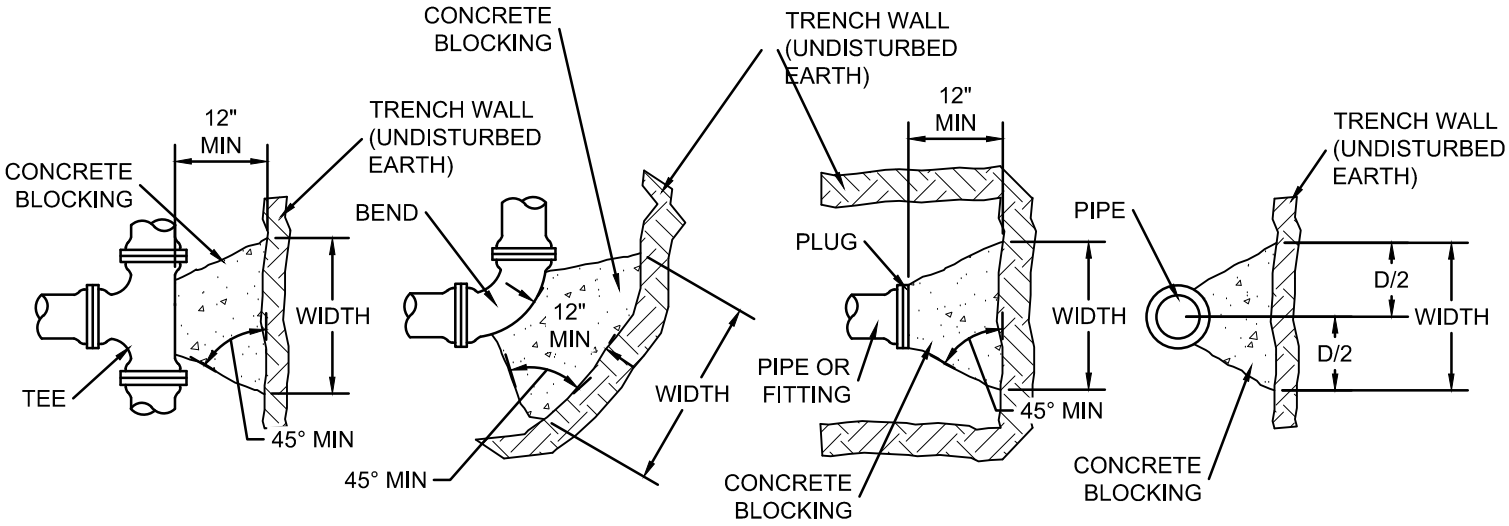
FORCE MAIN REACTION BLOCKING

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.21

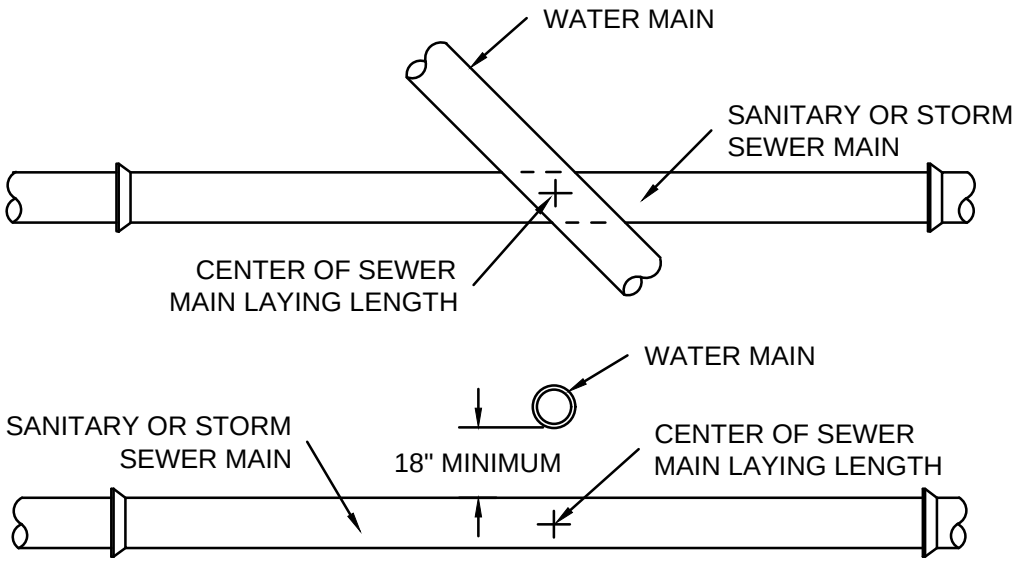


	TEE		22½°		45°		90°		PLUG	
SIZE	W	D	W	D	W	D	W	D	W	D
3", 4"	2'-6"	1'-0"	1'-0"	0'-9"	1'-6"	1'-3"	2'-9"	1'-3"	1'-6"	1'-6"
6"	3'-3"	1'-6"	2'-0"	1'-0"	2'-6"	1'-6"	4'-3"	1'-6"	2'-3"	2'-3"
8"	4'-3"	2'-0"	2'-0"	1'-9"	3'-9"	1'-9"	6'-0"	2'-0"	3'-0"	3'-0"
10"	5'-3"	2'-6"	3'-0"	1'-9"	4'-0"	2'-6"	7'-3"	2'-6"	3'-9"	3'-9"
12"	6'-0"	3'-0"	3'-6"	2'-0"	4'-9"	3'-6"	7'-9"	3'-0"	4'-3"	4'-3"

NOTES:
1. CONCRETE REACTION BLOCKING SHALL NOT COVER PIPE JOINTS, BOLTS, OR GLANDS.
2. CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH NOT LESS THAN 2000 PSI AFTER 28 DAYS. UNOPENED BAGS OF SACKRETE ARE NOT ACCEPTABLE.
3. WRAP DI FITTINGS WITH 8 MIL VISQUEEN OR POLYETHELENE ENCASEMENT.

FORCE MAIN REACTION BLOCKING

SCALE: NONE



NOTES:

1. WATER MAIN AND SEWER MINIMUM SEPARATION: 18" VERTICAL SEPARATION 10'-0" HORIZONTAL SEPARATION.
2. WHERE WATER MAIN AND SEWER SEPARATION IS LESS THAN 18" VERTICAL OR 10' HORIZONTAL, THE SEWER MUST BE DUCTILE IRON, SDR-21 PVC, OR CONCRETE ENCASED.

CROSSOVER AND SEPARATION REQUIREMENTS FOR SEWER AND WATER MAINS

SCALE: NONE

WESSLER ENGINEERING

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MIN XING & SEP. REQ. FOR SWR & WTR

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.22

92104-MS.dwg

INFORMATION SHOWN MAY BE MODIFIED SUBJECT TO THE REQUIREMENTS OF WARRICK COUNTY, TOWN OF CHANDLER OR STATE REGULATORY AGENCY.

STREAM CROSSING DETAILS

SCALE: NONE

WESSLER ENGINEERING

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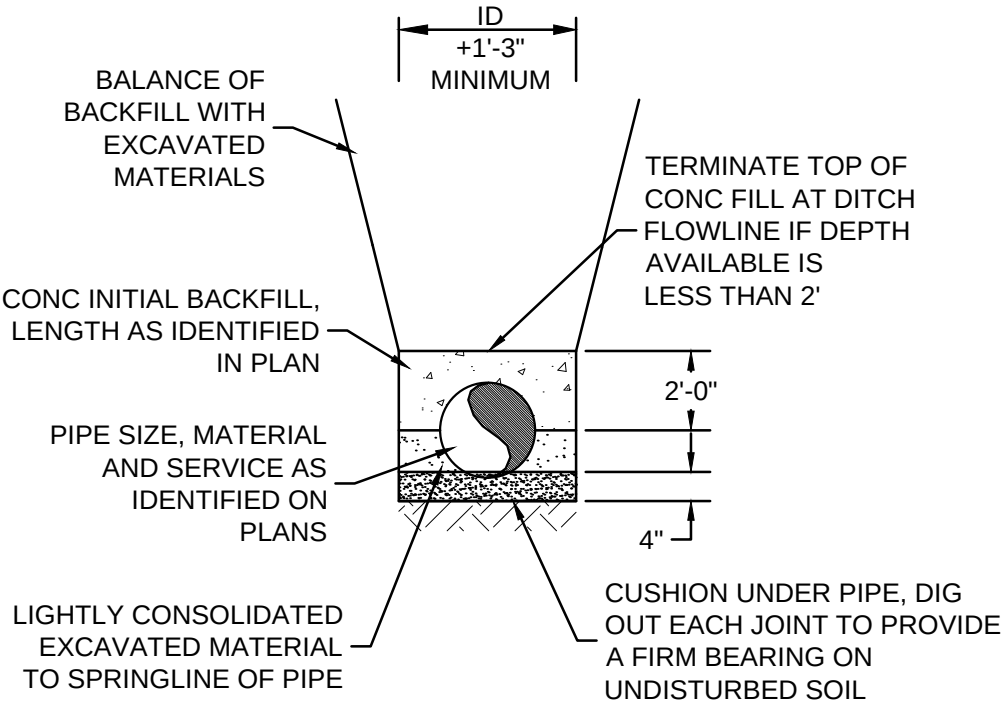
STREAM CROSSING

