



UNIVERSITY AREA JOINT AUTHORITY

Standard Specifications  
For the Construction of an Extension to the  
**SANITARY SEWER SYSTEM**

Owned by

**UNIVERSITY AREA JOINT AUTHORITY**

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**STANDARD SPECIFICATIONS  
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## **POLICY**

### **1.01 STATEMENT OF POLICY**

- A. It is the policy of the University Area Joint Authority (UAJA, Authority), in Centre County, Pennsylvania, which owns, operates, administers and maintains a wastewater collection system for the conveyance of wastewater to the treatment facility owned by the University Area Joint Authority to accept any request for service to a new development within the service area of the Authority as defined by the then current Sewage Facilities Act (Act 537) of the municipality in which the new land development proposal is offered so long as the request for service meets the intent of this policy and these regulations. Consideration to approve any proposed sanitary sewer extension to the existing system shall be given so long as capacity exists in the collection system for conveyance, capacity exists at the University Area Joint Authority facility for treatment, no prohibited wastes are discharged and all other regulations of the Authority are met. In the event subject sewers are accepted by the Authority, the responsibility for operation and maintenance of those sewers will be assumed by the Authority unless special circumstances and conditions must be met as delineated in the Sewer Extension Agreement between the Developer of the property and the Authority.

### **1.20 REGULATIONS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION**

- A. All regulations and requirements of the Pennsylvania Department of Environmental Protection (DEP) as those regulations and requirements pertain to the construction of sanitary sewers are incorporated herein as if those rules and regulations were fully written in this document.
- B. Any DEP rule, regulation and/or requirement which is more stringent than the rules and regulations contained in this document have precedence and shall supersede the regulations contained herein.
- C. The construction of sanitary sewers shall not be permitted until the proper permit(s) has been issued either by the Department of Environmental Protection to the Authority or the Authority itself has issued a permit to the Developer authorizing construction of sanitary sewers.

### **1.03 OWNERSHIP AND EASEMENTS**

- A. The Authority shall assume ownership and will authorize use of, and will maintain and operate sanitary sewers, which have been constructed by a Developer to serve the land improved by the Developer in question under the following terms and conditions:
  - 1. The Developer has requested and the Authority has approved service to the Developer's project.
  - 2. The Developer has provided evidence that Land Planning Modules or an Exemption, as may be required by the Department of Environmental Protection and/or the Municipality in which the development occurs, have been approved.
  - 3. The Developer has provided to the Authority the appropriate Sewer Extension Agreement, which will differ depending on whether a Water Quality Management Permit must be obtained from the DEP. Examples of the Sewer Extension Agreements, as required, are attached hereto as Appendix A and B.
  - 4. The Developer of the land in question provides to the Authority, temporary and permanent easements as may be required to construct and maintain sewers in

accordance with the rules and regulations then in effect at the time said easements are obtained. Easements shall be obtained and shall be recorded in the name of the Authority.

5. All permanent easements obtained and recorded for the Authority shall have a minimum width of 20 feet, centered upon the sanitary sewer or beneficial reuse waterline.
6. Easement width shall be determined based on the following table:

<b>Trench Depth (ft)</b>	<b>Sanitary Sewer Diameter/Easement Width (ft)</b>			
	<b>8"-12"</b>	<b>15"-18"</b>	<b>21"-27"</b>	<b>30"-36"</b>
<b>0-6</b>	20	20	25	25
<b>6-8</b>	20	20	25	25
<b>8-10</b>	20	25	25	25
<b>10-12</b>	20	25	25	30
<b>12-14</b>	30	30	30	35
<b>14-16</b>	30	35	35	40
<b>16-18</b>	30	35	40	40
<b>18-20</b>	40	40	45	45

7. Where the depth of the sanitary sewer exceeds 20 feet, easement width requirements will be determined by the Authority on a case-by-case.
8. No structures are permitted to be constructed within the permanent easement of the sanitary sewer for purposes of future repair requirements.

#### 1.04 DEFINITION OF TERMS

- A. "Authority" - The University Area Joint Authority, a body politic and corporate created to construct, operate, and maintain a public sanitary sewer system to serve College, Harris, Patton, and Ferguson Townships, whose responsibility it is to inspect and approve all sanitary sewers that are to discharge into and become a part of the existing public sanitary sewer system. The Authority reserves the right to employ an agent to perform its inspection duties.
- B. "Consultant" - The individual, firm or corporation presently employed as Consulting Engineer by the Authority responsible for the review and advisement to the Authority as to the satisfaction of the sewerage system design as presented by the Developer.
- C. "Contractor" - The individual, firm, partnership, co-partnership or corporation designated by the Developer for the construction of sanitary sewers and associated facilities.
- D. "Developer" - The party or parties seeking approval for construction of sanitary sewers and bearing the financial burden of construction.
- E. "Easement" - Right of access to private property to allow construction or maintenance of public utility. The permanent easement prohibits the building of any permanent structures within the right-of-way except fences.
- F. "Engineer" - The individual, firm, or corporation designated by the Developer as responsible for the preparation of drawings or plans necessary for construction of sanitary sewers and appurtenances and the "As-Built" drawings.

G. "Gravity Basement Service" -

1. For new home construction on lots where the profile of the building setback line is equal to or higher than the profile over the sewer main, the sewer main shall be constructed at an elevation such that the invert of the lateral servicing the lot shall be 9' below the finish grade shown on the profile over the sewer main.
2. For new home construction on lots where the profile of the building setback line is lower than the profile over the sewer main, a first floor elevation is to be established and shown on the plan. The sewer main shall be constructed at an elevation such that the invert of the lateral servicing the lot shall be 9' below the first floor elevation.
3. Every service lateral shall be constructed at a grade sufficient to achieve a velocity of two (2) feet per second [2% or 1/4" per foot for six (6") inch pipe] with an additional 8" in elevation (drop) provided for connecting the service lateral to the sewer main.

H. "System Laterals" - the sewer which connects the house sewer to the main line sewer. A lateral connection (to be 6" minimum) normally begins at the right-of-way or property line and connects to the street sewer by means of a "wye" fitting.

I. "Building Lateral" - That portion of the sewer conveying the sewage from the structure to the system lateral and being within private property. It is not part of the system dedicated to the Authority. The size and material of the house connection are subject to the plumbing ordinance of the Township; however, the Building sewer and construction of same are subject to inspection and testing by the Authority. If the Building sewer is installed independently of the other sewers, it is subject to testing and connection procedures as being presently used by the Authority.

J. "Planning Commission" - The Local governing body responsible for the coordinated review of comprehensive planning.

K. "Planning Module" - Components 3 and 4 of the Pennsylvania Department of Environmental Protection Sewage Facilities Planning Modules.

L. "Pressure Sewer System" - A sanitary sewer system that utilizes individual grinder sewage pumps for each customer to convey sewage under pressure to the Force Main Sewer. Typically, a Pressure Sewer System includes a gravity House Connection, a grinder pump station, a pressure lateral, and a force main.

M. "Gravity Main Line Sewer" - The sewer or sewers in the public or private right-of-way which services, or is capable of serving, more than one "Building lateral".

N. "Township" - The municipal governing body of College Township, Ferguson Township, Harris Township, or Patton Township.

O. "Work" - The installation of the sewer lines and appurtenances performed by the Contractor or Developer; Project.

1.05 ABBREVIATIONS

UAJA - University Area Joint Authority  
DEP - Pennsylvania Department of Environmental Protection  
PennDOT - Pennsylvania Department of Transportation  
OSHA - Occupational Safety and Health Administration

## 1.06 GENERAL SEQUENCE OF AUTHORITY APPROVAL

- A. Submission Time - All project design plans shall be submitted to the University Area Joint Authority and successfully pass through the review process outlined in Section 2.0 PLAN SUBMITTALS in order to be eligible for placement on the Board's regularly scheduled meeting agenda.
- B. Approval for the construction of an extension to the system owned by the University Area Joint Authority shall follow, in general, the stages outlined below:
  - 1. Planning Approval/Service Approval
    - a. The Developer shall submit one copy of a Land Development Plan or Sketch Plan to the Authority accompanied by a written request that the Authority either authorize execution of Planning Documents or certify documentation for a Planning Exemption, for the proposed development. The Sketch or Land Development Plan must at least show the proposed lot layout within the subdivision. Draft copies of Sewage Facilities Planning Modules (in duplicate) or a Planning Exemption Card as may be required by the municipality and/or the Department of Environmental Protection shall accompany the Land Development Plan or Sketch. As a minimum, the Land Development Plan and/or Sketch Plan must contain the following information:
      - i. The name of the proposed subdivision or land development.
      - ii. North Arrow.
      - iii. Graphics Scale.
      - iv. Day, month, year plan prepared and/or revised.
      - v. Name and address of Developer.
      - vi. Name and address of individual or firm preparing the plan.
      - vii. Key map showing location of proposed subdivision and land development.
      - viii. Total acreage of property.
      - ix. Location and widths of rights-of-way and cartways.
      - x. The layout of each lot.
      - xi. Utility, drainage and other easements.
      - xii. Point of connection to existing sewer system.
      - xiii. Preliminary layout of proposed sewage facilities
    - b. Based upon the information presented by the Developer in the Request for Planning/Service, the Authority shall make a determination whether an application for a "Special Permit for the Discharge of Non-Domestic Wastewater" must be submitted to the Authority with respect to service to any one individual, or all the lots contained in the Subdivision Plan or Land Development Plan. It is the intent herein to ascertain at this time whether wastewater, which is proposed for discharge to the sanitary sewer, will require pretreatment to be provided by the Developer of the subdivision and/or lot within that subdivision before discharge to the sewer is permitted.
    - c. The Authority shall take into consideration the Developer's request for planning approval, and, if appropriate, shall authorize execution of the Sewage Facilities Planning Modules. If the Authority deems the submission for planning approval to be incomplete, additional action necessary by the Developer to gain planning approval shall be indicated at the meeting when the request for planning approval is considered.

- d. The Authority's approval of the Request for Planning/Service shall not constitute approval of the final design of the wastewater collection system required for service to the proposed subdivision or Land Development Plan.

2. Final Design Approval

- a. The Developer and/or their Engineer shall present to the Authority a design of sanitary sewers required to provide service to the subdivision or project which is to be developed. The Developer is referred to Section 2.0 – PLAN SUBMITTALS for requirements of the final design when submitting same to the Authority for review and approval.
- b. The Developer shall present to the Authority for its consideration a fully executed (in duplicate) Sewer Extension Agreement as contained in Appendices B and/or C attached hereto.
- c. Based upon the content of the submittal for final design approval, the Authority will either approve the submission or make recommendations which will indicate what action must be taken by the Developer prior to the Developer receiving approval of final design of the extension to the wastewater collection system. If additional information is required, the Developer shall be so notified.
- d. If a Water Quality Management Permit is not required to be obtained from the DEP, the Developer shall submit, in duplicate, an application for an Authority issued Water Quality Management Permit. The application shall be accompanied by the applicable fee in effect at the time application is made. Subsequent to final design approval of the wastewater collection system required to serve the Developer's subdivision and/or land development project, the Authority, if appropriate, will issue a Water Quality Management Permit authorizing the construction of sanitary sewers. In the event a Water Quality Management Permit must be obtained from the Department of Environmental Protection, the Developer shall submit along with the request for final design approval, the appropriate application mandated by the Department of Environmental Protection in duplicate accompanied by the requisite fee as mandated by the Department. Following approval of the final design, the Authority shall submit the application for a Water Quality Management Permit to the Department of Environmental Protection.
- e. Construction of sanitary sewers may not commence until the requisite Water Quality Management Permit has been issued either by the Authority or by the Commonwealth of Pennsylvania, Department of Environmental Protection.

3. Procedures for Obtaining Approval to Construct and Use Sewers

- a. The Developer and/or their Engineer shall present to the Authority for review and approval As-Built drawings, prepared and certified by the Engineer, of the extension constructed to the collection system owned by the University Area Joint Authority. At the time the As-Built drawings are presented for review and approval, the Developer shall convey to the Authority the sanitary sewer extension as detailed in the Sewer Extension Agreement. The requirements for As-Built drawings are contained in Section 2.04 herein. No extension constructed by the Developer will be accepted and approved for use until such time as As-Built drawings have

been approved, the Authority has televised the pipe construction and has found it to be free of defects, all fees have been paid to the Authority and/or the Authority's representative, and the Deed of Dedication has been offered to the Authority.

- b. The Developer shall pay all fees, premiums, royalties, etc. necessary for the construction as well as for the processing of applications for the proposed project. Where required, the Developer shall have the Engineer prepare the application for a Water Quality Management Permit to be issued by the Authority or the Department of Environmental Protection, whichever is applicable. In the event an application is prepared for submission to the Department of Environmental Protection, it shall be prepared in the name of the Authority together with all required modules. These documents shall be delivered to the Authority in triplicate for review by the Authority and the Authority's Consulting Engineer. The Consultant, after review and approval of the permit application, modules and other documents, together with the necessary plans shall provide their approval to the Authority in writing before documentation is submitted to the Department of Environmental Protection or the Authority issues a Water Quality Management Permit in its own behalf. The Developer shall pay all premiums for bonds even if the Authority must obtain a bond prior to the commencement of construction.

The Developer shall provide the necessary blasting bond if such is required by the Commonwealth of Pennsylvania Department of Transportation.

The Developer is also responsible for the following permits and approvals and any associated fees.

- 1) PennDOT Highway Occupancy Permit and Maintenance Bond
- 2) Township/Borough Road or Street Occupancy Permit
- 3) Stream Encroachment Permit
- 4) NPDES Permit for Stormwater Discharges Associated with Construction Activities
- 5) Soil Erosion and Sedimentation Control Approval
- 6) Earth Disturbance Permit
- 7) Any other Permits required by any Agency

If required by the Authority, the Developer shall obtain the Permits in the name of the Authority.

The Developer shall pay the Authority for all costs of inspection of the construction of extensions to the sanitary sewer system. A pre-construction conference shall be held at which time the predetermined, estimated fee for inspection shall be paid. No construction may be initiated until this fee has been paid.

## 1.07 BOND AND MAINTENANCE

The Developer shall post a bond in accordance with the requirements of the Authority which bond shall cover the cost of construction of the wastewater collection facilities shown on the plans as approved by the Authority and maintenance of the wastewater collection facilities for a period of eighteen months. The bond shall be posted concurrently with the bonds for other public improvements related to the project and shall be in an amount approved by the Township and/or the Authority.

If blasting is to be performed, a blasting bond, in accordance with PennDOT requirements shall be posted by the Authority, but the cost of said bond shall be borne by the Developer or their Contractor.

The Developer shall maintain all sewage and related paving items associated with the project, and shall correct all defects in workmanship and materials, including settlement of backfill, for a period of eighteen (18) months from the date of acceptance of the wastewater collection facilities by the Authority.

When repairs or replacements are required, the Authority will notify the Developer in writing advising of the extent of the work. Within seven (7) days thereafter, the Developer shall begin to perform the necessary work and carry it through expeditiously until it is completed. If the Developer delays beyond the seven (7) days from the date of said notice, the Authority will institute action under the bond to have the work done by outside forces and charge same against the Surety on the bond.

#### 1.08 REFERENCE TO STANDARDS

Whenever reference to specifications or to standards is made relative to the furnishing of materials or testing thereof to conform to the standards of any technical society, organization, or body, it shall be construed to mean the latest standards, code, specifications, or tentative specification adopted and published at the date of issuance of the Water Quality Management Permit by the Authority, even though reference has been made to an earlier standard.

Reference to a technical society, organization, or body may be made in the Specifications by abbreviation, in accordance with the following list:

ACI	American Concrete Institute
AGA	American Gas Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
CIPRA	Cast Iron Pipe Research Association
Fed Spec.	Federal Specification
AASHTO	American Association of State Highway and Transportation Officials
NEMA	National Electrical Manufacturers Association
AWPA	American Wood Preservers Association
OSHA	Occupational Safety and Health Administration
SCS	Soil Conservation Service
PA DEP	Pennsylvania Department of Environmental Protection
US EPA	US Environmental Protection Agency

When no reference is made to a code, standards or specification, the Standard Specification of the ASTM shall govern.

#### 1.09 INDEMNIFICATION AND INSURANCE

- A. Indemnification: The work performed by the Developer, Contractor and Developer's Engineer shall be at the risk of the Developer, Developer's Contractor and Developer's

Engineer exclusively. To the fullest extent permitted by law, Developer, Developer's Contractor and Developer's Engineer shall indemnify, defend (at Developer, Developer's Contractor and Developer's Engineer sole expense) and hold harmless the Authority and Authority's Engineer's, joint ventures, representatives, members, designees, officers, directors, employees, agents, successors and assigns ("Indemnified Parties") from and against any and all claims for bodily injury, death or damage to property, demands, damages, actions, causes of actions, suits, losses, judgments, obligations and any liabilities, costs and expenses (including but not limited to investigative and repair costs, attorneys' fees and costs) ("Claims") which arise or are in any way connected with the Work performed, materials furnished, or Services provided under this Agreement by the Developer, Developer's Contractor and Developer's Engineer or its agents. These indemnity and defense obligations shall apply to any acts or omissions, negligent or willful misconduct of the Developer, Developer's Contractor and Developer's Engineer, its employees or agents, whether active or passive. Said indemnity and defense obligations shall further apply, whether or not said claims arise out of the concurrent act, omission or negligence of the Indemnified Parties, whether active or passive. The Developer, Developer's Contractor and Developer's Engineer shall not be obligated to indemnify or defend Authority and Authority's Engineer for claims found to be due to the sole negligence or willful misconduct of Indemnified Parties.

The Developer, Developer's Contractor and Developer's Engineer indemnification and defense obligations hereunder shall extend to Claims occurring after this Agreement is terminated as well as while it is in force, and shall continue until it is finally adjudicated and any and all actions against the Indemnified Parties for such matters which are indemnified hereunder are fully and finally barred by applicable laws.

- B. Insurance: Upon execution of this Agreement, and prior to the Developer, Developer's Contractor and Developer's Engineer commencing any work or services, the Developer, Developer's Contractor and Developer's Engineer shall carry commercial general liability insurance on ISO form CG 00 01 10 01 (or a substitute form providing equivalent coverage) and the Developer, Developer's Contractor and Developer's Engineer shall provide the Authority and Authority's Engineer with a Certificate of Insurance and Additional Insured Endorsement on ISO form CG 20 10 11 85 (or a substitute form providing equivalent coverage) or the combination of ISO forms CG 20 10 10 01 and CG 20 37 10 01 (or a substitute form providing equivalent coverage) naming the Authority and Authority's Engineer as Additional Insureds thereunder.

Additional Insured coverage shall apply as primary insurance with respect to any other insurance afforded to Authority and Authority's Engineer. The coverage available to the Authority and Authority's Engineer, as Additional Insureds, shall not be less than \$1 million Each Occurrence, \$2 million General Aggregate, \$2 million Products/Completed Operations Aggregate, and \$1 million Personal and Advertising Injury limits. Such insurance shall cover liability arising from premises, operations, independent contractors, products-completed operations, personal and advertising injury, and liability assumed under an insured contract (including the tort liability of another assumed in a business contract). There shall be no endorsement or modification of the Commercial General Liability form arising from pollution, explosion, collapse, underground property damage or work performed by the Developer, Developer's Contractor and Developer's Engineer. All Contractors insurance carriers must maintain an A.M. Best rating of A- or better. Coverage shall be afforded to the Additional Insureds whether or not a claim is in litigation.

The insurance coverage required in the previous paragraph shall be of sufficient type, scope and duration to ensure coverage for the Authority and Authority's Engineer for liability related to any manifestation date within the applicable statutes of limitation and/or repose which pertain to any work performed by or on behalf of the Authority and Authority's Engineer.



Each Certificate of Insurance shall provide that the insurer must give the Authority and Authority's Engineer at least 30 days' prior written notice of cancellation and termination of the Developer, Developer's Contractor and Developer's Engineer coverage thereunder. Not less than two weeks prior to the expiration, cancellation or termination of any such policy, the Developer, Developer's Contractor and Developer's Engineer shall supply the Authority and Authority's Engineer with a new and replacement Certificate of Insurance indicating the Additional Insured endorsement as proof of renewal of said original policy. Said new and replacement endorsements shall be similarly endorsed in favor of the Authority and Authority's Engineer as set forth above.

Additionally and prior to commencement of the Work, the Developer, Developer's Contractor and Developer's Engineer shall provide the Authority and Authority's Engineer with a Certificate of Insurance showing liability insurance coverage for the Developer, Developer's Contractor and Developer's Engineer and any employees for Workers Compensation, Employers Liability, Automobile Liability and Umbrella Liability. In the event any of these policies are terminated, Certificates of Insurance showing replacement coverage shall be provided to the Authority and Authority's Engineer. Coverage limits shall be no less than the following:

Workers Compensation and Employers Liability Insurance: As required by law and affording 30 days written notice to the Developer, Developer's Contractor and Developer's Engineer prior to cancellation or non-renewal. Limits are to be a minimum of \$100,000 each Accident, \$500,000 Disease policy limit, and \$100,000 disease each Employee.

Business Automobile Liability Insurance: Written in the amount of not less than \$1 million Each Accident.

Umbrella Liability Insurance: The coverage shall not be less than \$2 million Each Occurrence, \$2 million Aggregate. Such insurance shall provide coverage over and above the stated General Liability, Employers Liability and Automobile Liability limits.

#### 1.10 WORKMANSHIP AND MATERIALS

It is the intent of the University Area Joint Authority to require all sewer construction, which is carried out under the auspices of this policy by a Developer as defined herein, in College, Harris, Patton and/or Ferguson Townships, to meet the specifications of the Authority, and to require the Developer to adhere strictly to the requirements enumerated herein and in the specifications. The intent of the Specifications is to define the quality and character of the workmanship and materials necessary to meet the requirements of the University Area Joint Authority, the Pennsylvania Department of Environmental Protection and the Pennsylvania Department of Transportation for sewer construction in the rights-of-way and paved areas of state and township highways.

#### 1.11 NOTIFICATION OF UTILITY COMPANIES

The Developer and/or representatives are hereby advised of their obligation under the Underground Utility Line Protection Law, to contact all utility companies who maintain underground utilities in the project area. The Authority will not assume any responsibility for the failure of the Developer and /or representatives to fulfill their requirements and obligations under the Underground Utility Line Protection Law, as amended.