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.23

92104-MS.dwg



DITCH CROSSING

SCALE: NONE

NOTE:

1. TO BE UTILIZED WHEN COVER IS LESS THAN 3 FEET.

WESSLER ENGINEERING

More than a Project™

DITCH CROSSING

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.24

92104-MS.dwg

92104-MS.dwg

WESSLER ENGINEERING
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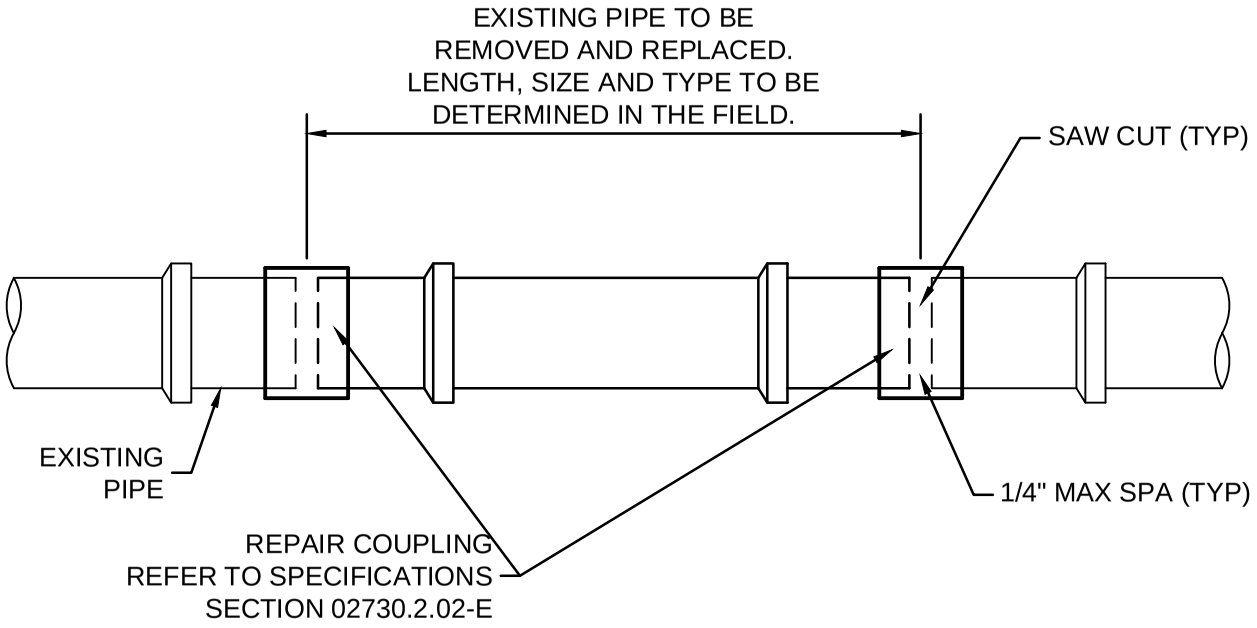
SANITARY SEWER REPAIR

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.25



SANITARY SEWER REPAIR

SCALE: NONE

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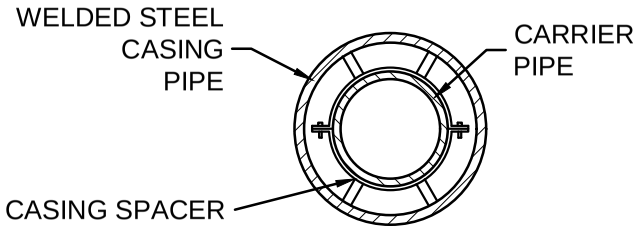
TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

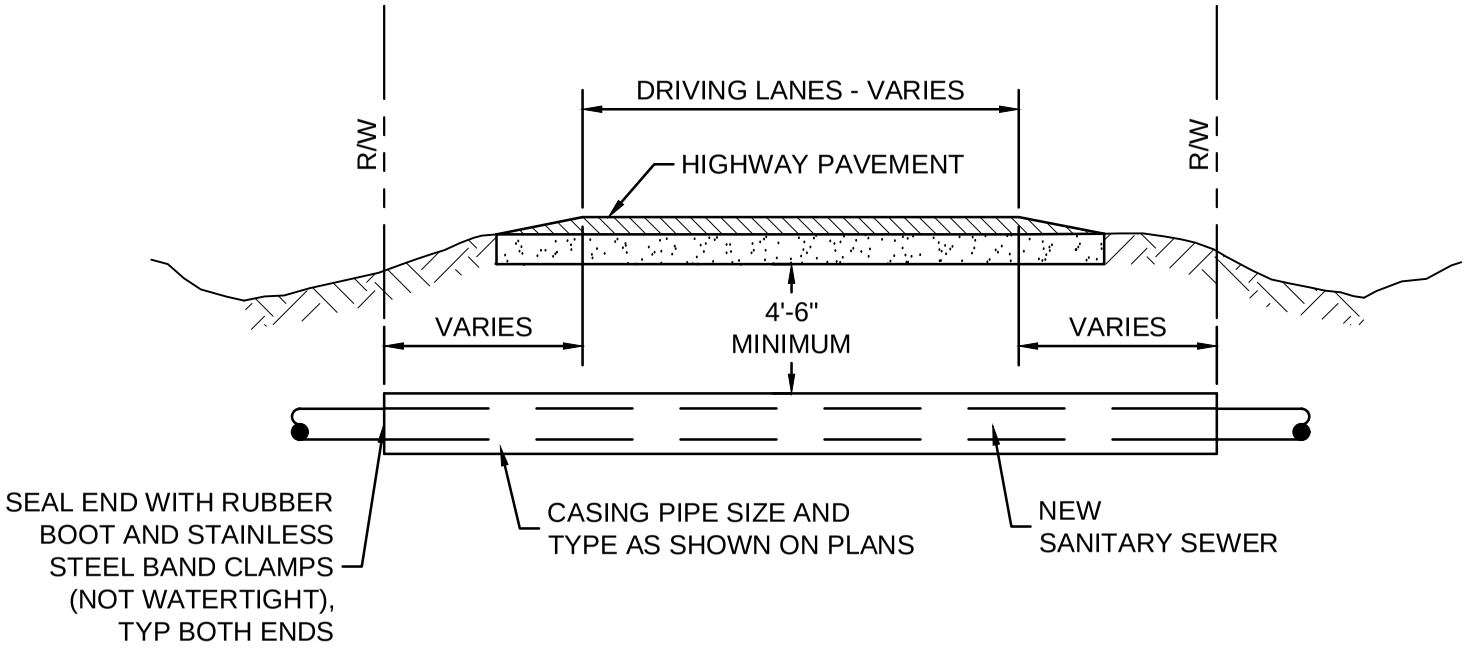
FIGURE NO.26

CASING PIPE



CASING SPACER

SCALE: NONE



CASING PIPE

SCALE: NONE

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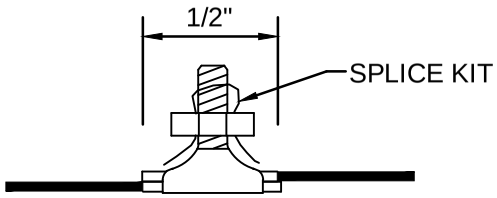
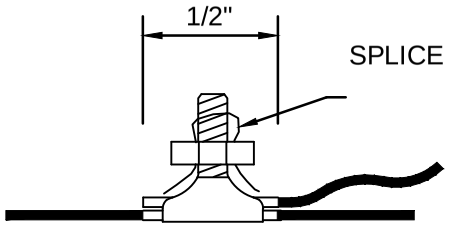
TRACER WIRE INSTALLATION

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

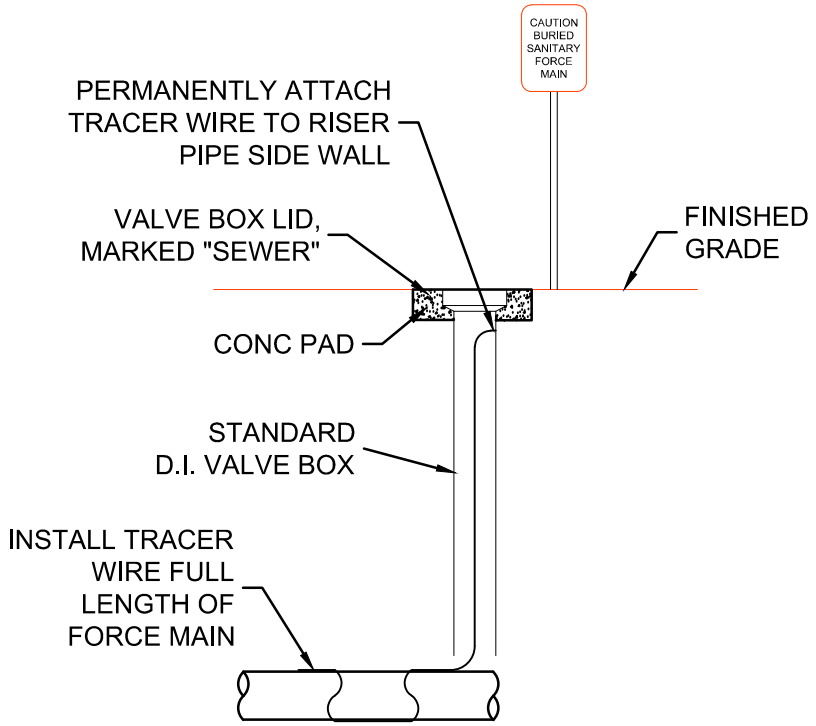
FIGURE NO.28



EXTENSION CONNECTION



BRANCH CONNECTION



SURFACE CONNECTION

TRACER WIRE INSTALLATION DETAILS

SCALE: NONE

NOTES:

1. THE CONTRACTOR SHALL INSTALL TRACER WIRE ALONG THE ENTIRE LENGTH OF EACH FORCE MAIN. BRING UP TO SURFACE AT EACH VALVE INSTALLATION, OR AT A MINIMUM OF EVERY 2,000 FEET, WITH A VALVE BOX SURFACE CONNECTION AS SHOWN.