#### 1.12 PRESSURE SEWER SYSTEMS

The construction of a pressure sewer system will be considered when the following is met:

##### A. Criteria

1. The finish grade of the proposed development requires conventional gravity sewer mains to be greater than 15-feet deep as measured from the top of the sewer pipe to finish grade.
2. Site-specific conditions include wetlands, streams, or other natural water obstructions.
3. The location of the pressure sewer system is such that subsequent development in the vicinity will not be forced to connect to the pressure sewer system.

B. Additional Requirements

1. Each residence or building structure must have an individual grinder pump station. Sharing of grinder pump stations is not allowed. All grinder pump stations shall be located exterior to and at least 10-feet from any structures on the property.
2. Prior to the issuance of individual connection permits within a development, the Developer, or property owner shall deposit funds with the Authority equal to the replacement cost of the grinder pump(s) and control panel(s) subject to connection. The funds will be placed in escrow by the Authority, and used to bring the expectant life of the pressure sewer system to 20-years. If the Developer deposits the funds, these costs may be passed on to the property owner, to be paid at the time of connection. The amount will coincide with current cost published in the fee schedule of the Rate Resolution at the time of connection

C. Responsibilities and Maintenance

1. The individual property owner will be responsible for the maintenance and operation of the following components of the pressure sewer system:
  - a. Power and Electrical
  - b. House lateral to the grinder pump station
  - c. Wet Well
  - d. Pressure lateral including all fittings
  - e. Controls
2. The Authority will be responsible for the maintenance of the following components of the pressure sewer system. The deeds of each property served by the pressure sewer system shall contain a covenant allowing the Authority access to the grinder pump station for inspection, maintenance, and observation.
  - a. Grinder Pump "Core"
  - b. Common Main
  - c. Control Panel

1.13 LATERALS (GRAVITY)

A. Single Family Residential

1. From the end of the six (6) inch system lateral, install a test-tee and reducer which transitions to four (4) inch Schedule 40. The test-tee shall be no further than two (2) feet inside the property line. Install an additional clean-out every fifty (50) feet and at any directional change (horizontal or vertical). Any separate connection of a detached structure to the primary use on the lot shall be considered a "Private to

Private” connection and shall follow the same requirements as the primary building connection however it shall require a separate permit as described in the Rate Resolution.

2. On properties where the sidewalk is to be located on the property rather than in the public Right-of-Way, the test-tee and reducer should be located in the Right-of-Way and the pipe shall be reduced and extended behind the sidewalk, within the utility easement.

B. Duplexes

1. Duplex buildings shall be served with an individual four (4) inch lateral to each unit adhering to specifications of the Authority. Any separate connection of a detached structure to the primary use on the lot shall be considered a “Private to Private” connection and shall follow the same requirements as the primary building connection however it shall require a separate permit as described in the Rate Resolution.

C. Three or More Units per Building (Multiple Unit)

1. Multiple unit buildings (greater than duplex), where each unit will be rented, may be served by one six (6) inch Schedule 40 lateral for the building. Any separate connection of a detached structure to the primary use on the lot shall be considered a “Private to Private” connection and shall follow the same requirements as the primary building connection however it shall require a separate permit as described in the Rate Resolution.
2. Multiple unit buildings (greater than duplex) that are condominiums may be provided service with one lateral subject to the following conditions:
  - a. A condominium association must be established and a maintenance agreement with UAJA must be enacted.
  - b. There must be no ability to subdivide the property, or any of the buildings within the condominium association, under current zoning regulations.
  - c. The laterals serving multi-unit buildings must be six (6) inches in diameter.
  - d. The minimum grade of the lateral must be one-quarter inch per foot (2.00%).
  - e. The lateral must extend completely through the building with a clean-out at the end.
  - f. Additionally, a clean-out must be provided for each individual unit in an accessible location that is not within the living area of the unit.
  - g. Grade certification must be provided to UAJA staff for each lateral within the association.
3. Multiple unit buildings (greater than duplex) that are condominiums and are constructed as two (2) stories or higher, may follow “Common Element” methodology as allowed by the [PA Uniform Condominium Act]. This provides for the use of common vertical stacks which converge into common 6” diameter lateral(s) prior to connection to the mainline sewer, where the lateral is not located under the building slab. If the lateral is located under the building slab, conditions a. through e. and g. of point 2 above will be required.

D. Commercial

1. Lateral design must be reviewed and approved by Staff.

E. Industrial

1. Lateral design must be reviewed and approved by Staff.

## **2.0 PLAN SUBMITTALS**

### **2.01 SUBMISSION TO AUTHORITY OF DESIGN AND AS-BUILT DRAWINGS FOR REVIEW AND APPROVAL**

- A. Design Drawings: Submission of Design Drawings shall be initiated by either Planning Module or Planning Exemption approval of the Developer's Land Development/Sketch Plan as documented by a statement informing the Developer to proceed with preparation of Design Drawings for the project. Prior to the submission, the Developer shall contact the Consultant to schedule the review dates for the Design Drawings. Scheduling must be completed to ensure that a comment letter is received from the Authority/Consultant in three (3) business days from the date of submission. The Developer shall then submit one (1) paper copy and one (1) Portable Document Format (PDF) file to the UAJA and one (1) PDF file to the Consultant. The UAJA will collaborate with the Consultant for the review. Comments will be electronically conveyed to the Developer and/or Engineer. If the review process requires numerous iterations, each submission must be scheduled with the Consultant to ensure the aforementioned response time. It is the responsibility of the Developer and Engineer to comply with the review schedule in order to secure a timely approval of the project Design Drawings.

At the time when the Design Drawings meet all the requirements established by the Authority, they will be presented to the UAJA Board at a regularly scheduled meeting for approval.

When approval of the drawings has been achieved, execution of the Sewer Extension Agreement completed, and assignment of a Water Quality Management Permit for construction has been made, then a "Job Conference" may be scheduled to discuss the project with the Contractor and UAJA Inspectors prior to the commencement of construction.

- B. As-Built Drawings: At the completion of construction, the Authority will perform a televisual inspection of the Collector Sewers and Laterals. If acceptable, notification will be provided to the Developer to proceed with the submission of preliminary "As-Built" drawings. Preliminary as-built drawings shall illustrate the installed system in conformance with requirements of Section 2.04 (B). The Developer and/or Engineer shall submit one (1) paper copy and one (1) portable document format (pdf) file to the UAJA and one (1) PDF file to the Consultant. The UAJA will collaborate with the Consultant for the review. Once all comments have been addressed, promptly submit As-built data detailed in Appendix D (Specifications for Electronic Submission) to enable a timely update of the Authority's Geographic Information System (GIS). Upon receipt and success incorporation of the data into the GIS to validate formatting conformance, notification will be provided to the Developer/Engineer to finalize submission of the As-Built Drawings. Within 30 days, submit two (2) paper copies and one (1) PDF file to the Authority and one (1) PDF to the Consultant.

- C. In addition to the As-Built Drawings required above, if the Authority deems it necessary, the Developer shall provide three (3) sets of any other plans, catalog cuts and specifications, as might be furnished for his project by a material or equipment manufacturer, whether it be a material, installation or maintenance specification.
- D. If the Project requires a DEP WQM permit for construction, then all submissions must be increased by two (2) additional sets for submission by the Authority to the Department for review. This includes both Design and As-Built drawings.
- E. If the Project requires the construction of a Pump Station or other facility containing mechanic or electrical equipment, the Developer shall provide two print sets of Operation and Maintenance Manuals and one (1) set as a PDF file.
- F. If inspection Escrow money is owed to the Authority, it will be identified in the As-Built Drawings approval letter and invoiced, accordingly. The invoice must be paid in full according to the terms of the invoice. If there is a balance to the escrow, it cannot be refunded until all requirements are met.
- G. All documents required for finalization must be submitted and acceptable and all inspection invoices must be paid before issuance of connection permits

## 2.02 MINIMUM STANDARDS FOR DESIGN

- A. Reference is made to the Minimum Standards for Construction Drawings contained herein and Section 1.02 for design standards not specified below. Reference is also made to the Domestic Wastewater Facilities Manual published by the Commonwealth of Pennsylvania, Department of Environmental Protection, Bureau of Water Quality Management, latest edition. In the event these standards require stricter standards than the Domestic Wastewater Facilities Manual published by the Commonwealth, these specifications take precedence.
- B. No mainline sewer pipe shall be less than eight (8) inches in diameter with the exception of service laterals, which shall be six (6) inches in diameter.
- C. All sewer pipe shall have a minimum of 4 feet of cover. Do not propose sewer mains in areas with fill greater than five (5) feet.
- D. Do not propose sewer mainlines within 10 feet from structures.
- E. The following are the minimum slopes that shall be provided:

Pipe Size (inches)	Minimum Slope in Feet per 100 Feet
8	0.50
10	0.38
12	0.32
14	0.27
15	0.25
16	0.24
18	0.22
21	0.20
24	0.18
27	0.167
30	0.158
36	0.146

- F. The maximum distance between manholes shall be three-hundred (300) feet. A manhole shall be provided at every change in horizontal and/or vertical alignment and as a termination for all 8 inch or greater diameter pipe.
- G. A minimum of 0.2 foot of drop is required across a manhole.
- H. Manholes greater than twenty (20) feet deep shall be a minimum of five (5) feet in diameter. Manholes greater than twenty (20) feet deep shall contain intermediate platforms. Maximum distance between platforms shall be twenty (20) feet vertically (minimum distance shall be ten (10) feet vertically).
- I. The manholes receiving pumped flow, and the following manhole shall be lined with HDPE or PVC.
- J. For new home construction, gravity basement service, as defined in 1.04 (F), shall be provided.
- K. When required by the Authority, any Developer desiring to discharge non-domestic wastewater to the sanitary sewer shall install a suitable control manhole or manholes on each connecting sewer or sewers (or each lateral connection) to facilitate observation, sampling, and measurement of the flow of non-domestic wastewater. At the discretion of the Authority the Developer must plumb the building so as to separate domestic and non-domestic wastewater. Such control manhole or manholes shall be accessible and safely located and shall be constructed in accordance with the plans approved by the Authority. The manhole or manholes shall be installed by the Developer at their expense and shall be maintained by the Developer so as to be safe and accessible to the Authority or its authorized representatives at all times.

## 2.03 STANDARDS FOR DESIGN DRAWINGS

- A. The Plans for construction shall include the elements as provided in Appendix C – Checklist for Design (and As Built) Drawings.

## 2.04 STANDARDS FOR "AS-BUILT" DRAWINGS

- A. The as-built plans shall include the elements as provided in Appendix C – Checklist for Design (and As Built) Drawings.

## 2.05 PLANS TO CONTRACTOR

- A. A sufficient number of Plans and Specifications shall be made available by the Developer to the Contractor or Contractors performing the work.

## 3.0 SCOPE OF WORK

### 3.01 GENERAL

- A. The work included in the proposed sewer construction shall be defined in detail and be complete in scope so that in no way shall the Authority be held responsible for any interconnection work or maintenance of roadway paving after final inspection and acceptance of the work.
- B. The Developer, or the Contractor under the construction contract with the Developer if such be the case, shall furnish all plant, materials, equipment, supplies, labor, transportation,

fuel, power, water and air necessary to complete and test the work properly, in accordance with the Specifications and Plans thereof.

- C. The work shall be complete and all the work, materials, and services not expressly called for in the Specifications or not shown on the Plans, which are necessary and required for the proper construction and operation of all items of work and equipment specified and shown, shall be performed, furnished and installed to the satisfaction of all regulatory agencies and governing bodies and the Authority.

### 3.02 QUANTITIES AND AMOUNTS OF WORK

- A. For purposes of establishing a book value of the sewer system of the Authority, copies of all lump sum and unit prices given to the Developer by the Contractor (Contractor's proposal to complete the work) shall be given to the Authority.
- B. Field changes in the work, requiring more or less of the items for which prices are stipulated in the Proposal, may be made upon written approval of the Authority. The "scope of work" must remain such that the Developer provides a complete, operational system.
- C. Records of final (As-Built) quantities along with lump sum or unit price tabulations shall be given to the Authority.

### 3.03 CONTRACTOR TO CHECK PLANS AND DATA

- A. The Contractor is required to check all dimensions and quantities on the Plans or Schedules given by the Developer's Engineer, and the Contractor shall notify the Engineer or Developer of all errors, omissions, conflicts, and discrepancies found therein. Contractor will not be allowed to take advantage of any error or omission in these Specifications, as the Authority shall furnish full instructions to the Developer should such errors or omissions be discovered, and the Developer shall carry out such instructions as if originally specified. Figures marked on the Plans shall, in general, be followed in preference to scale measurements. Large-scale drawings shall, in general, govern small-scale drawings. In all cases where dimensions are governed by conditions already established, the Contractor shall depend entirely on measurements by self. As a condition of overall approval and acceptance by the Authority, the Developer must agree to save harmless the Authority from any damage resulting from errors or omissions.

**END OF SECTION**

**UNIVERSITY AREA JOINT AUTHORITY  
1576 SPRING VALLEY ROAD  
STATE COLLEGE, PENNSYLVANIA 16801  
814-238-5361**

**SEWER EXTENSION AGREEMENT**

**DEP Permit Required**

**THIS AGREEMENT made and executed on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between the UNIVERSITY AREA JOINT AUTHORITY, a body corporate and politic existing by virtue of the laws of the Commonwealth of Pennsylvania, (hereinafter referred to as “Authority”), and \_\_\_\_\_ hereinafter referred to as “Developer”).**

**W I T N E S S E T H**

**WHEREAS, Developer intends and is about to develop a defined tract of land situated in \_\_\_\_\_ Township, County of Centre, Commonwealth of Pennsylvania and requests the Authority furnish sewage service thereto. The tract, the location and dimensions of the street, roads and alleys therein, and the existing structures and those intended to be erected thereon, are designated and described on a plan entitled ‘ \_\_\_\_\_ ’ and;**

**WHEREAS, Developer has made application to the Authority for permission to construct, at its own cost and expense and by its own contractors, a sanitary sewer system within the above designated and described tract of land shown on the plan and to connect same when completed unto the existing sewer system of the Authority. Developer acknowledges that such application has been made after having received information from officials of Authority as to the optional methods by which such construction and connection may be accomplished and the relative costs and expenses thereof under the Rules and Regulations of the Authority.**

**NOW, THEREFORE, in consideration of the payments and promises hereinafter made, both parties intending to be legally bound hereby, it is mutually agreed as follows:**

- 1. (a) That Developer, at its own cost and expense, will cause to be prepared, by qualified professional engineering personnel, detailed plans and specifications for the proposed extension to the sewer system of the Authority**



- (b) Such plans and specifications shall conform to the requirements of the Authority
- (c) All such plans, specifications, and Pennsylvania Department of Environmental Protection (DEP) permit application and supporting data shall be supplied to the Authority in at least three (3) counterparts for use by the Authority, plus such additional number as may be required by DEP and other regulatory bodies. The DEP permit application shall be prepared by the Developer in the name of the Authority.
- (d) The Authority may cause such plans, specifications and permit data to be submitted to the Consulting Engineers then representing the Authority. Such plans, specifications and permit data shall be revised or amended, if necessary, until they are unequivocally approved by the Authority as providing for an extension of a type and nature and so planned and to be constructed as to readily become an integral part of the sewer system of the Authority.
- (e) Promptly upon the Authority's approval as aforesaid, the approved plans, specifications and permit data will be submitted by the Authority to DEP requesting approval thereof and the issuance of a Water Quality Management Permit. Upon receipt of said permit and upon compliance by Developer with all applicable local ordinances and regulations, the Authority will notify the Developer that work may be started.
- (f) Developer shall be responsible for compliance with all DEP soil erosion and sedimentation control requirements. All charges, fees and fines in connection with these requirements shall be the Developer's responsibility.

2. Developer shall hire and employ and pay his own contractor or contractors to construct the extension according to the aforesaid approved plans and specifications, and the Authority shall have no responsibility or liability for payment of any part of the costs or expenses arising out of or relating to said construction or the labor, materials and equipment used therein or thereon or acquiring any right-of-ways and for injury or damage to any persons or property occurring upon or associated with the construction of the project.

3. Developer will not at any time discharge into the Collection System any effluent other than "domestic sewage" (which term is herein defined to mean "sewage" other than "industrial waste," as those two terms are defined in Section 73.1 of Title 25, Part 1, Subpart C, Article 1, Chapter 73 of the Rules and Regulations of the Department of Environmental Protection of the Commonwealth of Pennsylvania (herein

called “DEP”) emanating from the Development without the express written consent of the Authority, which consent shall not be unreasonably withheld or delayed, and without complying with such reasonable conditions as the Authority imposes under its “Rules and Regulations.”

Should the rules, regulations, orders of any governmental body or agency hereafter come into effect which prohibit the Authority from accepting certain types of sewage from the Development, Developer relieves the Authority from any and all responsibility under this Agreement as to the acceptance of such prohibited sewage.

4. Developer agrees to give the Authority ten (10) days written notice of Developer’s intention to begin construction of the extension so that its construction may be properly observed by the Authority. Any work, which has begun before the expiration of such ten- (10) day period will not be approved, as well as any improperly constructed work, the existence of which the Authority has notified Developer promptly after the observation, which has disclosed such improper construction. At all times, the sewer contractor shall keep on the construction site, available to the Authority one (1) copy of the Approved Plans and Specifications, any shop drawings approved by the Authority and the Authority’s current Standard Construction and Material Specifications (herein called “Authority’s Standard Specifications”).

5. During the course of the construction, all materials, workmanship and compliance with the approved plans and specifications shall be subject to the observation and approval of the Authority. Upon completion of the construction and prior to connection of the extension to the sewer system of the Authority, the Authority shall certify the satisfactory completion thereof.

6. Promptly upon completion of the extension, the Developer shall:

- (a) Cause to be prepared and furnished to the Authority at the expense of the Developer, two (2) sets of “Provisional As-Built” drawings of the completed extension project along with a cash deposit into an escrow account to cover all necessary engineering fees the Authority may have to incur to satisfactorily complete the “Provisional As-Built” to final As-Built content. Once the “Provisional As-Built” drawings have been approved, the Developer shall furnish at the expense of the Developer (2) two sets of “As-Built” drawings of the completed extension project, together with one (1) set of reproducible plans thereof.
- (b) Cause to be prepared, executed, acknowledged and delivered to the Authority ready for recording, at the sole expense of the Developer, a deed of dedication for the said entire extension project and conveyance of all pipes, manholes, and all its appurtenances, as well

as all rights, liberties and privileges appurtenant thereto including right-of-ways over the streets, road, alleys, and thoroughfares and private lands necessary to the existence of future maintenance thereof. In the event a deed of dedication is not offered to the Authority, the Authority shall be entitled to specific performance of the Agreement and the costs of enforcing the Agreement, including reasonable attorney's fees, shall be paid by the defaulting party and shall be made a part of the order of the Court in granting specific performance.

- (c) Prior to making physical connection between Developer's extension and the Authority's sewer system, Developer shall furnish the Authority with a maintenance bond, with corporate surety to cover all maintenance expenses incurred in connection with the extension for the period of eighteen (18) months following acceptance by the Authority of the dedication of such system. The bond shall be in the amount of fifteen percent (15%) of the cost of construction of the extension and shall be in the form approved by the Authority. In lieu of a bond, the Developer may put up a cash escrow or a Letter of Credit, in the amounts as specified above, provided the Letter of Credit is satisfactory to and in a form approved by the Authority.
- (d) Prior to the dedication of the streets to the Township, the Developer shall convey unto the Authority, by an instrument in a form approved by the Authority and at the Developer's cost, an easement for the laying, relaying, maintenance and repair for the sewer lines in the extension at their installed locations in the beds of such streets or across the lands of the Development, or both.

7. Upon receipt and recording of said deed of dedication, the extension project and all parts and appurtenances thereof as above described shall be, become and remain the sole, absolute and permanent property of the Authority free and clear of any lien, obligations or other liability in favor of the Developer, its successors or assigns, its contractor or contractors, its and their laborers, and material men and any of their creditors, or in favor of any other person or corporation, to the same end and effect as if the Authority had constructed the extension project with its own labor and its own expense; and thereafter the Authority shall maintain, repair, rebuild and otherwise act toward said extension as its own property and at its own cost and expense and Developer shall have no further obligation or responsibility thereto except as hereinafter provided. Nothing herein shall be construed to discharge or dilute the contractual obligations of the contractor or contractors of the Developer to guarantee their workmanship and to maintain their ditches and paving for a certain period of time following completion.

8. Developer agrees to pay all costs incurred by the Authority in the performance of this Agreement, including but not limited to:

- (a) The charges of the Authority's Consulting Engineer for review of plans, specifications, shop drawings, and other data related to the sewer extension and for observation of construction.
- (b) All fees and charges, if any, paid by the Authority to DEP or other regulatory bodies.
- (c) The expenses and charges for observation of construction.
- (d) All attorneys' fees, legal and recording expenses.

Developer further agrees to deposit, from time to time as required by the Authority, such sum of money as is deemed necessary by the Authority to pay the estimated costs, which will be incurred by the Authority for a particular phase of the project. Such sum shall be held by the Authority, without interest, for application by the Authority toward payment of the costs incurred by the Authority. Should the sum deposited exceed the actual costs incurred by the Authority, the balance remaining upon completion of that particular phase of the project shall be funded in full to the Developer or held for application toward subsequent phases of the work. Should the sum deposited be insufficient to pay the actual costs incurred by the Authority, Developer shall pay the deficiency to the Authority upon demand and prior to the connection of the extension to the sewer system of the Authority.

9. This Agreement is intended to implement the provisions of the Rules and Regulations adopted by the UNIVERSITY AREA JOINT AUTHORITY for the maintenance and operation of the sewer system and provisions of this Agreement shall at all times be subject to said rules and regulations.

IN WITNESS WHEREOF, the Authority has caused the within Agreement to be executed in its corporate name and its corporate seal to be hereunto affixed, duly attested by its Secretary; and Developer has caused same to be executed by its duly authorized representatives all on the day and date first above written.

ATTEST:

UNIVERSITY AREA JOINT AUTHORITY

By: \_\_\_\_\_

Secretary/Assistant Secretary

By: \_\_\_\_\_

Chair/Vice-Chair

By: \_\_\_\_\_

Developer

STATE OF PENNSYLVANIA )

) SS

COUNTY OF CENTRE )

On this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, a Notary Public in and for the Commonwealth of Pennsylvania personally appeared \_\_\_\_\_, who acknowledged himself to be the \_\_\_\_\_ of the University Area Joint Authority, a body politic and corporate, and that he as such an officer, being authorized to do so executed the foregoing instrument for the purposes therein contained by signing the name of said University Area Joint Authority by himself as such officer.