2. MARK EACH SURFACE CONNECTION LOCATION WITH A SIGN MARKED "CAUTION BURIED SANITARY FORCE MAIN". SIGNAGE MATERIAL AND INSTALLATION METHODS SHALL MEET THE WARRICK COUNTY HIGHWAY STANDARDS.

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SANITARY SEWER STANDARDS
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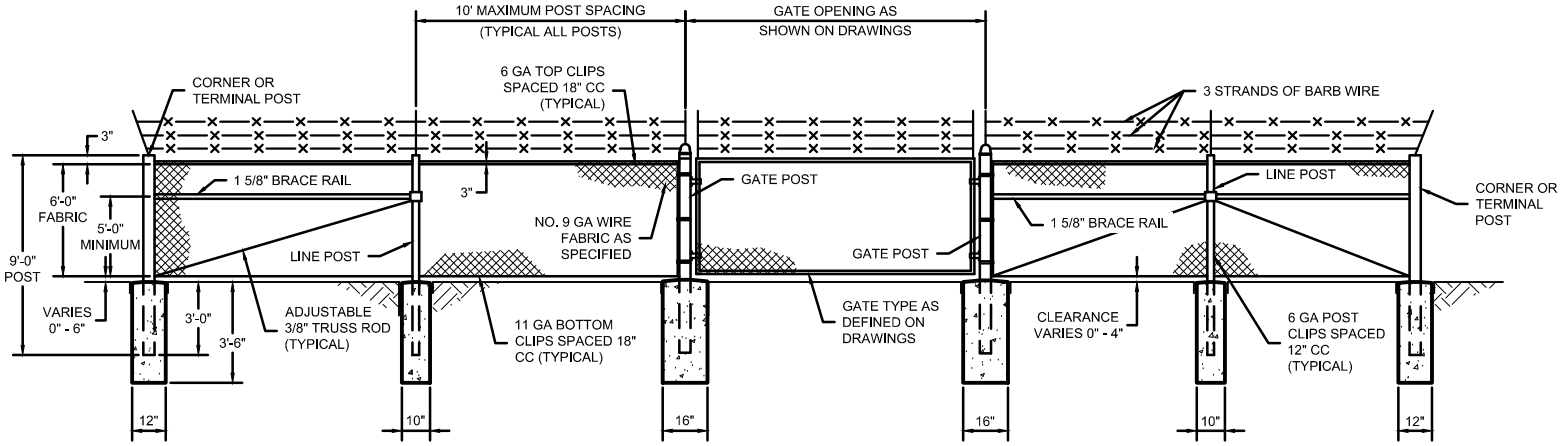
CHAIN LINK FENCE

FIGURE NO.29



NOTES:
1. INSTALL TERMINAL POSTS AT EACH FENCE CORNER OR END. INSTALL GATE POSTS EACH GATE OPENING. SPACE LINE POSTS AT A MAXIMUM OF 10' SPACING WHERE TERMINAL, GATE OR PULL POSTS ARE NOT REQUIRED.
2. SPACE PULL POSTS AT A MAXIMUM OF 500' ON LONG STRAIGHT RUNS ALONG CONSISTENT GRADES, AT EVERY HORIZONTAL BEND GREATER THAN 10° WHERE TERMINAL POSTS ARE NOT REQUIRED, AND AT EVERY MAJOR CHANGE OF GRADE. DO NOT USE PULL POSTS AS GATE OR TERMINAL POSTS.
3. ALL CONCRETE IN POST ANCHORS SHALL CONFORM TO THE SPECIFICATIONS.

CHAIN LINK FENCE INSTALLATION

SCALE: NONE

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TOWN OF CHANDLER, INDIANA
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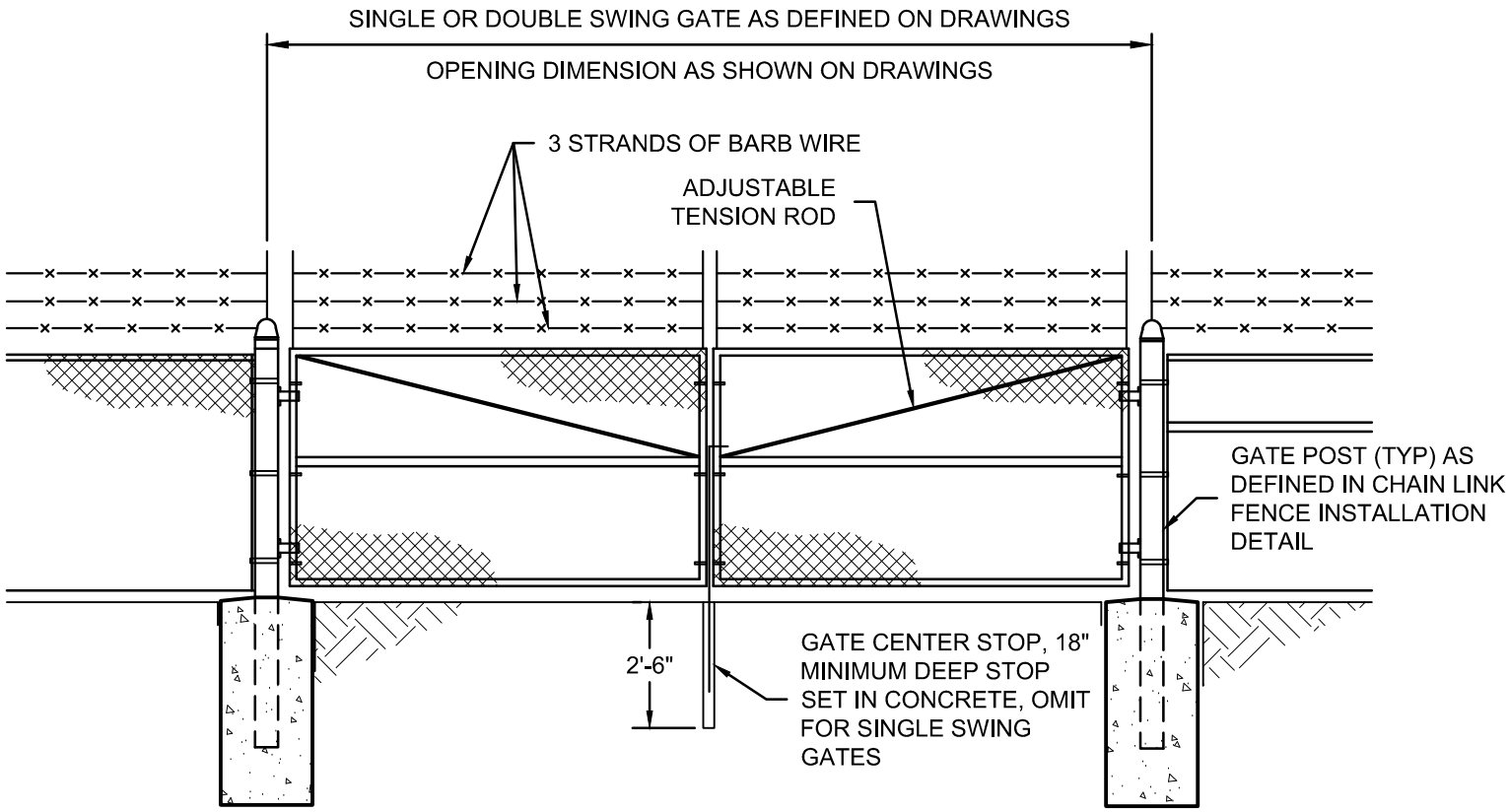
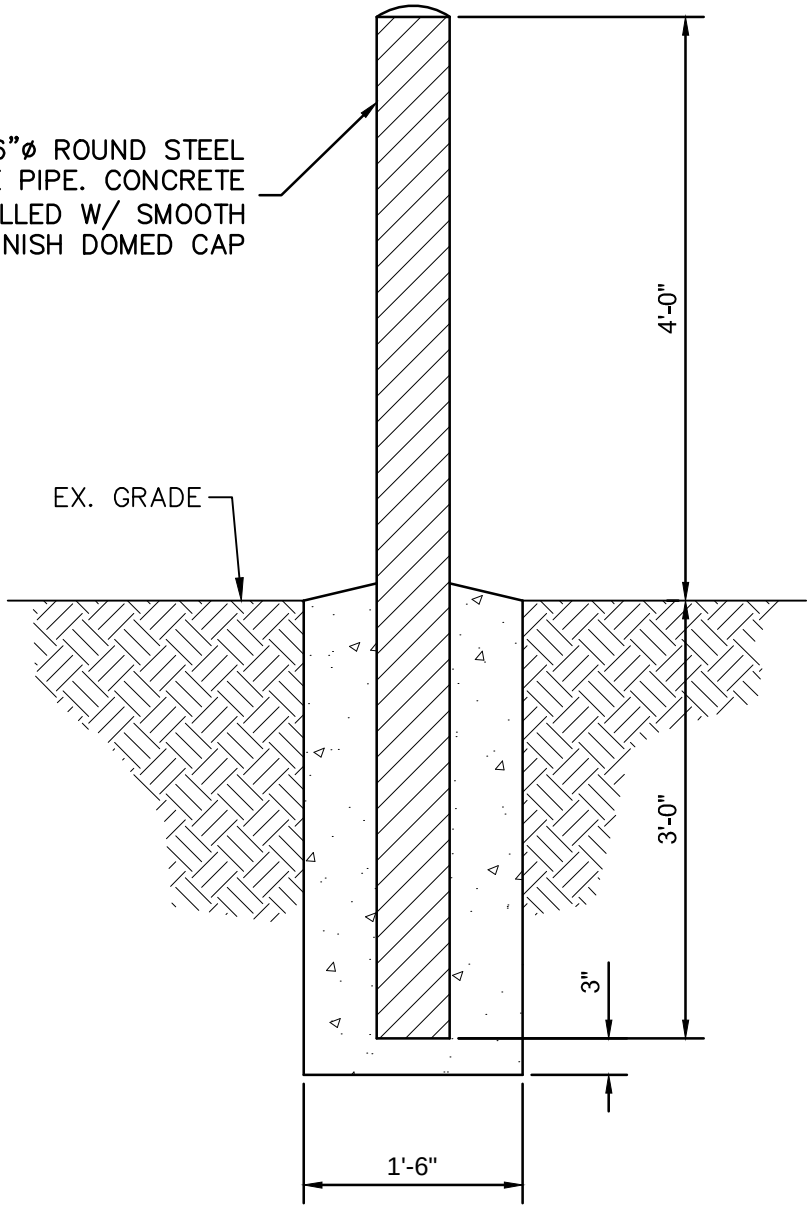
FIGURE NO.30

DRIVEWAY SWING GATE INSTALLATION



DRIVEWAY SWING GATE INSTALLATION

SCALE: NONE



NOTE:
ALL BOLLARDS SHALL BE SET IN CONCRETE.

CONCRETE BOLLARD DETAIL

SCALE: NONE

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CONCRETE BOLLARD DETAIL

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.31

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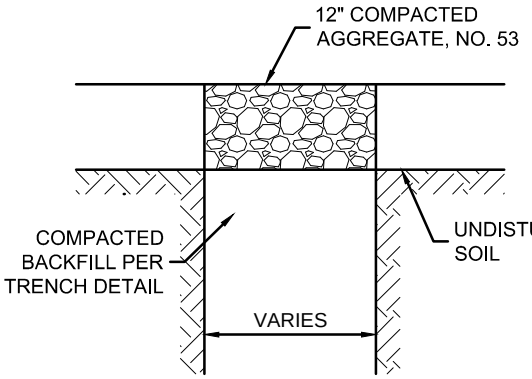
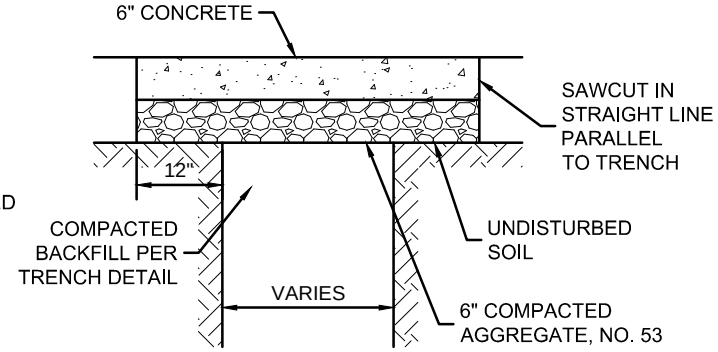
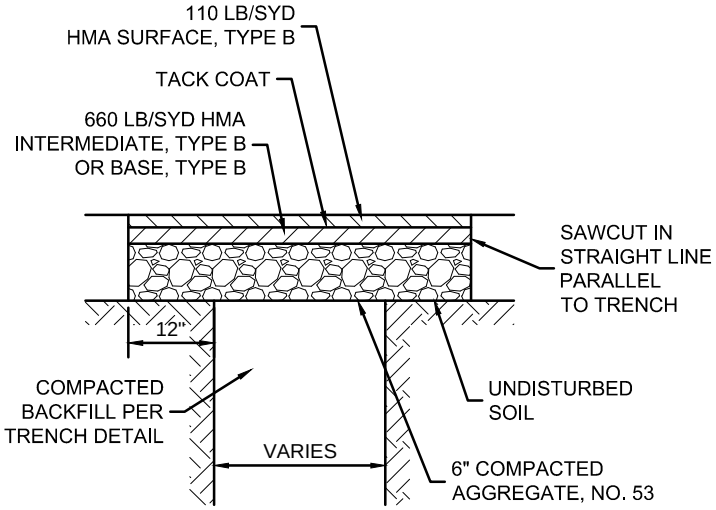


CRUSHED STONE SURFACE



CONCRETE PAVEMENT



ASPHALT PAVEMENT

INCIDENTAL PAVEMENT

SCALE: NONE

NOTE:

1. ALSO TO BE USED FOR NEW PAVEMENTS AT LIFT STATIONS

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INCIDENTAL PAVEMENT

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SANITARY SEWER STANDARDS
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FIGURE NO.32

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SANITARY SEWER STANDARDS
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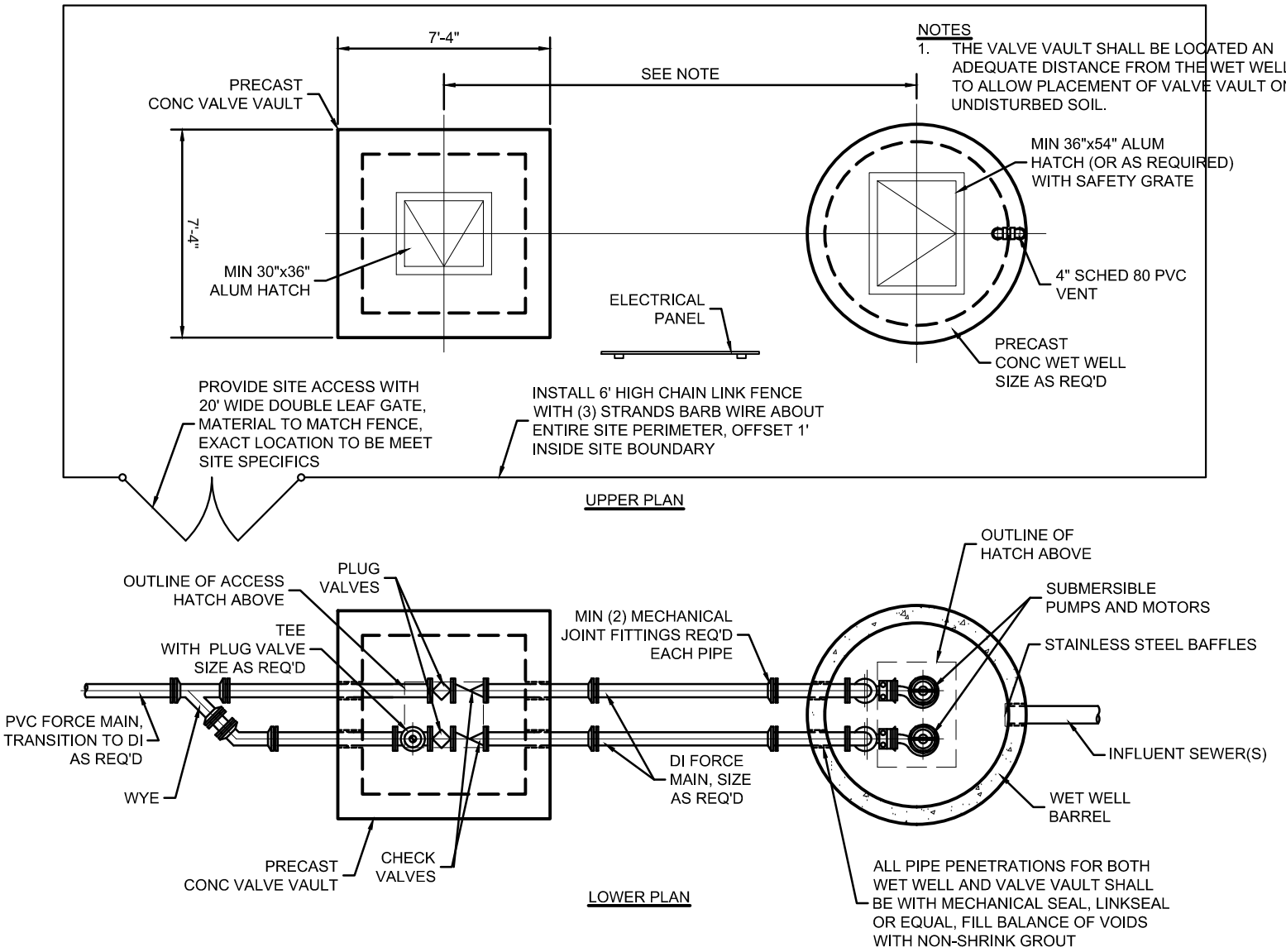
FIGURE NO.33