IN WITNESS WHEREOF, I hereunto set my hand and notorial seal.

\_\_\_\_\_ (SEAL)

COMMONWEALTH OF PENNSYLVANIA     )

)

COUNTY OF CENTRE                     )

On this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me,  
a Notary Public in and for the Commonwealth of Pennsylvania, personally appeared -  
\_\_\_\_\_, known to me (or satisfactorily proven) to be the person(s)  
whose name(s) is/are subscribed to the within instrument and acknowledged himself / herself / themselves to  
the Developer(s) of the real estate described in the foregoing instrument in \_\_\_\_\_  
(Township), Centre County, Pennsylvania, or its environs, and that he / she / they, as such Developer(s)  
executed the foregoing instrument for the purpose therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official seal the day and year first above  
written.

\_\_\_\_\_(SEAL)

My office location is: \_\_\_\_\_  
\_\_\_\_\_

My commission expires: \_\_\_\_\_

c:\main\forms\extagr.

**UNIVERSITY AREA JOINT AUTHORITY**

1576 SPRING VALLEY ROAD

STATE COLLEGE, PENNSYLVANIA 16801

814-238-5361

**SEWER EXTENSION AGREEMENT**

**DEP Permit Not Required**

THIS AGREEMENT made and executed on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between the UNIVERSITY AREA JOINT AUTHORITY, a body corporate and politic existing by virtue of the laws of the Commonwealth of Pennsylvania, (hereinafter referred to as "Authority"), and \_\_\_\_\_(hereinafter referred to as "Developer") for .

**W I T N E S S E T H**

WHEREAS, Developer intends and is about to develop a defined tract of land situated in \_\_\_\_\_ Township, County of Centre, Commonwealth of Pennsylvania and requests the Authority furnish sewage service thereto. The tract, the location and dimensions of the street, roads and alleys therein, and the existing structures and those intended to be erected thereon, are designated and described on a plan entitled \_\_\_\_\_ and;

WHEREAS, Developer has made application to the Authority for permission to construct, at its own cost and expense and by its own contractors, a sanitary sewer system within the above designated and described tract of land shown on the plan and to connect same when completed unto the existing sewer system of the Authority. Developer acknowledges that such application has been made after having received information from officials of Authority as to the optional methods by which such construction and connection may be accomplished and the relative costs and expenses thereof under the Rules and Regulations of the Authority, and;

WHEREAS, Developer understands under the provisions of Act No. 40 of 1989 the Department of Environmental Protection, Commonwealth of Pennsylvania is not required to issue a Part II Water

Quality Management Permit for Construction of sanitary sewers which sewers will serve Developer's subdivision(s) by gravity.

NOW, THEREFORE, in consideration of the payments and promises hereinafter made, both parties intending to be legally bound hereby, it is mutually agreed as follows:

1. (a) That Developer, at its own cost and expense, will cause to be prepared, by qualified professional engineering personnel, detailed plans and specifications for the proposed extension to the sewer system of the Authority.

(b) Such plans and specifications shall conform to the requirements of the Authority.

(c) All such plans, specifications, and Authority permit application and supporting data shall be supplied to the Authority in at least three (3) counterparts for use by the Authority, plus such additional number as may be required by any other regulatory body. The permit application shall be prepared by the Developer in the name of the Developer.

(d) The Authority may cause such plans, specifications and permit data to be submitted to the Consulting Engineers then representing the Authority. Such plans, specifications and permit data shall be revised or amended, if necessary, until they are unequivocally approved by the Authority as providing for an extension of a type and nature and so planned and to be constructed as to readily become an integral part of the sewer system of the Authority.

(e) Promptly upon the Authority's approval as aforesaid, and upon compliance by Developer with all applicable local ordinances and regulations, the Authority will issue the required permit and notify the Developer that work may be started.

(f) Developer shall be responsible for compliance with all soil erosion and sedimentation control requirements. All charges, fees and fines in connection with these requirements shall be the Developer's responsibility.

2. Developer shall hire and employ and pay his own contractor or contractors to construct the extension according to the aforesaid approved plans and specifications, and the Authority shall have no responsibility or liability for payment of any part of the costs or expenses arising out of or relating to said



construction or the labor, materials and equipment used therein or thereon or acquiring any right-of-ways and for injury or damage to any persons or property occurring upon or associated with the construction of the project.

3. Developer will not at any time discharge into the Collection System any effluent other than “domestic sewage” (which term is herein defined to mean “sewage” other than “industrial waste,” as those two terms are defined in Section 73.1 of Title 25, Part 1, Subpart C, Article 1, Chapter 73 of the Rules and Regulations of the Department of Environmental Protection of the Commonwealth of Pennsylvania (herein called “DEP”) emanating from the Development without the express written consent of the Authority, which consent shall not be unreasonably withheld or delayed, and without complying with such reasonable conditions as the Authority imposes under its “Rules and Regulations.”

Should the rules, regulations, orders of any governmental body or agency hereafter come into effect which prohibit the Authority from accepting certain types of sewage from the Development, Developer relieves the Authority from any and all responsibility under this Agreement as to the acceptance of such prohibited sewage.

4. Developer agrees to give the Authority ten (10) days written notice of Developer’s intention to begin construction of the extension so that its construction may be properly observed by the Authority. Any work which has begun before the expiration of such ten (10) day period will not be approved, as well as any improperly constructed work, the existence of which the Authority has notified Developer promptly after the observation which has disclosed such improper construction. At all times, the sewer contractor shall keep on the construction site, available to the Authority one (1) copy of the Approved Plans and Specifications, any shop drawings approved by the Authority and the Authority’s current Standard Construction and Material Specifications (herein called “Authority’s Standard Specifications”).

5. During the course of the construction, all materials, workmanship and compliance with the approved plans and specifications shall be subject to the observation and approval of the Authority. Upon completion of the construction and prior to connection of the extension to the sewer system of the Authority, the Authority shall certify the satisfactory completion thereof.

6. Promptly upon completion of the extension, the Developer shall:

(a) Cause to be prepared and furnished to the Authority at the expense of the Developer, five (5) sets of “as-built” drawings of the completed extension project, together with one (1) set of reproducible plans thereof.

(b) Cause to be prepared, executed, acknowledged and delivered to the Authority ready for recording, at the sole expense of the Developer, a deed of dedication for the said entire extension project and conveyance of all pipes, manholes, and all its appurtenances, as well as all rights, liberties and privileges appurtenant thereto including right-of-ways over the streets, road, alleys, and thoroughfares and private lands necessary to the existence of future maintenance thereof. In the event a deed of dedication is not offered to the Authority, the Authority shall be entitled to specific performance of the Agreement and the costs of enforcing the Agreement, including reasonable attorney’s fees, shall be paid by the defaulting party and shall be made a part of the order of the Court in granting specific performance.

(c) Prior to making physical connection between Developer’s extension and the Authority’s sewer system, Developer shall furnish the Authority with a maintenance bond, with corporate surety to cover all maintenance expenses incurred in connection with the extension for the period of eighteen (18) months following acceptance by the Authority of the dedication of such system. The bond shall be in the amount of fifteen percent (15%) of the cost of construction of the extension and shall be in the form approved by the Authority. In lieu of a bond, the Developer may put up a cash escrow or a Letter of Credit, in the amounts as specified above, provided the Letter of Credit is satisfactory to and in a form approved by the Authority.

(d) Prior to the dedication of the streets to the Township, the Developer shall convey unto the Authority, by an instrument in a form approved by the Authority and at the Developer’s cost, an easement for the laying, relaying, maintenance and repair for the sewer lines in the extension at their installed locations in the beds of such streets or across the lands of the Development, or both.

7. Upon receipt and recording of said deed of dedication, the extension project and all parts and appurtenances thereof as above described shall be, become and remain the sole, absolute and permanent property of the Authority free and clear of any lien, obligations or other liability in favor of the Developer, its successors or assigns, its contractor or contractors, its and their laborers, and material men and any of their creditors, or in favor of any other person or corporation, to the same end and effect as if the Authority had constructed the extension project with its own labor and its own expense; and thereafter

the Authority shall maintain, repair, rebuild and otherwise act toward said extension as its own property and at its own cost and expense and Developer shall have no further obligation or responsibility thereto except as hereinafter provided. Nothing herein shall be construed to discharge or dilute the contractual obligations of the contractor or contractors of the Developer to guarantee their workmanship and to maintain their ditches and paving for a certain period of time following completion.

8. Developer agrees to pay all costs incurred by the Authority in the performance of this Agreement, including but not limited to:

(a) The charges of the Authority's Consulting Engineer for review of plans, specifications, shop drawings, and other data related to the sewer extension and for observation of construction.

(b) All fees and charges, if any, paid by the Authority to other regulatory bodies.

(c) The expenses and charges for observation of construction.

(d) All attorney's fees, legal and recording expenses.

Developer further agrees to deposit, from time to time as required by the Authority, such sum of money as is deemed necessary by the Authority to pay the estimated costs which will be incurred by the Authority for a particular phase of the project. Such sum shall be held by the Authority, without interest, for application by the Authority toward payment of the costs incurred by the Authority. Should the sum deposited exceed the actual costs incurred by the Authority, the balance remaining upon completion of that particular phase of the project shall be funded in full to the Developer or held for application toward subsequent phases of the work. Should the sum deposited be insufficient to pay the actual costs incurred by the Authority, Developer shall pay the deficiency to the Authority upon demand and prior to the connection of the extension to the sewer system of the Authority.

9. This Agreement is intended to implement the provisions of the Rules and Regulations adopted by the UNIVERSITY AREA JOINT AUTHORITY for the maintenance and operation of the sewer system and provisions of this Agreement shall at all times be subject to said rules and regulations.

IN WITNESS WHEREOF, the Authority has caused the within Agreement to be executed in its corporate name and its corporate seal to be hereunto affixed, duly attested by its Secretary; and Developer

has caused same to be executed by its duly authorized representatives all on the day and date first above written.

ATTEST:

UNIVERSITY AREA JOINT AUTHORITY

By: \_\_\_\_\_  
Secretary/Assistant Secretary

By: \_\_\_\_\_  
Chair/Vice-Chair

By: \_\_\_\_\_  
Developer

COUNTY OF CENTRE ) SS

IN WITNESS WHEREOF, I hereunto set my hand and notorial seal.

\_\_\_\_\_ (SEAL)

)

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\_\_\_\_\_(SEAL)

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## **Appendix C – Checklist for Design (*and As Built*) Drawings**

### **All Sheets**

1. Name of the Project, Subdivision, and Phase.
2. Name of the Municipality, County, and State.
3. Name of the Collection Authority.
4. Name of the Developer/Permittee.
5. Name of the Engineering firm.
6. Seal and signature of responsible Professional Engineer.
7. Date of Preparation and revision level.
8. Connection Permit Number/Issue Date for existing sewer.
9. Sewer Extension Permit Number and space for Issue Date.
10. Sheet size of 24 inch by 36 inch.

### **Cover Sheet**

1. Key Location Map w/North Arrow
2. PA One-Call Serial Number for Design (*and add Construction for As Built Plans*).
3. List of Plans and sheet references.

### **General Plan Sheet**

1. General Plan of the Project.
2. Subdivision and Phases identified.
3. Lots defined and identified.
4. Street and ROW limits identified.
5. Connection to existing sanitary system labeled.
6. Scaled to use a majority of the sheet.
7. Legend of existing and proposed features.
8. Relevant general and specific project notes.
9. Benchmark reference labeled.
10. Table of Manholes (*with coordinates to be entered for As Built Plans*).
11. (*Reference UAJA Inspector's Field Book No. for As Built Plans*).

### **Plan and Profile Sheets**

1. Plan & Profile Scales:  
1 inch = 50 feet horizontal, and 1 inch = 5 feet vertical  
Scale tolerance of 0.10 inch.  
(20 feet horizontal and 2 feet vertical, with prior approval)
2. Legend of existing and proposed features.
3. Relevant general and specific project notes.
4. Flow Arrows.
5. North Arrow.
6. Benchmark reference labeled (if within plan view).
7. The datum shall be that of the Authority's system.
8. Connection to existing sanitary manhole labeled (if within plan view).
9. Manholes should be numbered starting at the lowest elevation (usually and existing manhole which should be labeled as such) and increasing consecutively to the highest

elevation along the major trunk line. Branches shall be numbered in a like fashion. There shall be no duplication of numbers on the project.

10. Stationing for sewers shall begin at the center of the connecting manhole of the existing sewer and be indicated as 0+00. The stationing shall proceed in 50-foot intervals with exact stationing labeled for manholes, wyes and laterals. The stationing shall continue in a consecutive manner along the sewer and shall end at the center of the terminal manhole at the end of the tributary sewer(s).
11. Identify pipe material type, size and grade for each segment in both Plan and Profile views.
12. Elevations of the top of frame castings, and sewer inverts at manholes shall be shown. There shall be a minimum 0.20-foot difference in elevation between invert in and invert out for every manhole.
13. Profiles to be titled "Manhole Z to Manhole Y", (where MH Z is at the highest elevation and MH Y is at the lowest elevation).
14. Profiles shall present all underground utilities that are within the vertical plane of the sewer, ground profile(s) at the building setback line, and underground utilities located within the permanent ROW (*and the Final Profile over the sewer and at Building set back lines for As Built Plans*).
15. Profiles shall show stationing and manhole information, (including reference to direction), lateral wyes or taps, flow arrows, proposed structure elevations, locations and identifications. All length measurements must be made to the hundredth of a foot.
16. Profiles shall show the top of basement floor elevation for all structures proposed to be served by the sewer.
17. The location of proposed individual laterals shall be shown in both Plan and Profile views. "Wye" and lateral ends shall be stationed along the centerline of the sewer between manholes with a length and distance either left or right from the centerline of the sewer main.
18. A lateral shall be constructed to each lot within a subdivision. The lateral end elevation at the property line shall be indicated on the plans.
19. Lateral Tables to be sized and located to accommodate photocopying.
20. Lateral Tables to be labeled "Manhole Z to Manhole Y" (where MH Z is the furthest/highest elevation, and MH Y is the closest/lowest elevation) and lateral connections to be listed in the same descending order.
21. Lateral tables shall note if all laterals equal or exceed 2.5% slope.
22. Lateral tables shall be formatted as shown below:

Lateral Table - Manhole ____ to Manhole ____										
Lot	Address	Wye Sta.	Wye Inv. Elev.	End Lat. Sta.	End Lat. Elev.	Lat. Length	Lateral Construction Description	Pole Length	North	East
123	1234 STREET ADDRESS	XX+YY.ZZ	XXXX.YY	XX+YY.ZZ	XXXX.YY	XX.X	WYE, 45° or 22°, XX.X' - 6" PIPE, RED, CO, XX.X' - 4 or 6" PIPE, CAP or PLUG.	(for As Built Plans)		
124	"	"	"	"	"	"	"	"	"	"

### **Pump Station Sheets**

1. Pump Stations, if required, are to be designed on a case-by-case basis and require preliminary discussion with Authority staff prior to Design submittal (*and also for As Built Plan submissions*).



## Appendix D – Specifications for Electronic Submission (and checklist)

Within a GIS, there are two types of data, spatial (graphic) and tabular. Graphic data will be extracted from the CADD/GIS file for mains, laterals, and manhole identification codes. Tabular data will be obtained separately in Excel format (.xls) for mains/pipes, manholes, and lateral information.

### FILE REQUIREMENTS FOR CADD DRAWING EXCHANGE FILE (.dwg)

#### **A. General File Specifications**

1. A physical survey is required to obtain acceptable accuracy level. A level of accuracy consistent with that of a GPS (Global Positioning Systems) Survey ( $\pm 1/2$  feet horizontal and vertical) is preferred. Provide GPS data for the following: lateral stakes, and manholes.
2. A geodetic control method must be provided. All plans must be in Pennsylvania State Plane Coordinate System North Zone, using the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD88). Units shall be in US survey feet.
3. All digitally submitted CADD/Shapefiles-(Shapefiles are preferred) files must be spatially correct and the data tables must meet requirements as specified in Section C below.
4. Provide **.tiff** or **.pdf** format images for all sheets in drawing submission as specified in General Sewer Specifications.

#### **B. Spatial Data Layers**

The following data layers are to be provided as a CADD file, independent of the engineering firm's rendition of a completed CADD file. This CADD file should **only** include the following layers.

1. As-Built Sanitary Sewer Pipes
  - a. ☐ Defined layer must exist for all and only mains that are being designed for construction. This excludes existing mains.
  - b. ☐ This layer is named ASB\_PIPE.
  - c. ☐ All lines are drawn in the direction of flow, or from upstream manhole to downstream manhole.
  - d. ☐ Lines must break at each manhole.
  - e. ☐ All lines must have snapped endpoints at the center of each manhole.
2. As-Built Manholes
  - a. ☐ Defined layer must exist for all and only manholes that are being designed for construction. This excludes existing manholes. The manholes point layer must be separate layer from the manhole annotation layer.

- b. ☐ This layer is named ASB\_MH.
- c. ☐ Text with lower-left justification will be snapped to end of mains to create a manhole. The justification point is used in GIS to create a graphic point.
- d. ☐ The text must consist of the manhole-ID.
- e. ☐ The manhole ID is established from a prefix and manhole identification code. Prefixes are logically created based on subdivision name (i.e. Greenleaf Manor). New prefixes must be approved by UAJA in advance to avoid duplication (i.e. 'GM-22' may become 'GLM-22' if prefix 'GM' already exists in UAJA's system). If new development occurs in an existing subdivision, then communication with UAJA is necessary to ensure unique manhole IDs.

### 3. As-Built Laterals

- a. ☐ Defined layer must exist for all and only laterals that are being designed for construction. This excludes existing laterals.
- b. ☐ This layer is ASB\_LAT.
- c. ☐ All lines are extended to/trimmed by the main from which it connects.
- d. ☐ All lines are drawn in the direction of flow, or from upstream endpoint to downstream connection to main.
- e. ☐ Every lateral must have a lower-left justified number snapped to the upstream endpoint that corresponds with the database information for that lateral. This number must also exist in the laterals database. This is essential to link the graphics with the database information.

### 4. Proposed Centerlines

- a. ☐ Defined layer must exist for all proposed street centerlines being designed for construction.
- b. ☐ This layer is named ASB\_CL.

### 5. Proposed Pavement Edges

- a. ☐ Defined layer must exist for all proposed edges of pavement being designed for construction.
- b. ☐ This layer is named ASB\_PVMT.

### 6. Existing Sanitary Sewer Pipes

- a. ☐ Defined layer must exist for all and only mains that are existing.
- b. ☐ This layer is named EX\_PIPE.

### 7. Existing Laterals

- a. ☐ Defined layer must exist for all and only laterals that are existing.
- b. ☐ This layer is named EX\_LAT.

### 8. Existing Manholes

- a. ☐ Defined layer must exist for all and only manholes that are existing.
- b. ☐ This layer is named EX\_MH.

## 9. All Other Spatial Data

- a. ☐ Data layers including utility services, existing street centerlines, existing pavement, existing curbs, existing buildings, streams, and existing property lines may and should be included in the CADD file. These layers may include corresponding text layers (i.e. road names).

## **C. Tabular Data**

Template data tables will be provided in spreadsheet form. UAJA will supply the correct Microsoft Excel (.xls) tables file, which contains individual spreadsheets for main line, manhole, and lateral data. Required data field headers are in **BOLD** print. This file, along with other files related to electronic submission, may be downloaded from our website ([www.ujja.com](http://www.ujja.com)).

### 1. As-Built Sanitary Sewer Pipes

- a. ☐ The following data fields must exist in the pipe/main table: UPMH, DNMH, RECLENGTH, DIAMETER, MATERIAL, SLOPE, UPELEV, DNELEV.
- b. ☐ Each data field must contain valid information for each main.

### 2. As-Built Manholes

- a. ☐ The following data fields must exist in a separate manhole table: MH\_ID, Y (north GPS), X (east GPS), Z (vertical GPS), TC\_ELEV, CLEANOUT, VENTPIPE, FLUSH, FLAPPERGATE, DISH, and PUMPSTA.
- b. ☐ Each data field must contain valid information for each manhole.

### 3. As-Built Laterals

- a. ☐ The following data fields must exist in the lateral table: ADDRESS, LOT\_UNIT, WYE\_STA, WYE\_INV, END\_LAT\_ST, END\_LAT\_INV, LATERAL\_LENGTH, WYE\_INFO (lateral description), Y (north GPS), X (east GPS), Z (vertical GPS), POLELENGTH, DEPTH, and REDUCER.
- b. ☐ Each data field must contain valid information for each lateral.

## **FILE REQUIREMENTS FOR GIS SHAPEFILE (.shp)**

### **A. General File Specifications**

1. A physical survey is required to obtain acceptable accuracy level. A level of accuracy consistent with that of a GPS (Global Positioning Systems) Survey ( $\pm 1/2$  feet horizontal and vertical) is preferred. Must provide any available GPS data.
2. A geodetic control method must be provided. All plans must be in Pennsylvania State Plane Coordinate System North Zone, using the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD88). Units shall be in US survey feet.

3. All digitally submitted Shapefiles must be spatially correct and the data tables must meet requirements as specified in Section C below.
4. Provide **.tiff** or **.pdf** format images for all sheets in drawing submission as specified in General Sewer Specifications.

## **B. Spatial Data Layers**

The following data layers are to be provided as a CADD file, independent of the engineering firm's rendition of a completed CADD file. This CADD file should **only** include the following layers.

1. Pipe, manhole, and lateral data layers shall be included with each submittal.
2. Each layer must contain all and only the data for that particular layer.
3. Files must be named so that "main", "lat", or "mh" is at the end of the file name and before the file extension. Examples: GLManormain.shp, GLManorlat.shp, GLManormh.shp.

## **C. Tabular Data**

Template data tables will be provided in spreadsheet form. UAJA will supply the correct Microsoft Excel (.xls) tables file, which contains individual spreadsheets for main line, manhole, and lateral data. Data headers in these tables, and their ordering, must be used as the example for how the data in the shapefile will be organized. This file, along with other files related to electronic submission, may be downloaded from our website ([www.ujaja.com](http://www.ujaja.com)).