LIFT STATION LAYOUT



TYPICAL 2-PUMP LIFT STATION LAYOUT

SCALE: NONE

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SANITARY SEWER STANDARDS
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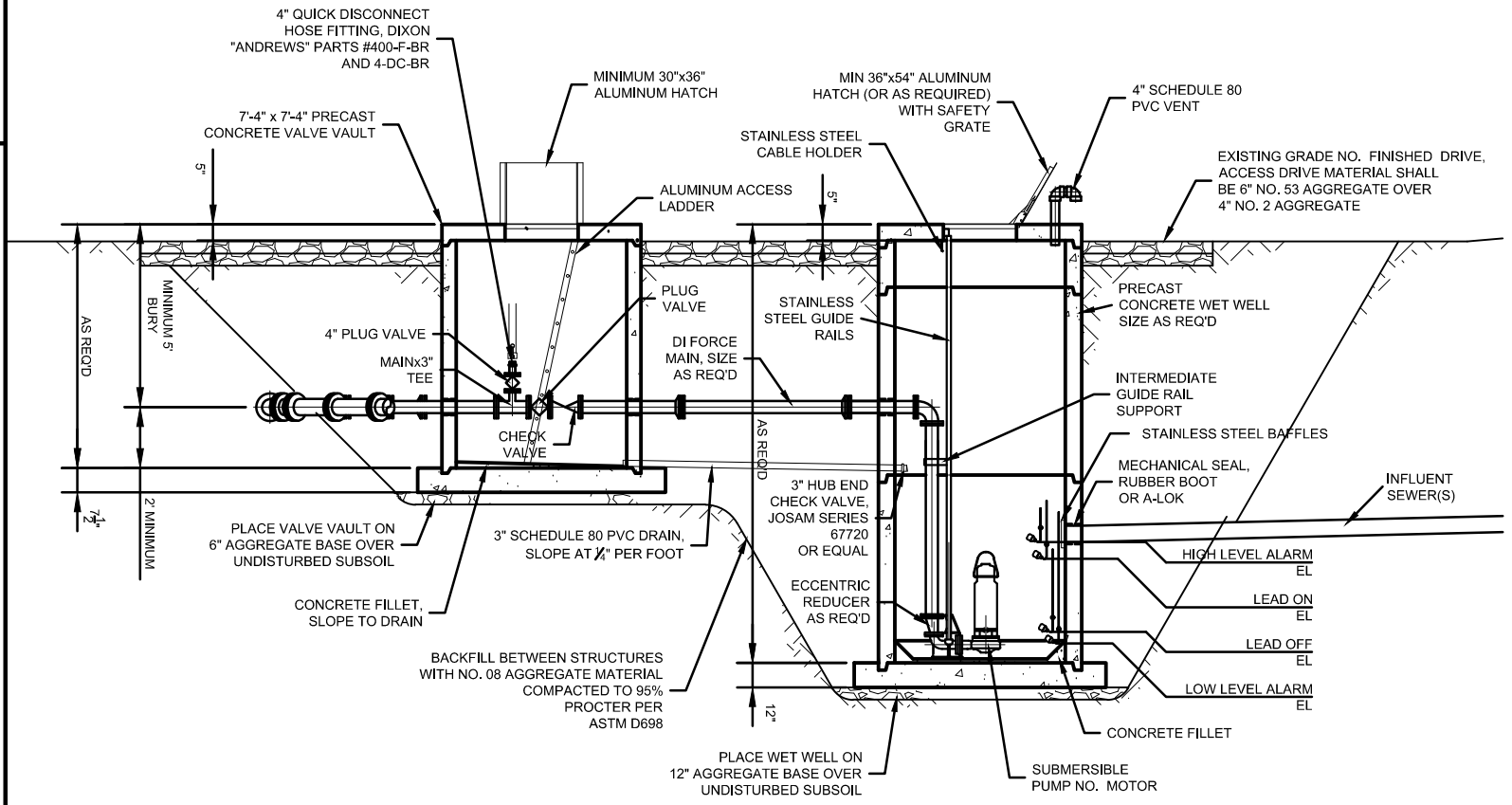
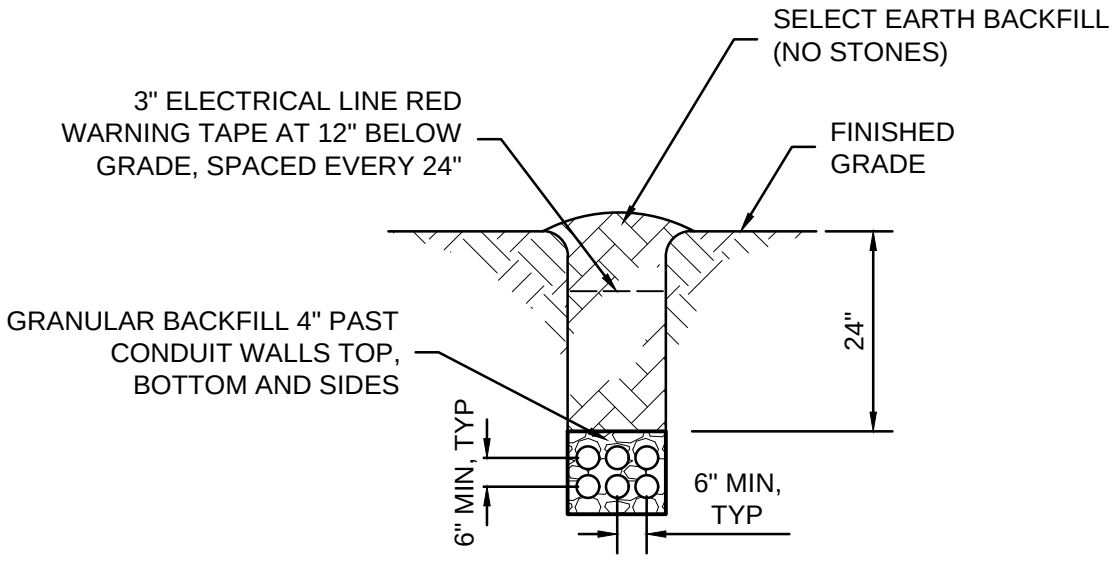
LIFT STATION SECTION

FIGURE NO.34



LIFT STATION SECTION

SCALE: NONE



CONDUIT TRENCH

SCALE: NONE

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CONDUIT TRENCH

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
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FIGURE NO.35

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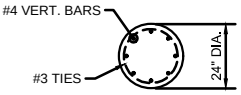
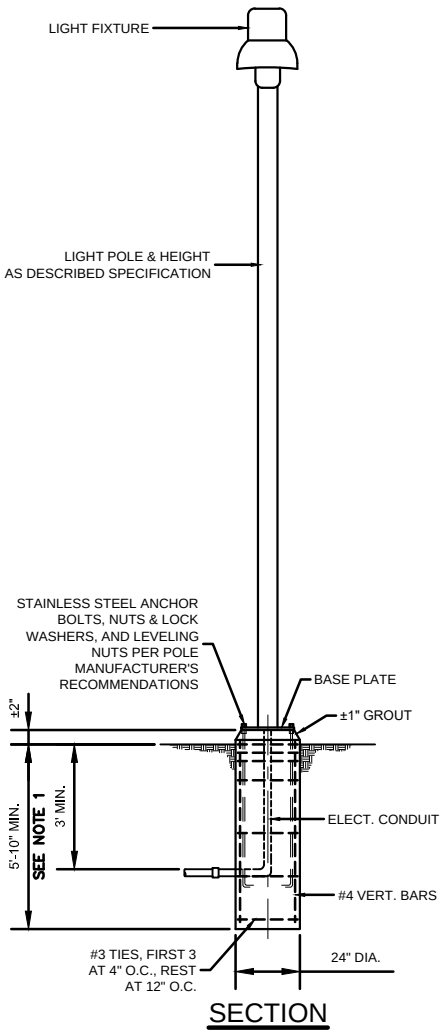


PLAN



SECTION

NOTES:

1. IF NOT SPECIFIED OR SHOWN ELSEWHERE, THE DEPTH AND REINFORCEMENT OF THE CONCRETE BASE SHALL BE AS DETERMINED BY THE POLE MANUFACTURER. STRUCTURAL LOADING SHALL BE DESIGNED FOR THE DEAD LOAD PLUS A 100 MPH WIND LOAD, STANDARD EXPOSURE PER STANDARD BUILDING CODE

NEW LIGHT & POLE DETAIL

NO SCALE

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NEW LIGHT AND POLE

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.36

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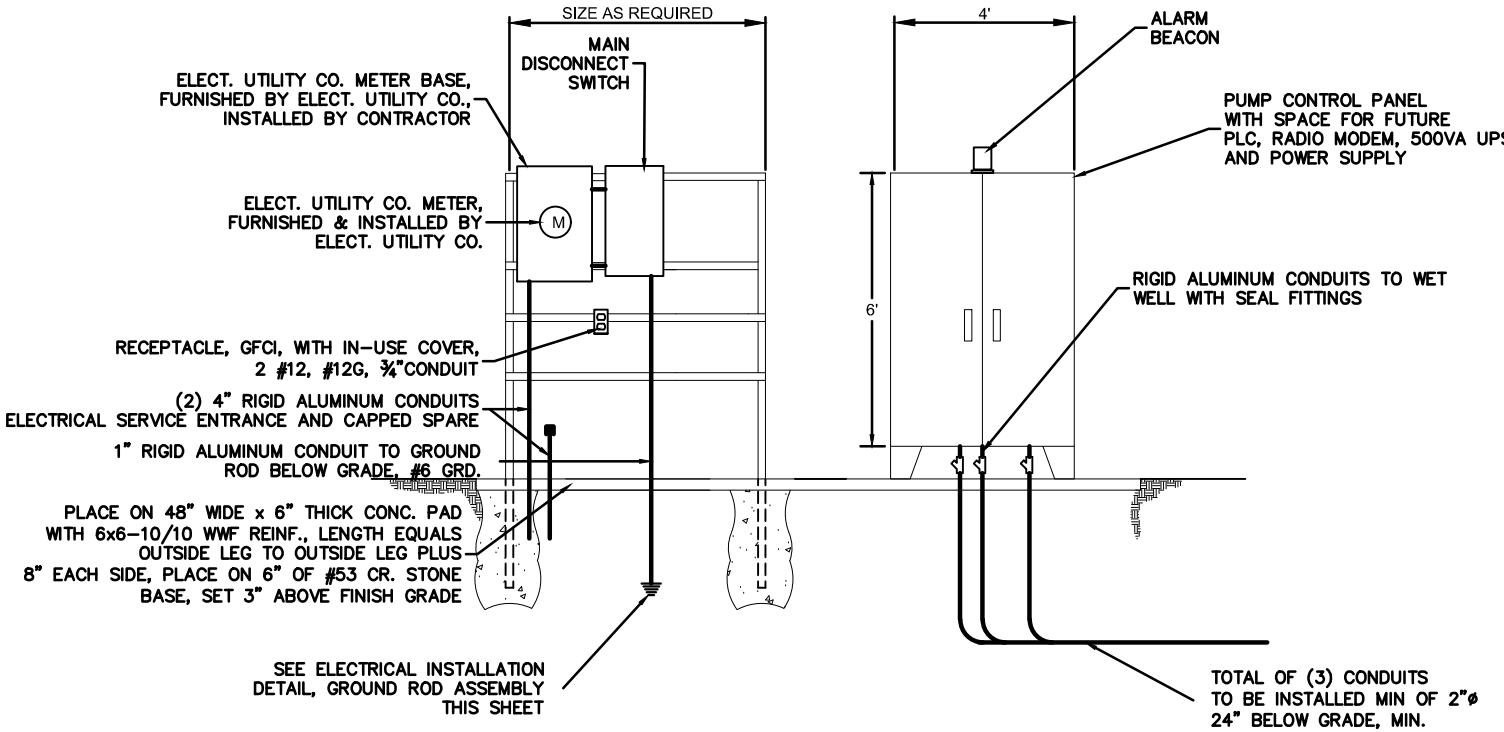
ELECTRIC CONTROL PANEL