1. Corresponding database files (shapefile .dbf) must contain the same structure and exact header names as the template data tables.
2. Each applicable data field must contain valid information for each feature.

UAJA - Summary of Development Review Process		
Item	Element	Schedule
1	Developer submits a request for planning/service that includes a development Sketch Plan, Request for Capacity letter, and draft Planning documents (planning module or exemption).	UAJA will respond within five (5) business days.
2	Developer submits the draft Design along with an executed Extension Agreement (Appendix B or C), and Water Quality Management (WQM) permit (UAJA or DEP).	UAJA forwards the DEP WQM permit application within three (3) business days. Review time by DEP can be as long as 90 calendar days and is not subject to UAJA control.  UAJA and the Engineer will provide initial comments on the Design within five (5) business days.
3	UAJA and the Engineer complete the Design plan review in an iterative process with the Developer's Engineer.	Time TBD depending on size and quality of the submission (conformance to UAJA requirements).
4	When the Design, Agreement and WQM permit are accepted, the Development will be recommended for Board approval at the next available meeting.	
5	Following Board approval of the Development, UAJA staff will be available to consult with the Developer to review inspection requirements, specifications, and construction schedule.	Time TBD by Developer.
7	Developer constructs coordinating inspections with UAJA.	Time TBD depending on technical complexity and field issues.
8	Developer submits the draft As-Built plans for review, and when acceptable, the electronic files.	UAJA and the Engineer will provide initial comments on the As-Built plans within five (5) business days.
9	When the As-Built Plans are accepted and the Electronic files have been provided and placed into UAJA GIS, connections will be allowed.	Following submission, the electronic files will be processed within five (5) business days.

**UNIVERSITY AREA JOINT AUTHORITY  
1576 SPRING VALLEY ROAD  
STATE COLLEGE, PENNSYLVANIA 16801  
814-238-5361**

**SEWER EXTENSION AGREEMENT**

**DEP Permit Required**

**THIS AGREEMENT made and executed on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between the UNIVERSITY AREA JOINT AUTHORITY, a body corporate and politic existing by virtue of the laws of the Commonwealth of Pennsylvania, (hereinafter referred to as “Authority”), and \_\_\_\_\_ hereinafter referred to as “Developer”).**

**W I T N E S S E T H**

**WHEREAS, Developer intends and is about to develop a defined tract of land situated in \_\_\_\_\_ Township, County of Centre, Commonwealth of Pennsylvania and requests the Authority furnish sewage service thereto. The tract, the location and dimensions of the street, roads and alleys therein, and the existing structures and those intended to be erected thereon, are designated and described on a plan entitled ‘ \_\_\_\_\_ ’ and;**

**WHEREAS, Developer has made application to the Authority for permission to construct, at its own cost and expense and by its own contractors, a sanitary sewer system within the above designated and described tract of land shown on the plan and to connect same when completed unto the existing sewer system of the Authority. Developer acknowledges that such application has been made after having received information from officials of Authority as to the optional methods by which such construction and connection may be accomplished and the relative costs and expenses thereof under the Rules and Regulations of the Authority.**

**NOW, THEREFORE, in consideration of the payments and promises hereinafter made, both parties intending to be legally bound hereby, it is mutually agreed as follows:**

- 1. (a) That Developer, at its own cost and expense, will cause to be prepared, by qualified professional engineering personnel, detailed plans and specifications for the proposed extension to the sewer system of the Authority**

- (b) Such plans and specifications shall conform to the requirements of the Authority
- (c) All such plans, specifications, and Pennsylvania Department of Environmental Protection (DEP) permit application and supporting data shall be supplied to the Authority in at least three (3) counterparts for use by the Authority, plus such additional number as may be required by DEP and other regulatory bodies. The DEP permit application shall be prepared by the Developer in the name of the Authority.
- (d) The Authority may cause such plans, specifications and permit data to be submitted to the Consulting Engineers then representing the Authority. Such plans, specifications and permit data shall be revised or amended, if necessary, until they are unequivocally approved by the Authority as providing for an extension of a type and nature and so planned and to be constructed as to readily become an integral part of the sewer system of the Authority.
- (e) Promptly upon the Authority's approval as aforesaid, the approved plans, specifications and permit data will be submitted by the Authority to DEP requesting approval thereof and the issuance of a Water Quality Management Permit. Upon receipt of said permit and upon compliance by Developer with all applicable local ordinances and regulations, the Authority will notify the Developer that work may be started.
- (f) Developer shall be responsible for compliance with all DEP soil erosion and sedimentation control requirements. All charges, fees and fines in connection with these requirements shall be the Developer's responsibility.

2. Developer shall hire and employ and pay his own contractor or contractors to construct the extension according to the aforesaid approved plans and specifications, and the Authority shall have no responsibility or liability for payment of any part of the costs or expenses arising out of or relating to said construction or the labor, materials and equipment used therein or thereon or acquiring any right-of-ways and for injury or damage to any persons or property occurring upon or associated with the construction of the project.

3. Developer will not at any time discharge into the Collection System any effluent other than "domestic sewage" (which term is herein defined to mean "sewage" other than "industrial waste," as those two terms are defined in Section 73.1 of Title 25, Part 1, Subpart C, Article 1, Chapter 73 of the Rules and Regulations of the Department of Environmental Protection of the Commonwealth of Pennsylvania (herein

called “DEP”) emanating from the Development without the express written consent of the Authority, which consent shall not be unreasonably withheld or delayed, and without complying with such reasonable conditions as the Authority imposes under its “Rules and Regulations.”

Should the rules, regulations, orders of any governmental body or agency hereafter come into effect which prohibit the Authority from accepting certain types of sewage from the Development, Developer relieves the Authority from any and all responsibility under this Agreement as to the acceptance of such prohibited sewage.

4. Developer agrees to give the Authority ten (10) days written notice of Developer’s intention to begin construction of the extension so that its construction may be properly observed by the Authority. Any work, which has begun before the expiration of such ten- (10) day period will not be approved, as well as any improperly constructed work, the existence of which the Authority has notified Developer promptly after the observation, which has disclosed such improper construction. At all times, the sewer contractor shall keep on the construction site, available to the Authority one (1) copy of the Approved Plans and Specifications, any shop drawings approved by the Authority and the Authority’s current Standard Construction and Material Specifications (herein called “Authority’s Standard Specifications”).

5. During the course of the construction, all materials, workmanship and compliance with the approved plans and specifications shall be subject to the observation and approval of the Authority. Upon completion of the construction and prior to connection of the extension to the sewer system of the Authority, the Authority shall certify the satisfactory completion thereof.

6. Promptly upon completion of the extension, the Developer shall:

- (a) Cause to be prepared and furnished to the Authority at the expense of the Developer, two (2) sets of “Provisional As-Built” drawings of the completed extension project along with a cash deposit into an escrow account to cover all necessary engineering fees the Authority may have to incur to satisfactorily complete the “Provisional As-Built” to final As-Built content. Once the “Provisional As-Built” drawings have been approved, the Developer shall furnish at the expense of the Developer (2) two sets of “As-Built” drawings of the completed extension project, together with one (1) set of reproducible plans thereof.
- (b) Cause to be prepared, executed, acknowledged and delivered to the Authority ready for recording, at the sole expense of the Developer, a deed of dedication for the said entire extension project and conveyance of all pipes, manholes, and all its appurtenances, as well



as all rights, liberties and privileges appurtenant thereto including right-of-ways over the streets, road, alleys, and thoroughfares and private lands necessary to the existence of future maintenance thereof. In the event a deed of dedication is not offered to the Authority, the Authority shall be entitled to specific performance of the Agreement and the costs of enforcing the Agreement, including reasonable attorney's fees, shall be paid by the defaulting party and shall be made a part of the order of the Court in granting specific performance.

- (c) Prior to making physical connection between Developer's extension and the Authority's sewer system, Developer shall furnish the Authority with a maintenance bond, with corporate surety to cover all maintenance expenses incurred in connection with the extension for the period of eighteen (18) months following acceptance by the Authority of the dedication of such system. The bond shall be in the amount of fifteen percent (15%) of the cost of construction of the extension and shall be in the form approved by the Authority. In lieu of a bond, the Developer may put up a cash escrow or a Letter of Credit, in the amounts as specified above, provided the Letter of Credit is satisfactory to and in a form approved by the Authority.
- (d) Prior to the dedication of the streets to the Township, the Developer shall convey unto the Authority, by an instrument in a form approved by the Authority and at the Developer's cost, an easement for the laying, relaying, maintenance and repair for the sewer lines in the extension at their installed locations in the beds of such streets or across the lands of the Development, or both.

7. Upon receipt and recording of said deed of dedication, the extension project and all parts and appurtenances thereof as above described shall be, become and remain the sole, absolute and permanent property of the Authority free and clear of any lien, obligations or other liability in favor of the Developer, its successors or assigns, its contractor or contractors, its and their laborers, and material men and any of their creditors, or in favor of any other person or corporation, to the same end and effect as if the Authority had constructed the extension project with its own labor and its own expense; and thereafter the Authority shall maintain, repair, rebuild and otherwise act toward said extension as its own property and at its own cost and expense and Developer shall have no further obligation or responsibility thereto except as hereinafter provided. Nothing herein shall be construed to discharge or dilute the contractual obligations of the contractor or contractors of the Developer to guarantee their workmanship and to maintain their ditches and paving for a certain period of time following completion.

8. Developer agrees to pay all costs incurred by the Authority in the performance of this Agreement, including but not limited to:

- (a) The charges of the Authority's Consulting Engineer for review of plans, specifications, shop drawings, and other data related to the sewer extension and for observation of construction.
- (b) All fees and charges, if any, paid by the Authority to DEP or other regulatory bodies.
- (c) The expenses and charges for observation of construction.
- (d) All attorneys' fees, legal and recording expenses.

Developer further agrees to deposit, from time to time as required by the Authority, such sum of money as is deemed necessary by the Authority to pay the estimated costs, which will be incurred by the Authority for a particular phase of the project. Such sum shall be held by the Authority, without interest, for application by the Authority toward payment of the costs incurred by the Authority. Should the sum deposited exceed the actual costs incurred by the Authority, the balance remaining upon completion of that particular phase of the project shall be funded in full to the Developer or held for application toward subsequent phases of the work. Should the sum deposited be insufficient to pay the actual costs incurred by the Authority, Developer shall pay the deficiency to the Authority upon demand and prior to the connection of the extension to the sewer system of the Authority.

9. This Agreement is intended to implement the provisions of the Rules and Regulations adopted by the UNIVERSITY AREA JOINT AUTHORITY for the maintenance and operation of the sewer system and provisions of this Agreement shall at all times be subject to said rules and regulations.

IN WITNESS WHEREOF, the Authority has caused the within Agreement to be executed in its corporate name and its corporate seal to be hereunto affixed, duly attested by its Secretary; and Developer has caused same to be executed by its duly authorized representatives all on the day and date first above written.

ATTEST:

UNIVERSITY AREA JOINT AUTHORITY

By: \_\_\_\_\_

Secretary/Assistant Secretary

By: \_\_\_\_\_

Chair/Vice-Chair

By: \_\_\_\_\_

Developer

STATE OF PENNSYLVANIA )

) SS

COUNTY OF CENTRE )

On this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me, a Notary Public in and for the Commonwealth of Pennsylvania personally appeared \_\_\_\_\_, who acknowledged himself to be the \_\_\_\_\_ of the University Area Joint Authority, a body politic and corporate, and that he as such an officer, being authorized to do so executed the foregoing instrument for the purposes therein contained by signing the name of said University Area Joint Authority by himself as such officer.

IN WITNESS WHEREOF, I hereunto set my hand and notorial seal.

\_\_\_\_\_ (SEAL)

COMMONWEALTH OF PENNSYLVANIA     )

)

COUNTY OF CENTRE                     )

On this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, before me,  
a Notary Public in and for the Commonwealth of Pennsylvania, personally appeared -  
\_\_\_\_\_, known to me (or satisfactorily proven) to be the person(s)  
whose name(s) is/are subscribed to the within instrument and acknowledged himself / herself / themselves to  
the Developer(s) of the real estate described in the foregoing instrument in \_\_\_\_\_  
(Township), Centre County, Pennsylvania, or its environs, and that he / she / they, as such Developer(s)  
executed the foregoing instrument for the purpose therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official seal the day and year first above  
written.

\_\_\_\_\_(SEAL)

My office location is: \_\_\_\_\_  
\_\_\_\_\_

My commission expires: \_\_\_\_\_

c:\main\forms\extagr.

**UNIVERSITY AREA JOINT AUTHORITY**

1576 SPRING VALLEY ROAD

STATE COLLEGE, PENNSYLVANIA 16801

814-238-5361

**SEWER EXTENSION AGREEMENT**

**DEP Permit Not Required**

THIS AGREEMENT made and executed on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between the UNIVERSITY AREA JOINT AUTHORITY, a body corporate and politic existing by virtue of the laws of the Commonwealth of Pennsylvania, (hereinafter referred to as "Authority"), and \_\_\_\_\_(hereinafter referred to as "Developer") for .

**W I T N E S S E T H**

WHEREAS, Developer intends and is about to develop a defined tract of land situated in \_\_\_\_\_ Township, County of Centre, Commonwealth of Pennsylvania and requests the Authority furnish sewage service thereto. The tract, the location and dimensions of the street, roads and alleys therein, and the existing structures and those intended to be erected thereon, are designated and described on a plan entitled \_\_\_\_\_ and;

WHEREAS, Developer has made application to the Authority for permission to construct, at its own cost and expense and by its own contractors, a sanitary sewer system within the above designated and described tract of land shown on the plan and to connect same when completed unto the existing sewer system of the Authority. Developer acknowledges that such application has been made after having received information from officials of Authority as to the optional methods by which such construction and connection may be accomplished and the relative costs and expenses thereof under the Rules and Regulations of the Authority, and;

WHEREAS, Developer understands under the provisions of Act No. 40 of 1989 the Department of Environmental Protection, Commonwealth of Pennsylvania is not required to issue a Part II Water

Quality Management Permit for Construction of sanitary sewers which sewers will serve Developer's subdivision(s) by gravity.

NOW, THEREFORE, in consideration of the payments and promises hereinafter made, both parties intending to be legally bound hereby, it is mutually agreed as follows:

1. (a) That Developer, at its own cost and expense, will cause to be prepared, by qualified professional engineering personnel, detailed plans and specifications for the proposed extension to the sewer system of the Authority.

(b) Such plans and specifications shall conform to the requirements of the Authority.

(c) All such plans, specifications, and Authority permit application and supporting data shall be supplied to the Authority in at least three (3) counterparts for use by the Authority, plus such additional number as may be required by any other regulatory body. The permit application shall be prepared by the Developer in the name of the Developer.

(d) The Authority may cause such plans, specifications and permit data to be submitted to the Consulting Engineers then representing the Authority. Such plans, specifications and permit data shall be revised or amended, if necessary, until they are unequivocally approved by the Authority as providing for an extension of a type and nature and so planned and to be constructed as to readily become an integral part of the sewer system of the Authority.

(e) Promptly upon the Authority's approval as aforesaid, and upon compliance by Developer with all applicable local ordinances and regulations, the Authority will issue the required permit and notify the Developer that work may be started.

(f) Developer shall be responsible for compliance with all soil erosion and sedimentation control requirements. All charges, fees and fines in connection with these requirements shall be the Developer's responsibility.

2. Developer shall hire and employ and pay his own contractor or contractors to construct the extension according to the aforesaid approved plans and specifications, and the Authority shall have no responsibility or liability for payment of any part of the costs or expenses arising out of or relating to said

construction or the labor, materials and equipment used therein or thereon or acquiring any right-of-ways and for injury or damage to any persons or property occurring upon or associated with the construction of the project.

3. Developer will not at any time discharge into the Collection System any effluent other than “domestic sewage” (which term is herein defined to mean “sewage” other than “industrial waste,” as those two terms are defined in Section 73.1 of Title 25, Part 1, Subpart C, Article 1, Chapter 73 of the Rules and Regulations of the Department of Environmental Protection of the Commonwealth of Pennsylvania (herein called “DEP”) emanating from the Development without the express written consent of the Authority, which consent shall not be unreasonably withheld or delayed, and without complying with such reasonable conditions as the Authority imposes under its “Rules and Regulations.”

Should the rules, regulations, orders of any governmental body or agency hereafter come into effect which prohibit the Authority from accepting certain types of sewage from the Development, Developer relieves the Authority from any and all responsibility under this Agreement as to the acceptance of such prohibited sewage.

4. Developer agrees to give the Authority ten (10) days written notice of Developer’s intention to begin construction of the extension so that its construction may be properly observed by the Authority. Any work which has begun before the expiration of such ten (10) day period will not be approved, as well as any improperly constructed work, the existence of which the Authority has notified Developer promptly after the observation which has disclosed such improper construction. At all times, the sewer contractor shall keep on the construction site, available to the Authority one (1) copy of the Approved Plans and Specifications, any shop drawings approved by the Authority and the Authority’s current Standard Construction and Material Specifications (herein called “Authority’s Standard Specifications”).

5. During the course of the construction, all materials, workmanship and compliance with the approved plans and specifications shall be subject to the observation and approval of the Authority. Upon completion of the construction and prior to connection of the extension to the sewer system of the Authority, the Authority shall certify the satisfactory completion thereof.

6. Promptly upon completion of the extension, the Developer shall:

(a) Cause to be prepared and furnished to the Authority at the expense of the Developer, five (5) sets of “as-built” drawings of the completed extension project, together with one (1) set of reproducible plans thereof.

(b) Cause to be prepared, executed, acknowledged and delivered to the Authority ready for recording, at the sole expense of the Developer, a deed of dedication for the said entire extension project and conveyance of all pipes, manholes, and all its appurtenances, as well as all rights, liberties and privileges appurtenant thereto including right-of-ways over the streets, road, alleys, and thoroughfares and private lands necessary to the existence of future maintenance thereof. In the event a deed of dedication is not offered to the Authority, the Authority shall be entitled to specific performance of the Agreement and the costs of enforcing the Agreement, including reasonable attorney’s fees, shall be paid by the defaulting party and shall be made a part of the order of the Court in granting specific performance.

(c) Prior to making physical connection between Developer’s extension and the Authority’s sewer system, Developer shall furnish the Authority with a maintenance bond, with corporate surety to cover all maintenance expenses incurred in connection with the extension for the period of eighteen (18) months following acceptance by the Authority of the dedication of such system. The bond shall be in the amount of fifteen percent (15%) of the cost of construction of the extension and shall be in the form approved by the Authority. In lieu of a bond, the Developer may put up a cash escrow or a Letter of Credit, in the amounts as specified above, provided the Letter of Credit is satisfactory to and in a form approved by the Authority.

(d) Prior to the dedication of the streets to the Township, the Developer shall convey unto the Authority, by an instrument in a form approved by the Authority and at the Developer’s cost, an easement for the laying, relaying, maintenance and repair for the sewer lines in the extension at their installed locations in the beds of such streets or across the lands of the Development, or both.

7. Upon receipt and recording of said deed of dedication, the extension project and all parts and appurtenances thereof as above described shall be, become and remain the sole, absolute and permanent property of the Authority free and clear of any lien, obligations or other liability in favor of the Developer, its successors or assigns, its contractor or contractors, its and their laborers, and material men and any of their creditors, or in favor of any other person or corporation, to the same end and effect as if the Authority had constructed the extension project with its own labor and its own expense; and thereafter



the Authority shall maintain, repair, rebuild and otherwise act toward said extension as its own property and at its own cost and expense and Developer shall have no further obligation or responsibility thereto except as hereinafter provided. Nothing herein shall be construed to discharge or dilute the contractual obligations of the contractor or contractors of the Developer to guarantee their workmanship and to maintain their ditches and paving for a certain period of time following completion.

8. Developer agrees to pay all costs incurred by the Authority in the performance of this Agreement, including but not limited to:

(a) The charges of the Authority's Consulting Engineer for review of plans, specifications, shop drawings, and other data related to the sewer extension and for observation of construction.

(b) All fees and charges, if any, paid by the Authority to other regulatory bodies.

(c) The expenses and charges for observation of construction.

(d) All attorney's fees, legal and recording expenses.

Developer further agrees to deposit, from time to time as required by the Authority, such sum of money as is deemed necessary by the Authority to pay the estimated costs which will be incurred by the Authority for a particular phase of the project. Such sum shall be held by the Authority, without interest, for application by the Authority toward payment of the costs incurred by the Authority. Should the sum deposited exceed the actual costs incurred by the Authority, the balance remaining upon completion of that particular phase of the project shall be funded in full to the Developer or held for application toward subsequent phases of the work. Should the sum deposited be insufficient to pay the actual costs incurred by the Authority, Developer shall pay the deficiency to the Authority upon demand and prior to the connection of the extension to the sewer system of the Authority.

9. This Agreement is intended to implement the provisions of the Rules and Regulations adopted by the UNIVERSITY AREA JOINT AUTHORITY for the maintenance and operation of the sewer system and provisions of this Agreement shall at all times be subject to said rules and regulations.

IN WITNESS WHEREOF, the Authority has caused the within Agreement to be executed in its corporate name and its corporate seal to be hereunto affixed, duly attested by its Secretary; and Developer

has caused same to be executed by its duly authorized representatives all on the day and date first above written.

ATTEST:

UNIVERSITY AREA JOINT AUTHORITY

By: \_\_\_\_\_  
Secretary/Assistant Secretary

By: \_\_\_\_\_  
Chair/Vice-Chair

By: \_\_\_\_\_  
Developer

COUNTY OF CENTRE ) SS

IN WITNESS WHEREOF, I hereunto set my hand and notorial seal.

\_\_\_\_\_ (SEAL)

COUNTY OF CENTRE

IN WITNESS WHEREOF, I hereunto set my hand and official seal the day and year first above written.

\_\_\_\_\_(SEAL)

My office location is: \_\_\_\_\_

My commission expires: \_\_\_\_\_

## **Appendix C – Checklist for Design (*and As Built*) Drawings**

### **All Sheets**

1. Name of the Project, Subdivision, and Phase.
2. Name of the Municipality, County, and State.
3. Name of the Collection Authority.
4. Name of the Developer/Permittee.
5. Name of the Engineering firm.
6. Seal and signature of responsible Professional Engineer.
7. Date of Preparation and revision level.
8. Connection Permit Number/Issue Date for existing sewer.
9. Sewer Extension Permit Number and space for Issue Date.
10. Sheet size of 24 inch by 36 inch.

### **Cover Sheet**

1. Key Location Map w/North Arrow
2. PA One-Call Serial Number for Design (*and add Construction for As Built Plans*).
3. List of Plans and sheet references.

### **General Plan Sheet**

1. General Plan of the Project.
2. Subdivision and Phases identified.
3. Lots defined and identified.
4. Street and ROW limits identified.
5. Connection to existing sanitary system labeled.
6. Scaled to use a majority of the sheet.
7. Legend of existing and proposed features.
8. Relevant general and specific project notes.
9. Benchmark reference labeled.
10. Table of Manholes (*with coordinates to be entered for As Built Plans*).
11. (*Reference UAJA Inspector's Field Book No. for As Built Plans*).

### **Plan and Profile Sheets**

1. Plan & Profile Scales:  
1 inch = 50 feet horizontal, and 1 inch = 5 feet vertical  
Scale tolerance of 0.10 inch.  
(20 feet horizontal and 2 feet vertical, with prior approval)
2. Legend of existing and proposed features.
3. Relevant general and specific project notes.
4. Flow Arrows.
5. North Arrow.
6. Benchmark reference labeled (if within plan view).
7. The datum shall be that of the Authority's system.
8. Connection to existing sanitary manhole labeled (if within plan view).
9. Manholes should be numbered starting at the lowest elevation (usually and existing manhole which should be labeled as such) and increasing consecutively to the highest

elevation along the major trunk line. Branches shall be numbered in a like fashion. There shall be no duplication of numbers on the project.

10. Stationing for sewers shall begin at the center of the connecting manhole of the existing sewer and be indicated as 0+00. The stationing shall proceed in 50-foot intervals with exact stationing labeled for manholes, wyes and laterals. The stationing shall continue in a consecutive manner along the sewer and shall end at the center of the terminal manhole at the end of the tributary sewer(s).
11. Identify pipe material type, size and grade for each segment in both Plan and Profile views.
12. Elevations of the top of frame castings, and sewer inverts at manholes shall be shown. There shall be a minimum 0.20-foot difference in elevation between invert in and invert out for every manhole.
13. Profiles to be titled "Manhole Z to Manhole Y", (where MH Z is at the highest elevation and MH Y is at the lowest elevation).
14. Profiles shall present all underground utilities that are within the vertical plane of the sewer, ground profile(s) at the building setback line, and underground utilities located within the permanent ROW (*and the Final Profile over the sewer and at Building set back lines for As Built Plans*).
15. Profiles shall show stationing and manhole information, (including reference to direction), lateral wyes or taps, flow arrows, proposed structure elevations, locations and identifications. All length measurements must be made to the hundredth of a foot.
16. Profiles shall show the top of basement floor elevation for all structures proposed to be served by the sewer.
17. The location of proposed individual laterals shall be shown in both Plan and Profile views. "Wye" and lateral ends shall be stationed along the centerline of the sewer between manholes with a length and distance either left or right from the centerline of the sewer main.
18. A lateral shall be constructed to each lot within a subdivision. The lateral end elevation at the property line shall be indicated on the plans.
19. Lateral Tables to be sized and located to accommodate photocopying.
20. Lateral Tables to be labeled "Manhole Z to Manhole Y" (where MH Z is the furthest/highest elevation, and MH Y is the closest/lowest elevation) and lateral connections to be listed in the same descending order.
21. Lateral tables shall note if all laterals equal or exceed 2.5% slope.
22. Lateral tables shall be formatted as shown below:

Lateral Table - Manhole ____ to Manhole ____										
Lot	Address	Wye Sta.	Wye Inv. Elev.	End Lat. Sta.	End Lat. Elev.	Lat. Length	Lateral Construction Description	Pole Length	North	East
123	1234 STREET ADDRESS	XX+YY.ZZ	XXXX.YY	XX+YY.ZZ	XXXX.YY	XX.X	WYE, 45° or 22°, XX.X' - 6" PIPE, RED, CO, XX.X' - 4 or 6" PIPE, CAP or PLUG.	(for As Built Plans)		
124	"	"	"	"	"	"	"	"	"	"

### **Pump Station Sheets**

1. Pump Stations, if required, are to be designed on a case-by-case basis and require preliminary discussion with Authority staff prior to Design submittal (*and also for As Built Plan submissions*).

## Appendix D – Specifications for Electronic Submission (and checklist)

Within a GIS, there are two types of data, spatial (graphic) and tabular. Graphic data will be extracted from the CADD/GIS file for mains, laterals, and manhole identification codes. Tabular data will be obtained separately in Excel format (.xls) for mains/pipes, manholes, and lateral information.

### FILE REQUIREMENTS FOR CADD DRAWING EXCHANGE FILE (.dwg)

#### **A. General File Specifications**

1. A physical survey is required to obtain acceptable accuracy level. A level of accuracy consistent with that of a GPS (Global Positioning Systems) Survey ( $\pm 1/2$  feet horizontal and vertical) is preferred. Provide GPS data for the following: lateral stakes, and manholes.
2. A geodetic control method must be provided. All plans must be in Pennsylvania State Plane Coordinate System North Zone, using the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD88). Units shall be in US survey feet.
3. All digitally submitted CADD/Shapefiles-(Shapefiles are preferred) files must be spatially correct and the data tables must meet requirements as specified in Section C below.
4. Provide **.tiff** or **.pdf** format images for all sheets in drawing submission as specified in General Sewer Specifications.

#### **B. Spatial Data Layers**

The following data layers are to be provided as a CADD file, independent of the engineering firm's rendition of a completed CADD file. This CADD file should **only** include the following layers.

1. As-Built Sanitary Sewer Pipes
  - a. ☐ Defined layer must exist for all and only mains that are being designed for construction. This excludes existing mains.
  - b. ☐ This layer is named ASB\_PIPE.
  - c. ☐ All lines are drawn in the direction of flow, or from upstream manhole to downstream manhole.
  - d. ☐ Lines must break at each manhole.
  - e. ☐ All lines must have snapped endpoints at the center of each manhole.
2. As-Built Manholes
  - a. ☐ Defined layer must exist for all and only manholes that are being designed for construction. This excludes existing manholes. The manholes point layer must be separate layer from the manhole annotation layer.

- b. ☐ This layer is named ASB\_MH.
- c. ☐ Text with lower-left justification will be snapped to end of mains to create a manhole. The justification point is used in GIS to create a graphic point.
- d. ☐ The text must consist of the manhole-ID.
- e. ☐ The manhole ID is established from a prefix and manhole identification code. Prefixes are logically created based on subdivision name (i.e. Greenleaf Manor). New prefixes must be approved by UAJA in advance to avoid duplication (i.e. 'GM-22' may become 'GLM-22' if prefix 'GM' already exists in UAJA's system). If new development occurs in an existing subdivision, then communication with UAJA is necessary to ensure unique manhole IDs.

### 3. As-Built Laterals

- a. ☐ Defined layer must exist for all and only laterals that are being designed for construction. This excludes existing laterals.
- b. ☐ This layer is ASB\_LAT.
- c. ☐ All lines are extended to/trimmed by the main from which it connects.
- d. ☐ All lines are drawn in the direction of flow, or from upstream endpoint to downstream connection to main.
- e. ☐ Every lateral must have a lower-left justified number snapped to the upstream endpoint that corresponds with the database information for that lateral. This number must also exist in the laterals database. This is essential to link the graphics with the database information.

### 4. Proposed Centerlines

- a. ☐ Defined layer must exist for all proposed street centerlines being designed for construction.
- b. ☐ This layer is named ASB\_CL.

### 5. Proposed Pavement Edges

- a. ☐ Defined layer must exist for all proposed edges of pavement being designed for construction.
- b. ☐ This layer is named ASB\_PVMT.

### 6. Existing Sanitary Sewer Pipes

- a. ☐ Defined layer must exist for all and only mains that are existing.
- b. ☐ This layer is named EX\_PIPE.

### 7. Existing Laterals

- a. ☐ Defined layer must exist for all and only laterals that are existing.
- b. ☐ This layer is named EX\_LAT.

### 8. Existing Manholes

- a. ☐ Defined layer must exist for all and only manholes that are existing.
- b. ☐ This layer is named EX\_MH.



## 9. All Other Spatial Data

- a. ☐ Data layers including utility services, existing street centerlines, existing pavement, existing curbs, existing buildings, streams, and existing property lines may and should be included in the CADD file. These layers may include corresponding text layers (i.e. road names).

### **C. Tabular Data**

Template data tables will be provided in spreadsheet form. UAJA will supply the correct Microsoft Excel (.xls) tables file, which contains individual spreadsheets for main line, manhole, and lateral data. Required data field headers are in **BOLD** print. This file, along with other files related to electronic submission, may be downloaded from our website ([www.ujja.com](http://www.ujja.com)).

#### 1. As-Built Sanitary Sewer Pipes

- a. ☐ The following data fields must exist in the pipe/main table: UPMH, DNMH, RECLENGTH, DIAMETER, MATERIAL, SLOPE, UPELEV, DNELEV.
- b. ☐ Each data field must contain valid information for each main.

#### 2. As-Built Manholes

- a. ☐ The following data fields must exist in a separate manhole table: MH\_ID, Y (north GPS), X (east GPS), Z (vertical GPS), TC\_ELEV, CLEANOUT, VENTPIPE, FLUSH, FLAPPERGATE, DISH, and PUMPSTA.
- b. ☐ Each data field must contain valid information for each manhole.

#### 3. As-Built Laterals

- a. ☐ The following data fields must exist in the lateral table: ADDRESS, LOT\_UNIT, WYE\_STA, WYE\_INV, END\_LAT\_ST, END\_LAT\_INV, LATERAL\_LENGTH, WYE\_INFO (lateral description), Y (north GPS), X (east GPS), Z (vertical GPS), POLELENGTH, DEPTH, and REDUCER.
- b. ☐ Each data field must contain valid information for each lateral.

## **FILE REQUIREMENTS FOR GIS SHAPEFILE (.shp)**

### **A. General File Specifications**

- 1. A physical survey is required to obtain acceptable accuracy level. A level of accuracy consistent with that of a GPS (Global Positioning Systems) Survey ( $\pm 1/2$  feet horizontal and vertical) is preferred. Must provide any available GPS data.
- 2. A geodetic control method must be provided. All plans must be in Pennsylvania State Plane Coordinate System North Zone, using the North American Datum of 1983 (NAD83) and the North American Vertical Datum of 1988 (NAVD88). Units shall be in US survey feet.

3. All digitally submitted Shapefiles must be spatially correct and the data tables must meet requirements as specified in Section C below.
4. Provide **.tiff** or **.pdf** format images for all sheets in drawing submission as specified in General Sewer Specifications.

## **B. Spatial Data Layers**

The following data layers are to be provided as a CADD file, independent of the engineering firm's rendition of a completed CADD file. This CADD file should **only** include the following layers.

1. Pipe, manhole, and lateral data layers shall be included with each submittal.
2. Each layer must contain all and only the data for that particular layer.
3. Files must be named so that "main", "lat", or "mh" is at the end of the file name and before the file extension. Examples: GLManormain.shp, GLManorlat.shp, GLManormh.shp.

## **C. Tabular Data**

Template data tables will be provided in spreadsheet form. UAJA will supply the correct Microsoft Excel (.xls) tables file, which contains individual spreadsheets for main line, manhole, and lateral data. Data headers in these tables, and their ordering, must be used as the example for how the data in the shapefile will be organized. This file, along with other files related to electronic submission, may be downloaded from our website ([www.ujaja.com](http://www.ujaja.com)).

1. Corresponding database files (shapefile .dbf) must contain the same structure and exact header names as the template data tables.
2. Each applicable data field must contain valid information for each feature.

UAJA - Summary of Development Review Process		
Item	Element	Schedule
1	Developer submits a request for planning/service that includes a development Sketch Plan, Request for Capacity letter, and draft Planning documents (planning module or exemption).	UAJA will respond within five (5) business days.
2	Developer submits the draft Design along with an executed Extension Agreement (Appendix B or C), and Water Quality Management (WQM) permit (UAJA or DEP).	UAJA forwards the DEP WQM permit application within three (3) business days. Review time by DEP can be as long as 90 calendar days and is not subject to UAJA control.  UAJA and the Engineer will provide initial comments on the Design within five (5) business days.
3	UAJA and the Engineer complete the Design plan review in an iterative process with the Developer's Engineer.	Time TBD depending on size and quality of the submission (conformance to UAJA requirements).
4	When the Design, Agreement and WQM permit are accepted, the Development will be recommended for Board approval at the next available meeting.	
5	Following Board approval of the Development, UAJA staff will be available to consult with the Developer to review inspection requirements, specifications, and construction schedule.	Time TBD by Developer.
7	Developer constructs coordinating inspections with UAJA.	Time TBD depending on technical complexity and field issues.
8	Developer submits the draft As-Built plans for review, and when acceptable, the electronic files.	UAJA and the Engineer will provide initial comments on the As-Built plans within five (5) business days.
9	When the As-Built Plans are accepted and the Electronic files have been provided and placed into UAJA GIS, connections will be allowed.	Following submission, the electronic files will be processed within five (5) business days.

**DIVISION 1 – GENERAL REQUIREMENTS**  
**SECTION 01 10 00 – SUMMARY OF WORK**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Access to site.
  - 4. Coordination with occupants.
  - 5. Work restrictions.
  - 6. Specification and drawing conventions.
  - 7. Miscellaneous provisions.

1.02 PROJECT INFORMATION

- A. Project Identification:
  - 1. Comply with the Authority's Rules and Regulations, Policies, and Minimum Standards for Construction Documents for requirements of project identification.

1.03 WORK COVERED IN THE CONTRACT DOCUMENTS

- A. The work of the project shall be clearly identified through the use of Contract Documents, comprised of Drawings and Specifications:
  - 1. Provide a description of the work.
  - 2. Describe the type of Contract and identify the number of prime contractors.

1.04 WORK BY THE AUTHORITY

- A. Refer to the Authority's Policy.
- B. The Authority will be the Applicant and provide assistance with the submission of Highway Occupancy Permits through the Pennsylvania Department of Transportation. The Developer/Contractor shall be responsible for the completion and submission of the permit application. The Authority will provide a project specific PennDOT M-950AA Form (Applicant's Authorization for Agent to Apply for Highway Occupancy Permit).
- C. The Authority will be the Applicant and provide assistance to the Developer/Contractor for submission of permits required for working in the Railroad right-of-way. The Develop-

er/Contractor shall be responsible for coordination, completion and submission of all documents to the railroad. The Developer shall be responsible for all associated fees.

- D. The Contractor will, at all times throughout the Work, cooperate fully with the Authority in permitting all necessary operations of the Authority to proceed unimpeded by the Contractor's operations.
- E. The Contractor must at all times coordinate his work schedule and sequencing, through the Authority, to avoid interference with necessary operations. All major alterations or adjustments to the sequencing and scheduling of the Work will be planned in advance at the regularly scheduled Project meetings during which representatives of the Owner and the Contractor will coordinate the work elements in such a way as will best meet the needs of the Owner.
- F. The Contractor must coordinate all construction activities and provide monthly written schedules with the Authority to insure minimal impact on the operation of the sewer system. This would include bypass pumping, lateral work, logistical functions, deliveries, construction activities in close proximity to the existing system, clean-up, scheduling, storage of materials and equipment, office trailers, staging functions, any other activities that may impact the Owner's facilities. Failure of the Contractor to comply with the provisions of this specification may be cause for the Owner/Engineer to order an immediate stoppage of the work until the situation is rectified to the satisfaction of the Owner/Engineer.
- G. The Authority reserves the right to employ and agent to perform inspection duties on a full-time basis for the entire duration of the work.

#### 1.05 ACCESS TO SITE

- A. Access to Site: At all times provide access to the Authority to perform inspection duties.
- B. Use of Site: Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. Limits: Confine construction operations areas where work is being completed.
- D. Driveways, Walkways, and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to residents and emergency vehicles at all time. Do not use these areas for parking or storage of materials.
- E. Cleaning
  - 1. Continuously keep rights-of-way, storage areas, streets, roads, highways and adjacent properties free from accumulations of waste materials, excess excavation, rubbish and windblown debris resulting from construction operations.
  - 2. Broom or water clean paved surfaces and remove surplus materials, tools, construction equipment and machinery as each work area is completed.
- F. Protection

1. Contractor shall make every effort to protect and avoid damage within the work area. Prior to the commencement of construction, the Contractor, Developer, and the Authority's representatives will meet to identify special needs and desires.
2. Contractor shall make every effort to protect and avoid damage to trees or shrubbery within the work area that are not designated for removal. Prior to the commencement of construction, the Contractor, Developer, and Authority's representatives will meet to identify special needs and desires.
3. The Contractor shall adequately close and/or protect all excavations, equipment, and materials stored within the site of the project.
4. It shall be the responsibility of the Contractor not to interfere with or create any hazards to traffic. No equipment or material will be stored or permitted to stand where traffic must be maintained. It shall be the responsibility of the Contractor to control dust on all roads, drives, walkways, and parking areas on which traffic is being maintained.
5. The Contractor shall take special care and attention and be responsible for the protection of all existing equipment located throughout the Project area. The Contractor shall immediately notify both the Authority and the Pennsylvania Department of Environmental Protection should a spill or other incident occur that may cause damage to surrounding water ways.

G. Public Relations

1. Contractor's attention is directed to the fact that, in the eyes of the general public, his conduct and attitude will be closely associated with that of the Authority. Accordingly, where operations of the Contractor require personal contact with the public, the Contractor and all his employees shall act in a courteous and respectful manner. Any violation of this section shall be considered sufficient cause for the Authority to order discharge of the employee involved, and he shall not be employed again on the work without written permission from the Authority.
2. Contractor shall use all means necessary to control dust on and near the work, including off-site borrow and stockpile areas if such dust is caused by the Contractor's operations. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.
3. In carrying out the work, the Contractor shall interfere as little as possible with traffic. The Contractor shall provide and maintain ingress and egress for all residents along the construction route.
4. Contractor shall be responsible for notifying all local emergency services, school districts, and other public agencies with regard to control and maintenance of traffic in the work area.
5. The Contractor shall obey and follow all posted speed limits.

1.06 HAZARDOUS ENVIRONMENTAL CONDITION

- A. The Contractor shall complete any mitigation in accordance with all local, state and federal laws and regulations.

#### 1.07 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
  - 2. Limit hours of work to applicable ordinances with the respective municipality. Establish work limitations prior to commencement of work.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by utility owner.

#### 1.08 INTENT OF CONTRACT DOCUMENTS

- A. The intent and meaning of the Contract Documents is that the Contractor, under the terms of the Contract, will take such action as necessary and/or required to provide labor, supervision, plant, materials, supplies, equipment, power, transportation, facilities, etc., whether temporary or permanent, which are indicated or may be reasonably inferred from each Drawing and each section of these Specifications, all of which are collectively necessary and/or required for the execution of the Work.
- B. The information shown on the Contract Drawings or referenced herein relative to the depiction of existing facilities is shown for information purposes only. No representatives or warranties are given or implied relative to the accuracy thereof. The data is presented or described only to indicate the general and approximate extent of existing facilities. The Contractor shall consider these facilities in the preparation of his bid and include any contingent costs in those items for which payment will be made. No separate payment will be made for adjustments or modifications in the work due to inaccuracies in the nature or assumption of existing facilities, except as may be determined or warranted by the Authority. Payment for changes in the work, if found necessary or prudent, shall be reimbursed only through procedure outlined in the General Conditions.
- C. The Contractor will note that the Contract Drawings are general in detail and scope with respect to the extent of demolition, cutting, patching, removal of existing facilities, etc. and that all such Work will be provided by the Contractor, whether specifically indicated on the Contract Drawings or not, which is necessary for the completion of the Work or for the proper operation and appearance of the finished installation, in accordance with the intent of the Contract Documents for this Project.

**PART 2 - PRODUCTS**

- Not used

**PART 3 - EXECUTION**

- Not used

**END OF SECTION**



**SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Construction Documentation.
  - 2. Preconstruction conference.
  - 3. Progress meetings.
- B. Related Sections
  - 1. All applicable Sections of Division 01.

**1.03 CONSTRUCTION DOCUMENTATION**

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Preliminary Construction Schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Submittals Schedule.
  - 4. Daily construction reports.
  - 5. Material location reports.
  - 6. Field condition reports.
  - 7. Special reports.
  - 8. Requests for Interpretations (RFI).

**1.04 DEFINITIONS**

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.

- B. Milestone: A key or critical point in time for reference or measurement.

#### 1.05 SUBMITTALS

- A. Submittals Schedule: Submit two copies of schedule. Arrange the following information in a tabular format:
1. Scheduled date for first submittal.
  2. Specification Section number and title.
  3. Submittal category (action or informational)
  4. Name of subcontractor.
  5. Description of the Work covered.
  6. Scheduled date for Engineer's final release or approval.
- B. Preliminary Construction Schedule: Submit two copies.
- C. Contractor's Construction Schedule: Submit two copies of initial schedule, large enough to show entire schedule for entire construction period.
1. Submit an electronic copy of schedule, in PDF format, labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- D. Schedule Reports: Concurrent with Construction Schedule, submit three copies of each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
- E. Monthly Construction Reports: Submit two (2) copies at monthly intervals.
- F. Material Location Reports: Submit two (2) copies at monthly intervals.
- G. Field Condition Reports: Submit two (2) copies at time of discovery of differing conditions.
- H. Special Reports: Submit two (2) copies at time of occurrence.

#### 1.06 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

1.07 PRECONSTRUCTION CONFERENCE

- A. A preconstruction conference shall be scheduled and administered by the entity overseeing the construction (i.e. Developer, Engineer, Construction Manager, etc). Notice to Proceed shall not be issued until a preconstruction conference has been completed.
- B. Attendance Required: Each Contractor shall be represented at the preconstruction conference by a person vested with the authority to make necessary decisions on behalf of the Contractor, and such decisions shall commit the Contractor to the agreed procedures, sequence of operations and time schedules. Also attending will be the Authority, and the Engineer. Subcontractors and Suppliers are not to attend the preconstruction conference.
- C. The Preconstruction Conference Agenda shall include the following discussion points, as applicable:
  - 1. Engineer's Status during Construction.
  - 2. Resident Project Representative (RPR).
  - 3. Project Communications.
  - 4. Contract Times.
  - 5. Access and Rights-of-Way.
  - 6. Permits and Approvals.
  - 7. Field Engineering.
  - 8. Changes in the Work.
  - 9. Work Schedule.
  - 10. Shop Drawings.
  - 11. Substitutions.
  - 12. Job Conference Schedule.
  - 13. Payment Applications.
  - 14. Temporary Utilities.
  - 15. Emergency Phone Numbers.
  - 16. Field Office Facilities.
  - 17. Subcontractors.