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.37

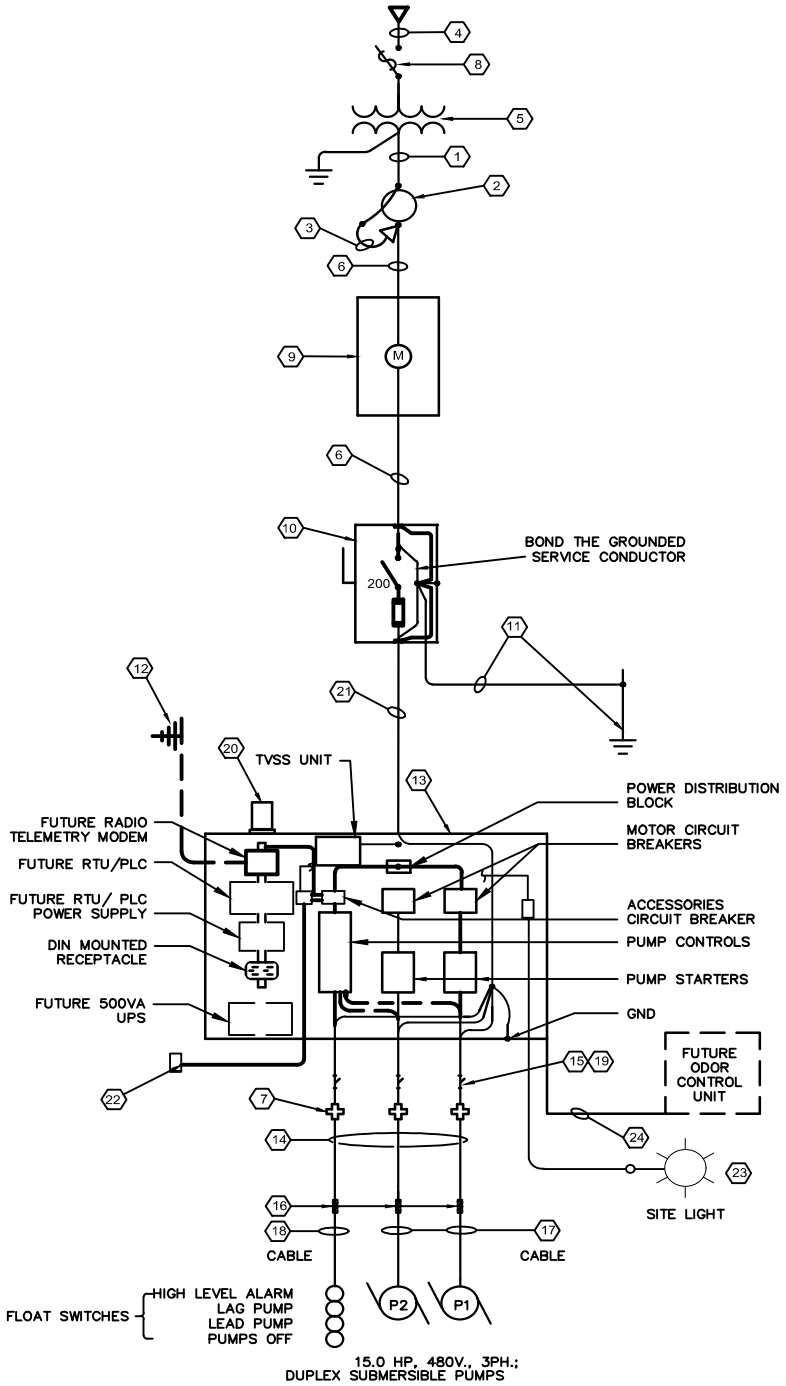


ELECTRICAL CONTROL PANEL ELEVATION

NO SCALE

KEYED ELECTRICAL NOTES

1. SLACK SPAN FURNISHED AND INSTALLED BY UTILITY.
2. POLE AND RISER FURNISHED AND INSTALLED BY UTILITY.
3. SERVICE DROP CONDUCTORS, CONDUIT, AND WEATHERHEAD BY THIS CONTRACTOR. TERMINATIONS AT WEATHERHEAD BY UTILITY.
4. MEDIUM VOLTAGE OVERHEAD UTILITY CONDUCTORS – BY UTILITY.
5. POLE MOUNTED UTILITY TRANSFORMER – BY UTILITY.
6. 4–#4/0, 4" RIGID ALUMINUM CONDUIT RISER ON POLE, 4–#4/0, 4" PVC AND 1–4" PVC SPARE C. UNDERGROUND, SEE CONDUIT TRENCH DETAIL. CONDUIT BY CONTRACTOR, WIRE FROM UTILITY POLE TO THE METER BASE BY THE ELECTRIC UTILITY. ALL OTHER WIRE IS BY THE CONTRACTOR.
7. CLASS 1, DIVISION 1, GROUP D CONDUIT UNIONS. SIMILAR TO CROUSE HINDS #UNF.
8. UTILITY CUT–OUTS – BY UTILITY.
9. METER BASE FURNISHED AND INSTALLED BY CONTRACTOR. METER FURNISHED AND INSTALLED BY UTILITY.
10. 200A, 480V, 3P, 4W, WITH GROUND, FUSED MAIN SERVICE ENTRANCE RATED DISCONNECT SWITCH WITH NEMA 4X STAINLESS STEEL ENCLOSURE AND FUSES (SIMILAR TO BUSSMAN LPS–RK–200SP).
11. 3/4" X 10' COPPER–CLAD GROUND ROD AND #6 GROUND, 3/4" C.
12. FUTURE YAGI ANTENNA, CABLE AND 2" RIGID ALUMINUM MAST TO BE INSTALLED IN FUTURE PHASE.
13. NEMA 4X PUMP MOTOR CONTROL PANEL. PANEL IS SIZED FOR FUTURE PLC, RADIO, UPS, AND POWER SUPPLY.
14. THREE 2" RIGID ALUMINUM CONDUITS, PUMP CABLES, AND FLOAT CABLES. CABLES FURNISHED WITH MOTORS AND FLOATS, COORDINATE LENGTHS WITH PUMP SUPPLIER. CABLES INSTALLED AND TERMINATED BY THIS CONTRACTOR.
15. THREE 2" RIGID ALUMINUM CONDUITS AND CONDUIT SEALS FOR CLASS 1, DIVISION 1, GROUP D HAZARDOUS ENVIRONMENT. CROUSE HINDS OR EQUAL.
16. STAINLESS STEEL STRAIN RELIEF CABLE GRIP AND STAINLESS STEEL HOOK FOR SUPPORT OF POWER AND CONTROL CABLES, ACCESSIBLE FROM WET WELL HATCH.
17. ONE POWER AND ONE SENSOR CABLE PER PUMP, FURNISHED WITH PUMP; COORDINATE CABLE LENGTH WITH PUMP MANUFACTURER.
18. WEIGHTED CABLE SET AND FOUR FLOAT SWITCHES, FURNISHED BY PUMP MANUFACTURER, INSTALLED BY CONTRACTOR.
19. THE INTERIOR OF THE WET WELL IS CLASSIFIED AS A CLASS 1, DIVISION 1, GROUP D HAZARDOUS ENVIRONMENT; ALL CONDUITS ENTERING WET WELL SHALL HAVE APPROVED CONDUIT SEALS INSTALLED.
20. HIGH LEVEL ALARM BEACON.
21. 3–#4/0, 1–#6 GND, 2" RIGID ALUMINUM C.
22. RECEPTACLE. 2–#12, 1–#12 GND,, ¾" RIGID ALUMINUM C.
23. SITE LIGHT, MOUNT ON 10' TALL ROUND ANODIZED ALUMINUM POLE, WITH STAINLESS STEEL ANCHOR BOLTS AND HARDWARE. 2 – #12, #12 GND, 3/4"C., HOLOPHANE MONGOOSE LED, WITH PHOTOCELL, MGLED – 6 5K–AS–F–L–V–H–PCSS
24. 1" C. WITH PULL STRING. CAP AND MARK LOCATION FOR FUTURE ODOR CONTROL UNIT.



230V, 3PH. SERVICE,
ONE-LINE DIAGRAM
NO SCALE

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230V 3PH ONE LINE DIAGRAM

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.38

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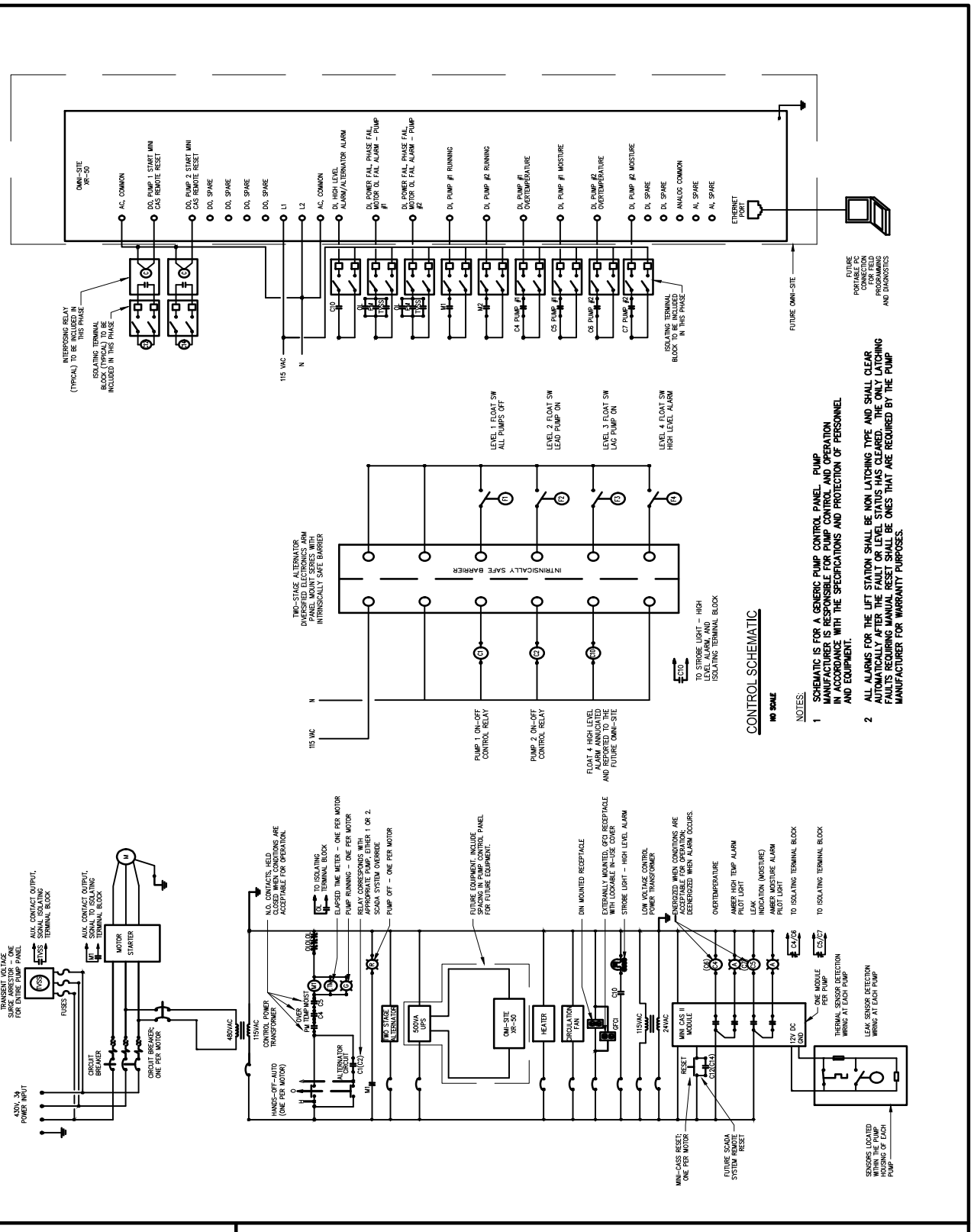

230V 3PH CONTROL SCHEMATIC

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TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.39

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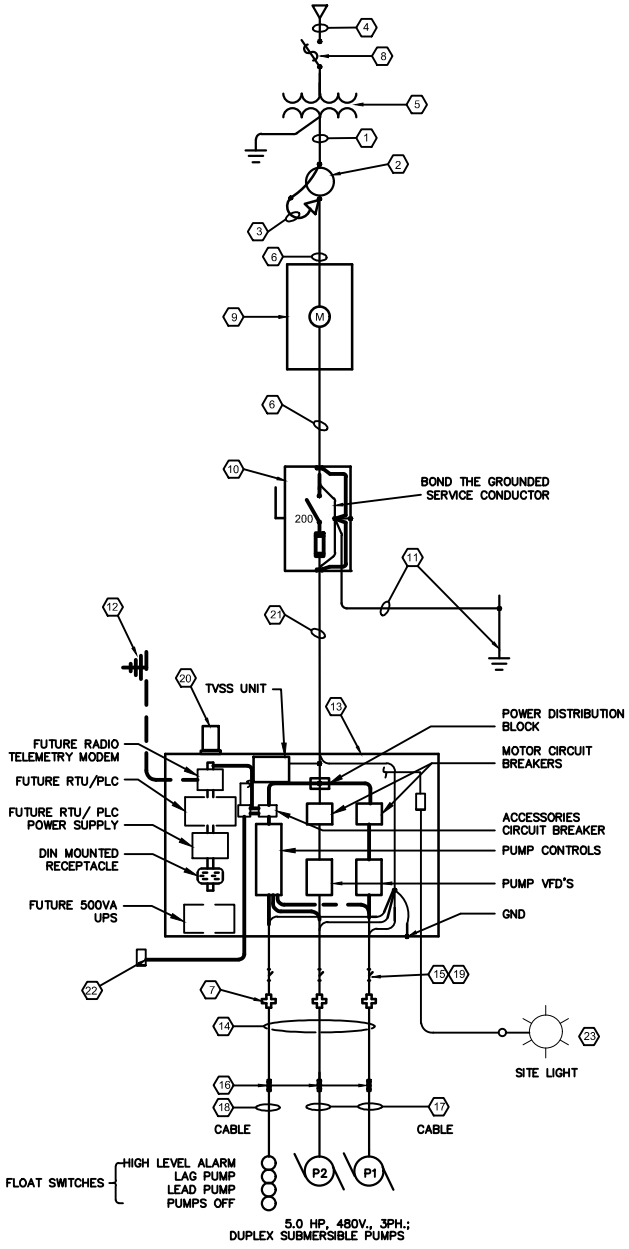
KEYED ELECTRICAL NOTES