- 18. Prevailing Wage and Payroll Certifications.
- 19. Insurances.
- 20. Steel Products Procurement Act Certifications.
- 21. Safety and OSHA.
- 22. Control of Work.

#### 1.08 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at regular monthly intervals.
- B. Attendance Required: Each Contractor shall be represented at such meetings by a person vested with the authority to make necessary decisions on behalf of the Contractor, and such decisions shall commit the Contractor to the agreed procedures, sequence of operations and time schedules. Also attending will be the Authority and Engineer. Subcontractors and Suppliers, as may be appropriate to agenda topics for each meeting.
- C. Progress Meeting Agenda:
  - 1. Previous meetings.
  - 2. Review of Work progress.
  - 3. Schedule.
  - 4. Identification of problems.
  - 5. Submittals.
  - 6. Coordination.
  - 7. Quality Assurance.

### PART 2 – PRODUCTS

#### 2.01 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
  - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section 01 33 00 in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
3. Initial Submittal: Submit two copies of complete schedule of all anticipated submittal dates to Engineer within 15 days of Notice to Proceed. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
4. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule. Update schedule at time of submission of each Application for Payment.

## 2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
  1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized.
  2. Schedules indicating a Substantial Completion or Final Completion date beyond the established Contract Times shall not be accepted.
- C. Activities: Treat each separate area and major process component as a separate numbered activity for each principal element of the Work. Comply with the following:
  1. Submittal Review Time: Include review and resubmittal times as indicated in Division 1 Section 01 33 00 Submittal Schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  2. Startup and Testing Time: Include not less than seven days for startup and testing.
  3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for the Authority's administrative procedures necessary for certification of Substantial Completion.
  4. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
    - a. Phasing: Arrange list of activities on schedule by phase.
    - b. Work under More Than One Contract: Include a separate activity for each contract.

- c. Work Restrictions: Show the effect of the following items on the schedule:
  - 1) Coordination with existing construction.
  - 2) Limitations of continued occupancies.
  - 3) Uninterruptible services.
  - 4) Partial occupancy before Substantial Completion.
  - 5) Use of premises restrictions.
  - 6) Provisions for future construction.
  - 7) Seasonal variations.
  - 8) Environmental control.
- 5. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- 6. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

#### 2.03 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within fifteen (15) days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction.

#### 2.04 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Schedule Preparation: Prepare a list of all activities required to complete the Work. Identify probable critical paths. Identify first workday of each week with a continuous vertical line.
  - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.

- h. Testing and commissioning.
  - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  - 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
  - 4. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar. Indicate all others in 1 percent increments.
- C. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Authority's approval of the schedule.
- D. Schedule Updating:
- 1. Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
    - a. Identification of activities that have changed.
    - b. Changes in early and late start dates.
    - c. Changes in early and late finish dates.
    - d. Changes in activity durations in workdays.
    - e. Changes in the critical path.
    - f. Changes in total float or slack time.
    - g. Changes in the Contract Time.

## 2.05 REPORTS

- A. Monthly Construction Reports: Prepare a monthly construction report recording the following information concerning events at Project site:
- 1. List of subcontractors at Project site.
  - 2. List of separate contractors at Project site.
  - 3. Approximate count of personnel at Project site.
  - 4. Equipment at Project site.
  - 5. Material deliveries.
  - 6. High and low temperatures and general weather conditions.
  - 7. Accidents.
  - 8. Meetings and significant decisions.

9. Stoppages, delays, shortages, and losses.
  10. Meter readings and similar recordings.
  11. Emergency procedures.
  12. Orders and requests of authorities having jurisdiction.
  13. Change Orders received and implemented.
  14. Work Change Directives received and implemented.
  15. Clarifications requested, received, and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial Completions and occupancies.
  19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.06 SPECIAL REPORTS

- A. Prepare Coordination Memoranda for distribution to each Contractor involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. Provide copy to the Authority.
- B. Prepare similar memoranda for the Authority and separate contractors where coordination of their work is required. All such memoranda must be provided to the Authority.

## 2.07 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.



2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
  2. Date.
  3. Name of Contractor.
  4. Name of Engineer.
  5. RFI number, numbered sequentially.
  6. Specification Section number and title and related paragraphs, as appropriate.
  7. Drawing number and detail references, as appropriate.
  8. Field dimensions and conditions, as appropriate.
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature.
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
  12. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs:
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Authority's Action: Authority will review each RFI, determine action required, and return it. Allow seven working days for Engineer's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.

- e. Requests for interpretation of Engineer's actions on submittals.
  - f. Incomplete RFIs or RFIs with numerous errors.
- 2. The Authority's action may include a request for additional information. Engineer's time for response will start again.
- 3. The Authority's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit claim in accordance with the General Conditions.
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within seven days of receipt of the RFI response.
- E. On receipt of Authority's action, immediately distribute the RFI response to affected parties. Review response and notify the Authority within seven days if Contractor disagrees with response.

### **PART 3 – EXECUTION**

#### **3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE**

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Authority, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION**

**DIVISION 1 – GENERAL REQUIREMENTS  
SECTION 01 32 00 – CONSTRUCTION PROGRESS DOCUMENTATION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Audio/Video documentation

1.02 QUALIFICATIONS

- A. Required video documentation shall be performed by an independent third party firm actively engaged, experienced and knowledgeable in video recording existing conditions on utility projects. The Authority reserves the right to request sample work and investigate the qualifications of any firm chosen to perform this work.

1.03 REQUIREMENTS

- A. Video documentation shall comply with the following requirements:
  - 1. Photodocumentation: At least 15 days prior to commencing site activities Contractor shall deliver photodocumentation to the Engineer and PennDOT verifying the preconstruction condition of the project site.
  - 2. If photodocumented conditions or locations are not discernible, complete or otherwise acceptable, the Engineer will either return the photodocumentation to the Contractor for resubmission or will create its own photodocumentation record and shall be reimbursed for the costs by the Contractor within 30 days after receipt of the invoice.
  - 3. The date of photodocumentation shall be identified on each cartridge, reel, slide or print.

1.04 SUBMITTALS

- A. Submit three (3) copies of each video recording to the Authority.
- B. Submit one (1) copy of each video recording of to each interested party and regulatory agency (Township, PennDOT, DEP, etc.).

**PART 2 - PRODUCTS**

2.01 EQUIPMENT REQUIREMENTS

- A. Audio-Video color DVD format and having been manufactured by a recognized manufacturer (i.e. 3M, MAXELL, SONY, FUJI, TDK, OVC, etc.). No used DVD's or "seconds" shall be allowed.
- B. All video shall be in color and conform to NTSC standards. It shall contain no electrical breaks with color correctly balanced to white.

- C. All camera-produced video shall have a horizontal resolution of 300 lines minimum with a signal to noise ratio of 45db. All synchronizing signals encoded upon delivered DVD's will conform to EIA standard RS-170A.
- D. Video portion of DVD shall contain electronically superimposed details of: YEAR, MONTH, DAY, TIME (24 hour clock). PROJECT NAME shall also be electronically superimposed in upper portion of screen area. This shall appear on all video made at customer's location. An index map shall be provided.
- E. Audio will be recorded during field production and shall contain verbal information relevant to the conditions and items appearing on the video (i.e. identifications of place, conditions, etc.).

### **PART 3 - EXECUTION**

#### **3.01 PROCEDURE**

- A. All Video to be done during periods of good visibility and not during periods of visible precipitation or while ground is covered by snow.
- B. Control direction of travel, panning rates, and zoom in-out rates in a manner that produces clarity of subject during playback.
- C. Include in outdoor Video coverage of driveways, sidewalks, curbs, ditches (to show drainage patterns), street (as full width as possible), landscaping, trees, shrubs, culverts, catch basins, retaining walls, headwalls, fences, visible utilities, and building exteriors within the zones of influence. Buildings should be identified both audibly and visibly when possible.
- D. Properly identify all Video (disks and cases) by disk number, date, locations and project name. Begin each tape with current date, project name and municipality.
- E. Supply a written index run sheet with a record of each disk contents and identifies locations, station numbers, line numbers, etc., referenced to time and date encoded on disk.

**END OF SECTION**

**DIVISION 1 - GENERAL REQUIREMENTS  
SECTION 01 33 00 - SUBMITTALS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Shop drawings.
- E. Product data.
- F. Samples.
- G. Manufacturers' instructions.
- H. Manufacturers' certificates.
- I. Steel Products Certification form.
- J. Shop Drawing Work.

**1.02 SUBMITTAL PROCEDURES**

- A. Submittals are to be transmitted to the Authority in electronic (PDF) format using a FTP site or other file sharing site established and maintained by the Authority. Submit a discrete electronically created PDF document for each product (converted scans are unacceptable). PDF documents must be searchable and bookmarked in accordance the documents table of contents. Where documents are marked with a scale, the PDF size must correspond.
- B. Sequentially number the transmittals. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contract Number, subcontractor or supplier, and specification Section number, as appropriate.
- D. Apply certification stamp, signed or initialed by Contractor, certifying that review, verification of products required, field dimensions, and coordination of information, is in accordance with the requirements of the Contract Documents. Submittals not containing a certification stamp shall be returned without review.
- E. Identify variations from Contract Documents and Product or system limitations, which may be detrimental to successful performance of the completed Goods.
- F. Provide 4" by 4" space for the Authority's review stamps.
- G. Revise and resubmit submittals as required, clearly identify all changes made since previous submittal.
- I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 ACTION ON SUBMITTALS

- A. Authority's Action: Where action and return is required or requested, the Authority will review each submittal, mark with the action taken, and return within a reasonable time period. Where submittal must be held for coordination, Contractor will be so advised by the Authority.
- B. Submittals returned with "APPROVED" action indicates that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Contract Documents. Contractor may proceed with performance of the work covered by the submittal.
- C. Submittals returned with "APPROVED AS CORRECTED" action indicates that the information submitted was found to be in conformance with the design concept and in compliance with the requirements of the Contract Documents, provided the noted clarifications or corrections are completed. Submission of a corrected submittal indicating the changes noted by the Authority is not required. Contractor may proceed with performance of the work covered by the submittal.
- D. Submittals returned with "REVISE AND RESUBMIT" action indicate that: (1) information submitted is at least partially not in conformance with the design concept, (2) information submitted is at least partially not in compliance with the requirements of the Contract Documents, (3) submittal is incomplete and does not include all items required by the individual specification Sections, or (4) certifications or computations required by the individual specification Sections have not been included in the submittal. Submittal will be returned to Contractor noting the reasons for noncompliance. Contractor shall not proceed with the performance of the work covered by submittal until corrected information is submitted and approved.
- E. Submittals returned with "NOT APPROVED" action indicates that the Authority interprets the information submitted to be not in conformance with the design concept or not in compliance with the Contract Documents. Performance of the work shall not proceed until submittal is revised, resubmitted and approved.

1.05 PROPOSED PRODUCTS LIST

- A. Submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 SHOP DRAWINGS

- A. Submit electronically.
- B. Each submission of shop drawings must be accompanied by a letter of transmittal listing the items in the submission. Each shop drawing must be marked with the name of the project, the name of the Contractor, and numbered consecutively.

1.07 PRODUCT DATA

- A. Submit electronically
- B. Identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. After review, distribute in accordance with Submittal Procedures.

1.08 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for the Authority's selection.
- C. Include identification on each sample, with full Project information.
- D. Submit the number or samples specified in individual specification Sections; two of which will be retained by the Authority.
- E. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

1.09 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.10 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Sections, submit manufacturers' certificate to the Authority for review, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Authority.

1.11 PENNSYLVANIA STEEL PRODUCTS ACT CERTIFICATION

- A. Use form attached to this Section (as applicable).

1.12 SHOP DRAWING WORK

- A. All work, which is related to shop drawing approval shall not be initiated until approved Shop Drawings have been received from the Authority.
- B. All work initiated by Contractor prior to receipt of approved shop drawings shall be at the sole risk of Contractor. Any and all rework, modifications, reinstallations, etc. necessitated by changes in the Work due to changes required by subsequently approved shop drawings will be completed by Contractor at no cost to the Authority.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.





This form must be executed by the Contractor and delivered to the Engineer before any item containing steel may be incorporated into any public works project in the Commonwealth of Pennsylvania. Execute and present this form for each type of steel product to be incorporated as provided above.

**STEEL PRODUCTS PROCUREMENT CERTIFICATION: Contractors**

**A. TO BE COMPLETED BY ALL CONTRACTORS:**

1. Name of Contractor's firm: \_\_\_\_\_ 2. Date Submitted: \_\_\_\_\_
3. Firm's address: \_\_\_\_\_ 4. Phone Number: ( ) \_\_\_\_\_
5. Contract No. \_\_\_\_\_ 6. Contract title: \_\_\_\_\_
7. Steel Product: \_\_\_\_\_
8. Name and address of supplier: \_\_\_\_\_

**B. TYPE OF STEEL PRODUCT (check and complete applicable category)**

1. ☐ Identifiable steel product: 100% of the steel in a product is identifiably marked as manufactured in the United States.
- a. Other documentation required: NONE
- b. Manner in which steel product is identifiable: \_\_\_\_\_
2. ☐ Non-identifiable structural steel: Less than 100% of the steel contained in the product is identifiable as provided above. Structural steel is defined as steel products used as a basic structural element of a project (i.e. steel beams, columns, decking, stairways, reinforcing bars, structural lintels, pipes, etc.)
- a. Other documentation required: Bills of lading, invoices and mill certificates that certify that the steel contained in the product was melted or manufactured in the United States.
3. ☐ Non-identifiable non-structural steel: all other steel products including door and window frames, machines, equipment, etc.
- a. Other documentation required: i.e. certification from supplier/fabricator.

- C. CERTIFICATION:** I, the undersigned officer of the above named firm, do certify that, to the best of my knowledge, the steel product listed above complies with the provisions of the Steel Products Procurement Act (73 P.S. §1881 et seq, as amended). I understand that by signing this document I certify that the facts contained herein are true. I further understand that this document is subject to the provisions of the Unsworn Falsification to Authorities Act (18 P.S. §4904) and the Steel Products Procurement Act, which provide penalties including, but not limited to, debarment from bidding on any Commonwealth of Pennsylvania public works project for a period of five years.

Witness:

\_\_\_\_\_  
Secretary or Treasurer

(Corporate Seal)

\_\_\_\_\_(SEAL)  
President or Vice President

**END OF SECTION**

**DIVISION 1 – GENERAL REQUIREMENTS**  
**SECTION 01 40 00 – QUALITY REQUIREMENTS**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality assurance and control requirements for individual manufacturing activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality assurance and control services required by the Authority, Engineer, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Contract to guard against defects and deficiencies and substantiate that proposed Goods will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Contract to evaluate that actual products incorporated into the Goods and completed Goods comply with requirements. Services do not include contract enforcement activities performed by an Engineer.
- C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Goods to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- E. Source Quality Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- F. Field Quality Control Testing: Tests and inspections that are performed on-site for evaluation of the performance and acceptability of the Goods.

- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.03 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Authority for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Authority for a decision before proceeding.

#### 1.04 SUBMITTALS

- A. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  - 11. Comments or professional opinion on whether tested or inspected Goods comply with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.

13. Recommendations on retesting and reinspecting.

- B. Permits, Licenses, and Certificates: For Authority's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Contract.

1.05 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- E. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.06 QUALITY CONTROL

- A. Authority Responsibilities: Where quality-control services are indicated as the Authority's responsibility, it will engage a qualified testing agency to perform these services.

1. The Authority will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to the Authority are the Contractor's responsibility. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by the Authority, unless agreed to in writing by the Authority.
  2. Notify testing agencies at least 24 hours in advance of time when testing or inspecting will be performed.
  3. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01330 Submittals.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for Goods, materials, products, etc. that replaced the same that failed to comply with the Contract Documents.
- E. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

## **PART 2 – PRODUCTS**

Not Used.

## **PART 3 – EXECUTION**

### **3.01 TEST AND INSPECTION LOG**

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to the Authority.
  4. Identification of testing agency or special inspector conducting test or inspection.

**END OF SECTION**

**DIVISION 1 - GENERAL REQUIREMENTS**  
**SECTION 01 41 26 - PERMIT REQUIREMENTS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Purpose - The purpose of this section is to provide the Contractor with the PENNDOT requirements relating to the permit issued to the Owner for regulations pertaining to construction activities within the PENNDOT rights-of-way.
- B. Compliance - The Contractor shall be responsible for all-special insurance requirements, bonding requirements, notifications, coordination, and compliance with the permit conditions as well as the PENNDOT regulations applicable to this work.

1.02 REFERENCES

- A. The following PENNDOT publications shall be applicable to this job:
  - 1. Publication 408, Specifications
  - 2. PA Code, Title 67, Transportation: Chapter 203, Temporary Traffic Control Guidelines
  - 3. PA Code, Title 67, Transportation: Chapter 441, Access to and Occupancy of Highway by Driveways and Local Roads
  - 4. PA Code, Title 67, Transportation: Chapter 459, Occupancy of Highways by Utilities
  - 5. PENNDOT Publication No. 72M: Standards for Roadway Construction

1.03 SUBMITTALS

- A. Certificate of Insurance: Contractor shall be responsible for including the Commonwealth of Pennsylvania, Department of Transportation, District 2-0 as a named insured on the policies so indicated. Contractor shall also be responsible for completion of PENNDOT Form M-945X (1-91) Certificate of Insurance initially and when policies are renewed. Under item (d), Policy numbers shall be shown for (d)(1) and (d)(2) and (d)(3) if blasting is proposed. If there is no blasting, so indicate under (d)(3). Form must be submitted as printed on both sides.

1.04 QUALITY ASSURANCE

- A. Debarred Contractor: In the event that the Contractor is or becomes debarred by PENNDOT under Pennsylvania Code Title 67, Chapter 459.3(1), the Contractor shall provide a subcontractor acceptable to the Owner and PENNDOT for completing the work at no additional cost to the Owner.

1.05 COORDINATION

- A. The Contractor shall be responsible for obtaining the insurance referred to in this specification, in a timely manner. No work shall be initiated on PENNDOT rights-of-way until the permit and these referenced documents have been submitted and approved by PENNDOT. No claim for contract time extension will be granted for delay in obtaining PENNDOT approval of insurance's.

1.06    WARRANTY

- A.     For all work in a PENNDOT right-of-way, the Contractor shall, for a period of two (2) years, correct any defects or failures in the materials or work without cost to the Authority.

**PART 2 - PRODUCTS**

2.01    MATERIAL

- A.     All materials including aggregate, paving, precast units, frame and covers, valve boxes, junction boxes and similar items shall be in compliance with PENNDOT requirements. All materials used in the PENNDOT Right-Of-Way shall be from PENNDOT approved suppliers as listed in Bulletin 15.

**PART 3 - EXECUTION**

3.01    NOTICE

- A.     It shall be the Contractor's responsibility to notify PENNDOT at least five days in advance of commencement of work within the highway right-of-way and to comply with all PENNDOT permit notification requirements.

3.02    INSPECTION

- A.     PENNDOT inspections may be required for all work in PENNDOT rights-of-way. The Authority will reimburse PENNDOT the cost of PENNDOT inspections but shall include the cost of the PENNDOT inspections thereof in amounts owed to the Authority.

3.03    PERMIT COMPLIANCE

- A.     The Contractor shall be responsible for complying with all provisions of the permit which shall include in addition to the permit, the application and attachments thereto, figures from Chapter 203 pertaining to Maintenance and Protection of Traffic as well as the drawings included in the Project Manual.

3.04    METHOD OF PAYMENT

- A.     The Contractor's compensation for insurance and special requirements for accomplishing of work in the PENNDOT right-of-way shall be included in the mobilization item when such item is included in a unit price contract. If there is no mobilization item, the compensation will be included in those items that incorporate the work in the PENNDOT right-of-way.

3.05    RESTORATION WORK

- A.     Technical Requirements
  - 1.     The technical requirements for temporary permitted restoration on a PENNDOT right-of-way is included in Section 32 12 00, entitled "Paving and Surfacing".
- B.     Restoration Security
  - 1.     If required by PENNDOT, the Developer/Contractor shall secure the Restoration and Maintenance Security in a form acceptable to the Department in the name of the University Area Joint Authority. Contractor shall schedule work on state highways leaving adequate time for bond processing. The Authority shall not be responsible



for time delays in obtaining PENNDOT approval of bond and insurance.

3.06 ROADWAY PROTECTION

- A. The roadways within the PENNDOT rights-of-way shall be protected in accordance with the following requirements:
1. To protect the pavement and shoulders, Contractor's equipment shall have rubber wheels or runners and have rubber, wood or similar protective pads between the outriggers and the surface.
  2. If other than rubber equipped machinery or equipment is used, the pavement and shoulders shall be protected from equipment damage by the use of matting or other suitable protective material.
  3. If the equipment damages the pavement or shoulders, the Contractor shall restore the damaged pavement or shoulder, or both, to its former condition, in a manner authorized by PENNDOT at no additional cost to the Authority.

3.07 DISPOSITION OF MATERIALS

- A. The responsibility of the Contractor for the disposition of materials within the PENNDOT rights-of-way is as follows:
1. The Contractor shall keep the roadway free of material which may be deposited by vehicles traveling upon or entering onto the highway during the performance of work.
  2. The Contractor is responsible for controlling dust conditions created by the Work.
  3. Excess material and material that is not suitable for backfill shall be promptly removed and properly disposed of outside the right-of-way as the work progresses. Other suitable material shall be stored so that there will be no interference with the flow of highway drainage.
  4. The Contractor shall not close a portion of the pavement or shoulder to traffic for the primary purpose of storing material. If the Contractor stores material on the pavement or shoulder, the Contractor shall repair or reconstruct the pavement and shoulder, if damaged, to its former condition, in a manner authorized by PENNDOT at no additional cost to the Authority. Delivered material may not be stored overnight on the pavement.

**END OF SECTION**

**DIVISION 1 - GENERAL REQUIREMENTS**  
**SECTION 01 50 00 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes:
  - 1. Temporary Utilities
  - 2. Temporary Facilities
  - 3. Temporary Controls

1.02 REGULATORY REQUIREMENTS

- A. Comply with all applicable laws and regulations of authorities having jurisdiction, including, but not limited to, building codes, health and safety regulations, utility company regulations, and environmental protection regulations.
- B. Provide electrical equipment which is UL listed.