1. SLACK SPAN FURNISHED AND INSTALLED BY UTILITY.
2. POLE AND RISER FURNISHED AND INSTALLED BY UTILITY.
3. SERVICE DROP CONDUCTORS, CONDUIT, AND WEATHERHEAD BY THIS CONTRACTOR. TERMINATIONS AT WEATHERHEAD BY UTILITY.
4. MEDIUM VOLTAGE OVERHEAD UTILITY CONDUCTORS – BY UTILITY.
5. POLE MOUNTED UTILITY TRANSFORMER – BY UTILITY.
6. 3–#4/0, 4" RIGID ALUMINUM CONDUIT RISER ON POLE, 3–#4/0, 4" PVC AND 1–4" PVC SPARE C. UNDERGROUND, SEE CONDUIT TRENCH DETAIL. CONDUIT BY CONTRACTOR, WIRE FROM UTILITY POLE TO THE METER BASE BY THE ELECTRIC UTILITY. ALL OTHER WIRE IS BY THE CONTRACTOR.
7. CLASS 1, DIVISION 1, GROUP D CONDUIT UNIONS. SIMILAR TO CROUSE HINDS #UNF.
8. UTILITY CUT–OUTS – BY UTILITY.
9. METER BASE FURNISHED AND INSTALLED BY CONTRACTOR. METER FURNISHED AND INSTALLED BY UTILITY.
10. 200A, 480V, 2P, 3W, WITH GROUND, FUSED MAIN SERVICE ENTRANCE RATED DISCONNECT SWITCH WITH NEMA 4X STAINLESS STEEL ENCLOSURE AND FUSES (SIMILAR TO BUSSMAN LPS–RK–200SP).
11. 3/4" X 10' COPPER–CLAD GROUND ROD AND #6 GROUND, 3/4" C.
12. FUTURE YAGI ANTENNA, CABLE AND 2" RIGID ALUMINUM MAST TO BE INSTALLED IN FUTURE PHASE.
13. NEMA 4X PUMP MOTOR CONTROL PANEL. PANEL IS SIZED FOR FUTURE PLC, RADIO, UPS, AND POWER SUPPLY.
14. THREE 2" RIGID ALUMINUM CONDUITS, PUMP CABLES, AND FLOAT CABLES. CABLES FURNISHED WITH MOTORS AND FLOATS, COORDINATE LENGTHS WITH PUMP SUPPLIER. CABLES INSTALLED AND TERMINATED BY THIS CONTRACTOR.
15. THREE 2" RIGID ALUMINUM CONDUITS AND CONDUIT SEALS FOR CLASS 1, DIVISION 1, GROUP D HAZARDOUS ENVIRONMENT. CROUSE HINDS OR EQUAL.
16. STAINLESS STEEL STRAIN RELIEF CABLE GRIP AND STAINLESS STEEL HOOK FOR SUPPORT OF POWER AND CONTROL CABLES, ACCESSIBLE FROM WET WELL HATCH.
17. ONE POWER AND ONE SENSOR CABLE PER PUMP, FURNISHED WITH PUMP; COORDINATE CABLE LENGTH WITH PUMP MANUFACTURER.
18. WEIGHTED CABLE SET AND FOUR FLOAT SWITCHES, FURNISHED BY PUMP MANUFACTURER, INSTALLED BY CONTRACTOR.
19. THE INTERIOR OF THE WET WELL IS CLASSIFIED AS A CLASS 1, DIVISION 1, GROUP D HAZARDOUS ENVIRONMENT; ALL CONDUITS ENTERING WET WELL SHALL HAVE APPROVED CONDUIT SEALS INSTALLED.
20. HIGH LEVEL ALARM BEACON.
21. 2–#4/0, 1–#6 GND, 2" RIGID ALUMINUM C.
22. RECEPTACLE. 2–#12, 1–#12 GND,, ¾" RIGID ALUMINUM C.
23. SITE LIGHT, MOUNT ON 10' TALL ROUND ANODIZED ALUMINUM POLE, WITH STAINLESS STEEL ANCHOR BOLTS AND HARDWARE. 2 – #12, #12 GND, 3/4"C., HOLOPHANE MONGOOSE LED, WITH PHOTOCELL, MGLED – 6 5K–AS–F–L–V–H–PCSS



460V, 3PH.
ONE-LINE DIAGRAM
NO SCALE

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460V 3PH ONE LINE DIAGRAM

TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.40

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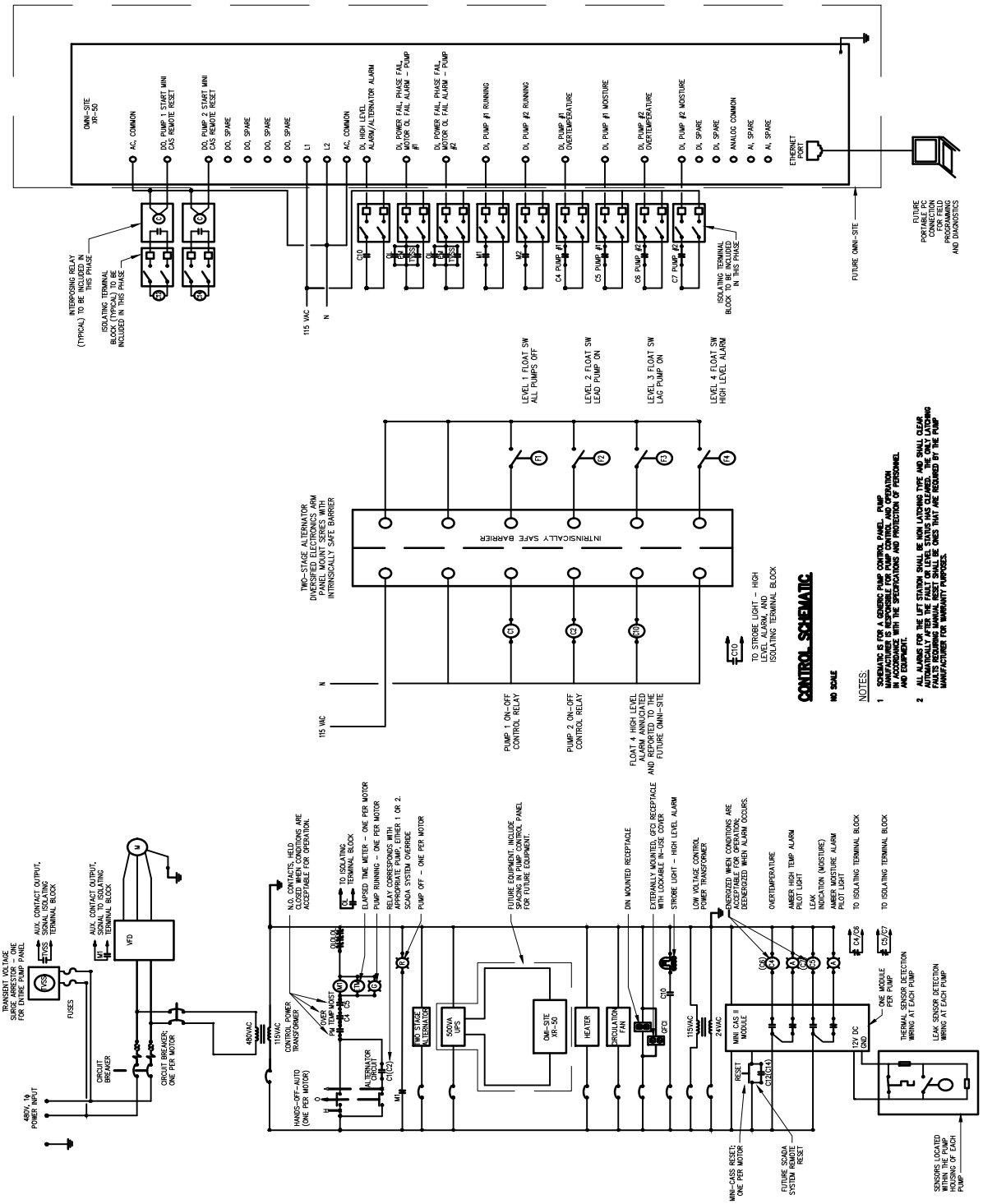

460V 3PH CONTROL SCHEMATIC

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TOWN OF CHANDLER, INDIANA
SANITARY SEWER STANDARDS
NOVEMBER 2017

FIGURE NO.41

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