1.03 RESPONSIBILITIES UNDER CONTRACT

- A. Depending on the location and extent of the project, the Authority may require the contractor to provide a field office. Consult with the Authority regarding this requirement prior to finalizing the project specifications.
- B. Each Contractor may furnish, install, and pay for his own field office(s), facilities within field offices(s), and storage facilities, and shall be responsible for removing these facilities upon completion of the Work. Contractor shall be responsible for coordinating and establishing the locations of these field offices and storage facilities.
- B. Each Contractor shall provide sanitary facilities at the project site. These sanitary facilities shall be available to the Contractor's workers, Authority's representatives and other visitors to the project site. Contractor shall maintain such facilities for the duration of the project.
- C. Project construction facilities shall include, but not be limited to, temporary heat, ventilation, water service, telephone service, internet service, sanitary facilities, barriers, parking, security, pedestrian control, and maintenance and protection of traffic.
- D. Temporary controls shall include dust control, sediment and erosion control, stormwater control, flood prevention, wastewater, traffic control, temporary fencing/security and progress cleaning.
- E. Maintenance and Protection of Traffic
  - 1. The Contractor will endeavor to minimize disturbance to the local residents.
  - 2. Contractors shall maintain access to and use of the plant for operating personnel at all times. When construction operations require blocking of regular access, temporary access shall be provided, including temporary driveways, walkways, bridges, decking, and other facilities required to maintain the on-going operation.

DIVISION 1 – GENERAL REQUIREMENTS

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SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

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3. The Contractor shall provide any necessary flagmen, signs, barriers, etc. for traffic control.

F. Storm Water Control

1. Contractor shall be responsible for the Sediment and Erosion Control measures and procedures as required by permits or plan approvals.
2. Maintain flow of site stormwater. Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping facility.
3. Protect site from puddling or running water. Contractor shall be responsible for flood damages to the Work. All flood damages shall be repaired to the satisfaction of Engineer.
4. Contractor assumes responsibility for damages to property caused by flooding due to blocking or restriction of storm water passages, natural waterways, and wastewater facilities.

G. Temporary Fencing/Security

1. At contractor's option, project site or sub-areas may be temporarily fenced.

1.04 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above-grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.05 SITE ACCESS AND PARKING

- A. Each Contractor is responsible for establishing access to the site of his work. The property and the right-of-way shall be established on the Contract Documents. Any requirements for additional land during construction for storage of material, locating trailers, or other temporary facilities, shall be provided by the Contractor at his cost. The Contractor shall obtain and provide for all necessary access to the property and rights-of-way shown on the plans. Contractor shall be responsible for acquiring, constructing, maintaining, and the restoration of any temporary access facilities required for this construction.
- B. Provide temporary gravel surface parking areas to accommodate construction personnel. When space is not adequate, provide off-site parking. Provide one designated space for the Authority.
- C. Provide access to fire hydrants at all times. Do not inhibit access to other utilities.
- D. Provide means of removing mud from vehicle wheels before exiting the project site.
- E. In the event that the designated site access is also to be utilized for the construction access, provide temporary access, including earthwork, surface and groundwater control, and erosion and sediment requirements, including stabilized entrance. Near the completion of construction, the Contractor will be responsible for grading or excavation as may be

necessary, and the construction of the permanent finished access driveway as provided for in the plans and project manual. In the event that it becomes necessary to utilize completed driveway or partially completed roadways for the delivery of construction material, such as aggregate fill or concrete, the Contractor shall be responsible for the degradation or damage that may result from this use.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

**3.01 PREPARATION**

- A. Fill and grade sites for temporary structures to provide drainage away from building.

**3.02 CONTRACTOR OFFICE AND FACILITIES**

- A. Size: As required by Contractor.
- B. Telephone: As required by Contractor.
- C. Other Furnishings: Contractor's option.

**3.03 REMOVAL**

- A. At completion of Work remove all temporary buildings, foundations, utility services, and materials. Clean and restore damage caused by installation of temporary facilities.
- B. Restore existing facilities used during construction to original condition.
- C. Restore permanent facilities that were used during construction to specified condition.

**END OF SECTION**

**DIVISION 1 – GENERAL REQUIREMENTS**  
**SECTION 01 77 00 – CLOSEOUT PROCEDURES**

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes

1. Administrative and procedural requirements for contract closeout
2. Inspection Procedures
3. Final Cleaning

B. Related Documents

1. Contract Documents, including specifications, drawings and details.

1.02 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Identify Work to be completed and reasons why the Work is not complete.
2. Advise Authority of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Authority unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Final Operation and Maintenance manuals as applicable.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Authority. Label with manufacturer's name and model number where applicable.
7. Complete commissioning and startup testing of systems as specified.
8. Submit test records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Submit changeover information related to Authority's occupancy, use, operation, and maintenance.

- B. Inspection: On receipt of Contractor's written request, the Authority will either proceed with inspection or notify Contractor of unfulfilled requirements. The Authority will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items identified that must be completed or corrected before certificate will be issued.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - 2. Results of completed inspection will form the basis of requirements for Final Completion.

### 1.03 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
  - 1. Completion of all remaining Work and requirements identified at time of Substantial Completion.
  - 2. Final Cleaning
  - 3. Submit Project Record Documents.
- B. Inspection: On receipt of written request from Contractor, the Authority will either proceed with inspection or notify Contractor of unfulfilled requirements. If all work has not been completed the Authority will notify the Contractor of outstanding construction that must be completed or corrected.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. The Contractor shall pay the Authority's costs for re-inspections of incomplete work.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 – EXECUTION

### 3.01 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B.     Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1.     Complete the following cleaning operations before requesting inspection for Final Completion for entire Project or for a portion of Project:
- a.     Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b.     Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c.     Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d.     Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e.     Remove labels that are not permanent.
  - f.     Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
  - g.     Replace parts subject to unusual operating conditions.
  - h.     Leave Project clean and ready for occupancy.
- C.     Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Authority's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

**END OF SECTION**

**DIVISION 1 – GENERAL REQUIREMENTS  
SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Emergency manuals.
  - 2. Operation manuals for systems, subsystems, and equipment.
  - 3. Maintenance and Warranty manuals for the care and maintenance of systems and equipment.

**1.02 DEFINITIONS**

- A. Definition in first paragraph below is from ASHRAE's "Technology Handbook."
  - 1. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
  - 2. Subsystem: A portion of a system with characteristics similar to a system.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Submit two draft copies of each manual to the Authority for review a minimum of 30 days prior to proposed date of start-up. Assemble manuals in three-ring binders. Omit product data and shop drawings at this submission stage. Submission, but not approval, of manuals is prerequisite for start-up.
- C. Submit two copies of the proposed final draft of each manual reflecting the Authority's comments a minimum of 14 days prior to start-up. Include Authority approved product data and shop drawings at this submission stage. Assemble manuals in three-ring binders. Submission, but not approval, of manual is prerequisite for start-up.
- D. Submit three copies of each final manual reflecting the Authority's comments on proposed final manual prior to dedication. Final manuals must be approved by the Authority before the ownership and operation responsibility will be assumed.



## **PART 2 – PRODUCTS**

### **2.01    MANUALS, GENERAL**

- A.    Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1.    Title page.
  - 2.    Table of contents.
  - 3.    Manual contents.
- B.    Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1.    Subject matter included in manual.
  - 2.    Name and address of Project.
  - 3.    Name and address of Authority.
  - 4.    Date of submittal.
  - 5.    Name, address, and telephone number of Seller.
  - 6.    Name and address of Engineer.
  - 7.    Cross-reference to related systems in other operation and maintenance manuals.
- C.    Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1.    If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D.    Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
  - 1.    Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a.    If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide

- essential information for proper operation or maintenance of equipment or system.
  - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and Title.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.02 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
- 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
- 1. Power failure.
  - 2. System, subsystem, or equipment failure.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
- 1. Instructions on stopping.

2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

## 2.03 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

#### 2.04 MAINTENANCE AND WARRANTY MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and Title.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.

- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds. No warranty shall start earlier than the date of Substantial Completion, unless approved by the Owner.
- G. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.05 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard printed maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
- G. Maintenance Service Representative: Include name and telephone number of authorized service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds. No warranty shall start earlier than the date of Substantial Completion, unless approved by the Owner.
- I. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.
1. Include procedures to follow and required notifications for warranty claims.

### **PART 3 – EXECUTION**

#### **3.01 MANUAL PREPARATION**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Authority's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- C.     Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1.       Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2.       Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Authority's operating personnel.
  
- D.     Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1.       Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  
- F.     Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information obtained during commissioning to ensure correct illustration of completed installation.
  
- G.     Include previously approved product data and shop drawings bearing Authority's approval stamp. Fold to text pages with title block exposed. Place shop drawings in clear plastic three-hole punched sheet protectors. If the Authority deems it acceptable, drawings may be submitted in rolled sets.

**END OF SECTION**

**DIVISION 1 – GENERAL REQUIREMENTS**  
**SECTION 01 78 39 – PROJECT RECORD DOCUMENTS**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Administrative and procedural requirements for Project Record Documents.
  - 2. Record Drawings.
  - 3. Record Product Data.
- B. Drawings, Details and Specifications.
- C. The Authority's Rules and Regulations and Policies.

1.02 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Submit Record Documents prior to request for substantial completion inspection and comply with the following:
  - 1. Record Drawings: Submit one set of marked-up Record Drawings.
  - 2. Record Product Data & Shop Drawings: Submit one copy of each approved Product Data and Shop Drawing submittal as an insert in the Operation and Maintenance Manual.

**PART 2 – PRODUCTS**

2.01 RECORD DRAWINGS

- A. These specifications outline the requirements for the development of record drawings by the field Contractor. For Developer constructed extensions, comply with the Authority's Policy, Sewer Extension Agreement and the Authority's Checklist for As-Built Drawings.
- B. Record Drawings: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.



- b. Accurately record information in an understandable drawing technique.
  - c. Record data as soon as possible after obtaining. Record and check the markup before enclosing concealed installations.
- 2. Content: Types of items requiring marking include, but are not limited to, the following:
  - a. Dimensional changes to Drawings.
  - b. Revisions to details shown on Drawings.
  - c. Depths of foundations in relation to plant datum.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Addendum, Field Order, Change Order or Work Change Directive.
  - k. Details not on the original Contract Drawings.
  - l. Field records for variable and concealed conditions.
  - m. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Record Drawings.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Addendum numbers, Field Order numbers, Work Change Directive numbers, Change Order numbers, and similar identification, where applicable.
- C. Newly Prepared Record Drawings: Prepare new Drawings where neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
  - 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  - 2. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  - 1. Cross out Engineer's title block and seal from all sheets and stamp all sheets with name of Contractor.

2. Record Drawings: Organize Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

## 2.02 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Addenda, Field Orders, Work Change Directives, and Change Orders where applicable.

## 2.03 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Miscellaneous records include the following:
  1. Material and equipment test and inspection reports.
  2. Equipment and material delivery slips.

# PART 3 – EXECUTION

## 3.01 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of following during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
  1. Drawings.
  2. Project Manuals.
  3. Addenda.
  4. Change Orders, Work Change Directives, and Field Orders.
  5. Reviewed shop drawings, product data, and samples.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's

reference during normal working hours. Contractor shall bring Project Record Documents to Progress Meetings for Engineer's review.

**END OF SECTION**

**DIVISION 3 – CONCRETE  
SECTION 03 30 00 – CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Cast-in-place concrete for foundations.
2. Floors and slabs on grade.
3. Control, expansion and contraction joint devices associated with concrete work, including joint sealants.
4. Equipment pads and anchors, light pole bases, thrust blocks, manhole bases, pits and vaults.

**1.02 REFERENCES**

**A. American Concrete Institute (ACI)**

1. ACI 301 – Structural Concrete for Buildings.
2. ACI 302 – Guide for Concrete Floor and Slab Construction.
3. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305R – Hot Weather Concreting.
5. ACI 306R – Cold Weather Concreting.
6. ACI 308 – Standard Practice for Curing Concrete.
7. ACI 318 – Building Code Requirements for Reinforced Concrete.
8. ACI 350 – Concrete Sanitary The Authoritying Structures.

**B. American National Standards Institute**

1. ANSI/ASTM D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type).
2. ANSI/ASTM D1190 – Concrete Joint Sealer, Hot-Poured Elastic Type.
3. ANSI/ASTM D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

- 4. ANSI/ASTM D1752 – Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- C. American Society for Testing and Materials
  - 1. ASTM C33 – Concrete Aggregates.
  - 2. ASTM C94 – Ready-Mixed Concrete.
  - 3. ASTM C150 – Portland Cement.
  - 4. ASTM C260 – Air Entraining Admixtures for Concrete.
  - 5. ASTM C494 – Chemicals Admixtures for Concrete.

#### 1.03 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit manufacturer's product data with application and installation instructions for materials and items to be utilized.
- B. Mix Design: Submit mix design for each mix to be used. Design shall indicate admixtures proposed for use. Mix design shall be reviewed by the Authority prior to use.
- C. Samples: Submit samples of materials as requested by the Authority, including names, sources and descriptions.
- D. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.
- E. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by the Authority. Material certificates shall be signed by supplier and Contractor certifying that each material item complies with, or exceeds, specified requirements.

#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Acquire aggregate from same source for all work.
- C. Conform to ACI 305R when concreting during hot weather.
- D. Conform to ACI 306R when concreting during cold weather.
- E. Use one brand of cement throughout project.
- F. Concrete Testing Service: Engage an independent testing laboratory acceptable to THE AUTHORITY to perform material evaluation tests and to design concrete mixes.

1.05 COORDINATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.
- B. Contractor is solely responsible for coordination of the concrete pours with the items to be imbedded in the concrete.

**PART 2 - PRODUCTS**

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I or Type II, Portland type. All wastewater structures shall be Type II, unless otherwise specified.
- B. Fine and Coarse Aggregates: ASTM C33. Do not use aggregate containing spalling causing deleterious substances.
- C. Water: Clean and not detrimental to concrete.

2.02 ADMIXTURES

- A. Use:
  - 1. In strict compliance with manufacturer's instructions, admixtures must be included in original concrete mix design reviewed by the Authority. No changes in mix design without prior approval of the Authority shall be permitted.
  - 2. Use of calcium chloride is prohibited.
- B. Air Entrainment:
  - 1. ASTM C 260, compatible with all other admixtures used.
  - 2. Use in exterior exposed concrete, additions in strict accordance with manufacturer's instructions for conditions anticipated for the concrete and aggregate size in mix.
- C. Water Reducing:
  - 1. ASTM C 494.
  - 2. Type A – Use as required for placement and workability. Must contain less than 0.1% chloride ion.
  - 3. Type F or Type G: Use in pumped concrete, architectural concrete, slabs in locations where chemicals are stored and concrete with water/cement ratios less than 0.5. Must contain less than 1% chloride ions.

- 4. Type E: Use in slabs placed at ambient temperatures below 50 degrees F. Must not contain any chloride ions.

#### 2.03 ACCESSORIES

- A. Bonding Agent: Polyvinyl Acetate.
- B. Epoxy Adhesive: ASTM C881, Two component modified epoxy resin suitable for use on dry or damp surface.
- C. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.
- D. Moisture (Vapor) Barrier: Provide polyethylene sheet moisture barrier cover over prepared base material where indicated; minimum thickness 6 mils. Use only materials which are resistant to decay when tested in accordance with ASTM E 154.

#### 2.04 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler:
  - 1. ASTM D1751; Asphalt impregnated fiberboard or felt, ¼ inch thick; tongue and groove profile, exterior use only.
  - 2. ASTM D1752; Premolded sponge rubber fully compressible with recovery rate of minimum 95 percent.
- B. Construction Joint Devices: Integral galvanized steel; 3/8 inch thick, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.
- C. Expansion and Contraction Joint Devices: ASTM B221; resilient neoprene filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; vinyl cover plate, of longest manufactured length at each location, recess mounted.
- D. Sealant: ASTM C309, acrylic copolymer, high solids curing and sealing compound.

#### 2.05 CONCRETE MIX

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Authority for preparing and reporting proposed mix designs. Determine standard deviation and required average compressive strength for each class of concrete to be utilized and provide supporting documentation that mix designs meet the indicated criteria.
- B. Submit written reports to the Authority of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Authority.

- C. Design Mixes: Provide normal weight concrete with the following properties, as indicated on applicable details:
1. 5,000 psi 28-day compressive strength. (Type II Cement).
  2. 4,000 psi 28-day compressive strength. (Type II Cement).
  3. 3,000 psi 28-day compressive strength. (Type II Cement).
- D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Reinforced foundation systems and treatment tanks – Not less than 1 inch or more than 4 inches.
  2. Concrete with high range water reducing admixtures – Not more than 8 inches.
  3. Ramps and sloping surfaces – Not more than 4 inches.
  4. Slabs and floors - Not less than 1 inch and not more than 3 inches.
  5. Miscellaneous Concrete – Not less than 1 inch and not more than 4 inches.
- E. Water-Cement Ratio: The maximum permissible water-cement ratio will be as follows:
1. 5,000 psi concrete – maximum water/cement = 0.40
  2. 4,000 psi concrete – maximum water/cement = 0.45
  3. 3,000 psi concrete – maximum water/cement = 0.50
- F. Minimum Cement Content: The minimum cement content utilized for the concrete mix design shall be as follows:
1. 5,000 psi concrete – 715 pounds per cubic yard.
  2. 4,000 psi concrete – 611 pounds per cubic yard.
  3. 3,000 psi concrete – 564 pounds per cubic yard.
- G. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Changes in mix design must have prior approval of the Authority and be at no additional cost to the Authority. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Authority before use in the Work.



- H. Use accelerating admixtures in cold weather only when approved by the Authority. Use of admixtures will not relax cold weather placement requirements.
- I. Use set retarding admixtures during hot weather only when approved by the Authority.
- J. Add air entraining agent to normal weight concrete mix for work exposed to exterior. Design the mix to have air content of  $6 \pm 1.5$  percent.

## 2.06 READY MIX CONCRETE

- A. Comply with requirements of ASTM C94, with the following exceptions:
  - 1. Water can be added to batch for material with insufficient slump only with agreement of the Authority. The Contractor is solely responsible for amount of water added and resulting strength of concrete. If concrete strength does not conform to 28 day compressive strength requirements, it shall be removed and replaced at no cost to the Authority.
  - 2. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified by ASTM C94 may be required.
  - 3. When air temperature is between 85° F and 90°F, reduce mixing and delivery time from 90 to 75 minutes, and when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that subsurface and field conditions are acceptable and ready to receive work.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

### 3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Notify the Authority a minimum of 24 hours prior to commencement of each significant pour. The Authority shall define "significant pour" based on the Contractor's work plan.

- D. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- E. Install vapor barrier under interior slabs on grade. Lap joints minimum 6 inches and seal watertight by sealant applied between overlapping edges and ends.
- F. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier materials; lap over damaged areas minimum 6 inches and seal watertight.
- G. Separate slabs on grade from vertical surfaces with isolation joint material.
- H. Place joint filler in floor slab pattern. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Extend joint filler from bottom of slab to within ¼ inch of finished slab surface.
- J. Install joint devices in accordance with manufacturer's instructions.
- K. Install construction joint devices in coordination with floor slab pattern. Set top to required elevations. Secure to resist movement by wet concrete.
- L. Install joint device anchors. Maintain correct position to allow joint cover to be flush with finished surfaces.
- M. Install joint covers in longest practical length, when adjacent construction activity is complete.

### 3.03 JOINTS

- A. Construction Joints:
  - 1. Locate and install to not impair strength and appearance of structure. Locations to be reviewed by the Authority.
  - 2. Place perpendicular to main reinforcement. Continue reinforcement across construction joints.
- B. Isolation Joints (Slabs on Grade):
  - 1. Construct isolation joints in slabs on grade as indicated on Drawings and at points of contact between slab and vertical surfaces, such as foundation walls, column pedestals, and grade beams.
- C. Contraction (Control) Joints (Slabs on Grade):
  - 1. Location: Construct joints to form panel of patterns. Use inserts ¼ inch wide by ¼ of slab depth unless otherwise indicated.

2. Form joints by inserting a premolded hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured, remove inserts and clean groove of loose debris.
3. With the Authority's written approval, contraction joints may be formed by saw cuts within 24 hours after slab finishing. Do not dislodge aggregate. Use 3/16 inch blade, cut  $\frac{1}{4}$  depth of slab thickness.

#### 3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301, ACI 304, ACI 305, ACI 306 and ACI 318.
- B. Ensure reinforcement, inserts, embedded parts, and formed expansion and contraction joints are not disturbed during concrete placement.
- C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken for each structural pour.
- D. Place concrete continuously between predetermined expansion, control, and construction joints.
- E. Do not interrupt successive placement; do not permit cold joints to occur.
- F. Maintain concrete at joints in walls continuously wet for 12 hours prior to pour. Place minimum 3 inches of grout above joint.
- G. Concrete Placement in Forms:
  1. Deposit concrete into forms continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
  2. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
  3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
  4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

H. Concrete Placement in Slabs:

1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
4. Provide surface within ¼ inch in 10 feet in any direction.
5. Place floor slabs in pattern.

I. Cold Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as specified.
2. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregate before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless chemical accelerators were accepted in mix designs.

J. Hot Weather Placement:

1. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305 and as specified.
2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.
3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete

K. Special Testing:

1. If the Authority determines that any concrete placement has not been completed in accordance with ACI and these specifications, the Contractor shall be

responsible for testing to verify compressive strength and other characteristics of the concrete.

3.05 CONCRETE FINISHING

- A. Provide all formed concrete surfaces to be left exposed to view with smooth rubbed finish. Rub surfaces within 24 hours of form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout.
- B. Provide all formed concrete surfaces not left exposed to view, including interior tank walls from 1 foot below normal water level, with a form finish. Form finish is texture imparted by form facing materials with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼ inch rubbed down or chipped off and repaired.
- C. At tops of walls, horizontal offsets and surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent uniformed surfaces, unless otherwise indicated or directed by the Authority.
- D. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
  - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
  - 2. Check and level surface plane to a tolerance not exceeding ¼ inch in 10 feet. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- E. Apply trowel finish to all monolithic slab surfaces. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet.
- F. Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with the Authority before application.
- G. Finish concrete floor surfaces not receiving other surface finish materials in accordance with ACI 301.
- H. Wood float surfaces which will receive quarry tile with full bed setting system.

- I. Steel trowel surfaces which will receive resilient flooring.
- J. Steel trowel surfaces which are scheduled to be exposed, except those to receive broom finish.
- K. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot.

### 3.06 PROTECTION AND CURING

- A. Protection:
  - 1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

### 3.07 FIELD QUALITY CONTROL

- A. Field testing to be performed in accordance with ACI 301.
- B. Tests of cement and aggregates may be requested by the Authority to ensure conformance with specified requirements.
- C. Fresh concrete sampling shall be in accordance with ASTM C172, with the exception of slump test which shall comply with ASTM C94.
  - 1. Slump: ASTM C143; one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
  - 2. Air Content: ASTM C173, volumetric method for normal weight concrete; ASTM C231 pressure method for normal weight concrete; one test for each set of compressive strength test specimens.
  - 3. Concrete Temperature: Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens made.
  - 4. Compressive Test Specimen: ASTM C31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed by THE AUTHORITY. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
  - 5. Compressive Strength Tests:
    - a. ASTM C39; one set for each 100 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; 2 specimens tested at 7 days, 3 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

- b. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
  - 6. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by the Authority if, in its judgement, adequate evidence of satisfactory strength is provided.
  - 7. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  - 8. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
  - 9. If required by the Authority, one additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- D. Field test results will be reported in writing to the Authority and the Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- E. Independent testing laboratory will make additional tests as directed by the Authority of in place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure. Independent testing laboratory may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods acceptable to the Authority. The Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.
- F. Concrete Basin Testing:
- 1. The Contractor is required to provide impermeable, watertight concrete and joints in structures and divider walls designed to hold water or other solution.
  - 2. Should honeycomb, cracks and/or such imperfections develop in such structures, they shall be fully and completely repaired at the Contractor's expense in a manner satisfactory to the Authority as soon as possible after they are discovered.
  - 3. Concrete work or joints with such imperfections which, in the opinion of the Authority, cannot be successfully repaired shall be removed and replaced with satisfactory work at Contractor's expense.

4. When the concrete work in structures and divider walls designed to hold water or other solutions has attained sufficient strength and all visible honeycomb, cracks or other such imperfections have been repaired, the Contractor shall fill each basin, tank, or compartment with water to within one (1) ft of the top of the structure. If the water level in the basin, tank or compartment being tested falls more than ½ inch in 24 hours, the cause of the leakage shall be determined and repaired and the basin retested.
5. All visible leaks shall also be repaired even though the test for watertightness has been met.
6. All repair work required as a result of the tests for watertightness shall be the Contractor's expense.

### 3.08 PATCHING

- A. Allow the Authority to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Authority upon discovery.
- C. Patch imperfections in accordance with ACI 301 to the satisfaction of the Authority.

### 3.09 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Authority.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon direction of the Authority for each discrete area.

### 3.10 FLOTATION PROTECTION

- A. The Contractor shall be solely responsible for the protection of any new concrete structures against flotation due to high groundwater conditions encountered during construction.
- B. The Contractor shall be responsible to undertake any additional work needed, to include pressure release valves, placement of additional concrete, backfilling and/or dewatering operations to assure flotation does not occur during the construction period at no cost to the Authority.
- C. If flotation does occur, the damaged concrete shall be removed and replaced to the satisfaction of the Authority at the Contractor's expense.

### 3.11 SCHEDULE

- A. Concrete cradles, encasements, and thrust blocks: 3,000 psi 28-day compressive strength.



- B. Strip footings for building foundations; foundations for stairs, bollards and other miscellaneous work: 3,000 psi 28-day compressive strength.

**END OF SECTION**

**SECTION 03 40 00 – PRECAST CONCRETE**

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes**

1. Precast concrete structures, including but not limited to wet wells, valve vaults, metering vaults, etc.
2. Precast concrete liners (HDPE).
3. Joint wrap
4. Accessories required for precast structures.

**1.02 REFERENCES**

**A. American Society for Testing and Materials**

1. ASTM C-33, Standard Specifications for Concrete Aggregate
2. ASTM A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
4. ASTM C890, Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structure.
5. ASTM C913-08, Standard Specification for Precast Concrete Water and Wastewater Structures.

**1.04 SYSTEM DESCRIPTION**

- A. Concrete Compressive Strength (ASTM C39): 5,000 psi minimum at 28 days.
- B. Water Resistive: No water intrusion through wall, base or top sections.
- C. Concrete shall be designed to be resistant to sulfate.
- D. Design standard precast concrete units to withstand design load conditions in accordance with applicable industry standards. Design must consider stressed induced during handling, shipping, and installation to avoid cracking or other handling damage.

**1.05 SUBMITTALS**

- A. Comply with Section 01 33 00.
- B. Product Data:
  1. Manufacturer's data

2. Manufacturer's standard storage, handling, and installation instructions
- C. Shop Drawings: Shop drawings shall be sealed by a Professional Engineer registered with the Pennsylvania State Registration Board and shall illustrate:
1. Plans, elevations, sections, and details of base, wall and top components.
  2. Joint details illustrating sealant and external wrap material.
  3. Pipe penetration details illustrating size, location and type of seal.
  4. Liner details illustrating embedment, field welding, joint coverage and interfacing with penetrations.
  5. Hatch frame details.
- D. Calculations: Calculations shall be sealed by a Professional Engineer registered with the Pennsylvania State Registration Board and shall include.
1. Buoyancy calculations assuming ground water elevation is equal to the top of concrete elevation provided on the Contract Drawings.
  2. Structural calculations.
- E. Quality Assurance/Control Submittals
1. Design date
  2. Test Reports
    - a. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
    - b. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete.
    - c. Concrete Testing
      - i. Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.
      - ii. Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C 1064.
      - ii. Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless

otherwise specified. In accordance with ASTM C 31, C 39, C 192.

3. Qualification Statements

- a. Upon request, the precast concrete producer shall supply copies of in-plant QA/QC inspection reports.

1.06 QUALITY ASSURANCE

- A. Qualifications: Manufacturer's standard product listing shall include wastewater products. The precast concerted producer shall have a quality control program which is audited for compliance.
- B. Certifications: Manufacturer shall be certified by the National Precast Concrete Association (NPCA) and shall have been for a minimum of five (5) years.
- C. Quality Control

- 1. The precast concrete producer shall show that the following quality control tests are performed as required and in accordance with ASTM International standards:

- a. Concrete Testing

- 1. Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.
- 2. Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C1064.
- 3. Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless otherwise specified. In accordance with ASTM C 31, C 39, C 192.
- 4. Air Content: Tests for air content shall be performed if the mix design specifies air entrainment. The air content will be measured in accordance with ASTM C 231. The Air Content shall be measured once per day per mix design.
- 5. Density (Unit Weight): Tests for Density (Unit Weight) shall be performed monthly for each mix design used at a minimum. Tests shall be in accordance with ASTM C 138

- b. Aggregate Testing

- 1. A full set of aggregate tests shall be performed on each aggregate at least annually by an independent testing agency or an in house test lab. These tests will include gradations (ASTM C136), Soundness (ASTM C 88), Organic Impurities (ASTM C 40), Sand Equivalent for fine aggregates only (ASTM D 2419).

2. Potential reactivity shall be performed once per each aggregate source, and when aggregate sources change (ASTM C 1260 or C1293).
3. Monthly, at a minimum, gradations shall be performed per ASTM C33.
4. Aggregate Moisture tests: Moisture tests on aggregates shall be performed in accordance with ASTM C 70 or ASTM C 566. Fine aggregate moisture content tests shall be performed at least once per day if there are no moisture meters, otherwise it shall be performed once per month. Alternatively the speedy moisture test is acceptable (ASTM D 4944).

c.      Preplacement Check

1. All products shall be inspected for accuracy prior to placing concrete. Checks shall include, but not be limited to, form condition and cleanliness, form dimensions, joints, release agent, blockouts, inserts and locations, lifting devices, reinforcing steel size, spacing, clearances and proper placement.
2. Preplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

d.      Postplacement Check

1. All products shall be inspected for accuracy after the concrete forms have been removed. Checks shall include, but not be limited to, dimensional checks, finishing, insert locations, squareness, honeycombing, cracking, marking, coatings, racking, hole size and location. Postplacement checks may require a corrective action report.
2. Postplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

D.      Outside Inspection

1. The customer or customer's agent (specifier) may place an inspector in the plant when the units covered by this specification are being manufactured. The precast concrete producer shall give notice of 3 days prior to the time the precast concrete units will be available for plant inspection

E.      Pre-installation Meeting

1. Contractor shall coordinate a project site meeting prior to delivery and installation with representatives of Authority, precast manufacturer, and installer to review site conditions, access to site, requirements of related of pre-requisite work (i.e. excavation, subgrade preparation, etc.), storage and hauling procedures, and protective measures.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Ship and handle precast sections in a manner as recommended by the manufacturer that will prevent damage. Units shall not be shipped until they have reached at least 70% of their specified 28-day design strength, unless damage will result.
- B. Acceptance at Site: Contractor shall be available at the site to take acceptance of all deliveries. Authority shall not be responsible for acceptance of deliveries. All deliveries attempted to be made without a Contractor's representative will be refused.
- C. Storage and Protection: Store precast concrete units in a manner that will minimize potential damage.

**PART 2 – PRODUCTS**

2.01 PRECAST REINFORCED WET WELLS

- A. Manufacturers
  - 1. Refer to Appendix A – List of Acceptable Manufacturers
- B. Concrete: Comply with Section 03 30 00.
- C. Pre-cast Concrete Sections:
  - 1. Pre-cast wet wells shall conform to specifications for ASTM C 478 "Pre-cast Reinforced Concrete Manhole Sections".
  - 2. The minimum wall thickness shall be eight inches. Pre-cast wet-wells shall be constructed with a pre-cast monolithic base structure having a minimum base thickness of eight inches.
  - 3. All sections shall have tongue and groove or otherwise overlapping joints. Joints shall be self-sealing utilizing a double layer of bituminous, butyl rubber sealant meeting or exceeding the requirements of ASTM C-990-91.
  - 4. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each pre-cast section.
  - 5. Pre-cast concrete top slabs shall be used.
  - 6. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the sections.
  - 7. The wet well joints shall be encapsulated with a heat shrink-wrap with a minimum thickness of 0.100". The wrap shall have a cross-linked polyolefin backing coated with a protective heat activated adhesive. The wrap should effectively bond to the substrate via primer provided by the manufacturer, providing corrosion and moisture protection. Joint wrap shall be ConWrap CS-212 by ConSeal conforming to ASTM E-1745, C-877, C-990 Specifications, or equal.

- E. Pipe Openings: Custom preformed during manufacturing to accommodate type of pipe and pipe opening seal specified.
  - 1. Modular Mechanical Type Pipe Opening Seals: Sleeves shall be cast into the concrete with water stop collar. Seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolute watertight seal between the pipe and the wall opening. The seal shall be constructed so as to provide electric insulation between the pipe and wall to reduce the occurrence of cathodic reaction between the two members. Wall penetration closures shall be "Link-Seal" as manufactured by Thunderline Corp., or equal.
- F. HDPE Liner: All interior wall and top surfaces of the wet wall shall have a protective liner.
  - 1. The HDPE embedment sheeting shall be mechanically bonded to the concrete by integral studs. The liner shall be cast in place by the precast manufacturer and all joints shall be fielded welded by a qualified and trained representative. Minimum thickness of the liner shall be 5 mm. All inserts and sleeves for piping shall be in accordance with the liner manufacturer's recommendations and shall result in complete coverage of all pre-cast sections.
- G. Exterior walls shall receive two coats of coal tar coating.
- H. Access Hatches shall be integrally cast into the concrete top to maximize the opening dimensions based on the wet well diameter and top configuration in accordance with Section 08 31 13.

## 2.01 PRECAST REINFORCED VAULTS

- A. Manufacturers
  - 1. Refer to Appendix A – List of Acceptable Manufacturers
- B. Concrete: Comply with Section 03 30 00.
- C. Pre-cast Concrete Sections:
  - 1. Pre-cast vaults shall conform to specifications for ASTM C 478 "Pre-cast Reinforced Concrete Manhole Sections".
  - 2. The minimum wall thickness shall be six inches. Pre-cast vaults shall be constructed with a pre-cast monolithic base structure having a minimum base thickness of eight inches.

3. All sections shall have tongue and groove or otherwise overlapping joints. Joints shall be self-sealing utilizing a double layer of bituminous, butyl rubber sealant meeting or exceeding the requirements of ASTM C-990-91.
  4. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each pre-cast section.
  5. Pre-cast concrete top slabs shall be used.
  6. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the sections.
  7. Vault joints shall be encapsulated with a heat shrink-wrap with a minimum thickness of 0.100". The wrap shall have a cross-linked polyolefin backing coated with a protective heat activated adhesive. The wrap should effectively bond to the substrate via primer provided by the manufacturer, providing corrosion and moisture protection. Joint wrap shall be ConWrap CS-212 by ConSeal conforming to ASTM E-1745, C-877, C-990 Specifications, or equal.
- E. Pipe Openings: Custom preformed during manufacturing to accommodate type of pipe and pipe opening seal specified.
1. Modular Mechanical Type Pipe Opening Seals: Sleeves shall be cast into the concrete with water stop collar. Seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolute watertight seal between the pipe and the wall opening. The seal shall be constructed so as to provide electric insulation between the pipe and wall to reduce the occurrence of cathodic reaction between the two members. Wall penetration closures shall be "Link-Seal" as manufactured by Thunderline Corp., or equal.
- F. Exterior walls shall receive two coats of coal tar coating.
- G. Access Hatches shall be integrally cast into the concrete top and located to facilitate removal of internal equipment, valves, piping, etc. Opening shall be a minimum of 30" square. Refer to Section 08 31 13.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Prepare subgrade as specified in Division 31.



- B. Place base unit, wall sections and top unit. Insure that gaskets for water tightness are properly installed between successive units.
- C. Remove or conceal lifting devices or inserts, and protect from rust or corrosion.
- D. Backfill structures in accordance with Division 31.

3.02 FIELD QUALITY CONTROL

- A. Field Test: Leak resistance testing is required for all precast concrete structures. Contractor shall utilize one or both of the of the following methods
  - 1. Vacuum Testing
    - a. Prior to backfill, vacuum test system according to ASTM C 1244 for manholes and ASTM C 1227 for septic tanks.
  - 2. Hydrostatic Testing
    - a. First Backfill the structure, then fill to the high water level, let stand for 24 hours. Refill to the original water line and measure the water level change over a 24 hour period. Loss due to leakage shall not exceed 1% of volume.
- B. Inspection
  - 1. Final field elevations and compaction properties shall be verified and documented.

**END OF SECTION**

**SECTION 08 31 13 - ACCESS HATCHES AND FRAMES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Floor Access Hatch. (exterior)

**1.02 SUBMITTALS**

- A. Product Data: For each type of hatch and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access hatches and frames.
- B. Shop Drawings: Show fabrication and installation details of customized hatches and frames. Include plans, elevations, sections, details, and attachments to other Work.
  - 1. Method of attaching hatch frames to surrounding construction.

**1.03 QUALITY ASSURANCE**

- A. Size hatches to maximize opening.
- B. Manufacturer shall have a minimum of five (5) years of experience with similar products.
- C. Source Limitations: Obtain hatches and frames through one source from a single manufacturer.
- D. Size Variations: Obtain Authority's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

**1.04 COORDINATION**

- A. Verification: Determine specific locations and sizes for access hatches needed to gain access to concealed equipment.

**1.05 WARRANTY**

- A. The Contractor and the Manufacturer shall warrant all manufactured items supplied under this section for a period of one (1) year. Warranty period shall commence on the date of substantial completion. This warranty shall include repair or replacement of any item failing during normal use. In the event that the manufacturer's standard warranty for any given item exceeds the period of one (1) year following substantial completion, then the longer period shall govern.
- B. Manufactured items shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it will be replaced at no expense to the Authority.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exceptions to this provision shall be allowed.

## **PART 2 – PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Floor Hatches:
    - a. Bilco
    - b. Halliday Products

### **2.02 FLOOR ACCESS HATCH**

- A. Floor Access Hatches shall be single or double leaf as indicated on Contract Drawings or identified on applicable schedules.
- B. Performance characteristics:
  - 1. Covers: Shall be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span. Manufacturer to provide structural calculations stamped by a registered professional engineer upon request. (Note: For installation in an off-street location where not subject to high density, fast moving traffic.)
  - 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
  - 3. Operation of the covers shall not be affected by temperature.
  - 4. Entire Hatch, including all hardware components, shall be highly corrosion resistant.
- C. Covers: Shall be 1/4" (6mm) aluminum diamond pattern.
- D. Frame: Channel frame shall be extruded aluminum with bend down anchor tabs around the perimeter.
- E. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.
- F. Drain Coupling: Provide a 1-1/2" (38mm) drain coupling located in the right front corner of the channel frame [note: can be placed at a different location if specified].
- G. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" (6mm) gusset support plate.

- H. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
- I. Hardware:
  - 1. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4" (6mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
  - 2. Covers shall be equipped with a hold open arm which automatically lock each cover in the open position.
  - 3. Covers shall be fitted with the required number and size of compression spring operators. Springs and spring tubs shall be Type 316 stainless steel.
  - 4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the covers.
  - 5. Hardware: Shall be Type 316 stainless steel throughout.
- J. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

#### 2.03 FABRICATION

- A. General: Provide access hatch assemblies manufactured as integral units ready for installation. Retrofit to existing precast concrete structure.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Latching Mechanisms: Furnish number required to hold hatches in flush, smooth plane when closed.

#### 2.04 FINISHES, GENERAL

- A. Factory finish shall be mill finish aluminum.

### PART 3 – EXECUTION

#### 3.01 PREPARATION

- A. Advise installers of other work about specific requirements relating to access hatch and floor hatch installation, including sizes of openings to receive access hatch and frame, as well as locations of supports, inserts, and anchoring devices.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor access Hatches and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install floor access Hatches flush with adjacent finish surfaces or recessed to receive finish material.
- D. Install units level, plumb, and in proper alignment with adjacent work.

3.03 ADJUSTING AND CLEANING

- A. Adjust hatches and hardware after installation for proper operation.
- B. Remove and replace hatches and frames that are warped, bowed, or otherwise damaged.
- C. Exposed surfaces shall be cleaned using methods acceptable to the manufacturer which will not damage the finish.

**END OF SECTION**

**DIVISION 09 - FINISHES**  
**SECTION 09 91 00 – PAINTING**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Surface preparation and field application of paints and coatings.

1.02 REFERENCES

- A. American Society for Testing and Materials
  - 1. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
  - 2. ASTM D2016 - Test Method for Moisture Content of Wood.
- B. National Association of Corrosion Engineer
  - 1. NACE - Industrial Maintenance Painting.
  - 2. NPCA - Guide to U.S. Government Paint Specifications.
- C. Steel Structures Painting Council
  - 1. SSPC - Steel Structures Painting Manual.

1.03 DEFINITIONS

- A. Refer to ASTM D16 for interpretation of terms used in this Section.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 01 33 00.
- B. Product Data: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.
- C. Samples: Submit samples of manufacturer's available paint colors for selection.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

1.05 COORDINATION

- A. Completely paint and finish all new surfaces throughout the project, including but not limited to, building, all new exposed piping, and mechanical equipment.
- B. The Contractor shall familiarize himself with the specifications of various other trades and all surfaces left unfinished by the requirements of their specifications shall be painted or finished as part of this Contract.
- C. All finish coat paint materials must be compatible with shop or manufacturer's prime coat

materials.

- D. No painting work shall be initiated until the item of equipment, materials, tankage, piping, or duct has satisfactorily passed the required testing.

#### 1.06 QUALITY ASSURANCE

##### A. Field Samples

1. Provide field sample of paint when requested by the Authority.
2. Provide field sample on smooth plywood, 12 inches square, illustrating coating color, texture, and finish.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, Federal Specification number, contents by volume, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45°F and a maximum of 90°F, in ventilated area, and as required by manufacturer's instructions.
- D. Storage space shall be kept clean at all times. Every precaution shall be taken to avoid fire hazards.

#### 1.08 PROJECT/SITE CONDITIONS

##### A. Environmental Requirements

1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the manufacturer.
2. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the manufacturer.
3. Minimum Application Temperatures for Paints: 45°F for interiors; 50°F for exterior; unless required otherwise by manufacturer's instructions.

#### 1.09 MAINTENANCE

##### A. Extra Materials

1. Provide one gallon of each color and type to Owner.
2. Label each container with color, type, texture, and locations in addition to the manufacturer's label.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Paint materials listed in the Schedule, are products of Tnemec and Carboline unless otherwise stated.
- B. Equivalent products of the following manufacturers may be used subject to approval.
  - 1. M.A.B. Paints, Inc.
  - 2. Sherwin-Williams, Inc.
  - 3. Or Equal

### **2.02 MATERIALS**

- A. Coatings: Ready mixed, except field-catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.
- E. Provide undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- F. Chemical Paint Remover: Manufacturer's standard formulation for removing paint coatings from masonry, concrete, or metal.
- G. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film forming, strippable masking material for protecting glass and metal surfaces from damaging effect of cleaners and removers.

### **2.03 FINISHES**

- A. Refer to paint schedule on the Contract Documents at end of section for surface finish schedule.
- B. Colors to be selected by Owner; not necessarily manufacturer's standard colors. Refer to color schedule at end of section and Contract Drawings.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify site conditions.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer. Verification by manufacturer's representative.



- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Starting of painting work will be construed as Contractor's acceptance of surfaces and conditions within any particular area or associated with any equipment or product.
- E. Test shop applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

### 3.02 GENERAL PREPARATION PROCEDURES

- A. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.
- C. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Correct defects and clean surfaces, which affect work of this Section. Remove existing coatings that exhibit loose surface defects.
- E. Seal with shellac and seal marks, which may bleed through surface, finishes.
- F. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Galvanized Surfaces Do not paint.
- I. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, fins and protrusions, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- J. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by power tool wire brushing or sandblasting; clean by washing with solvent as defined by SSPC SP1 methods. Ferrous metal surfaces subject to immersion service or wet conditions will be prepared in accordance with SSPC SP10 abrasive blast procedures as per instructions under 3.08. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- K. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent as per SSPC SP 1 methods. Prime bare steel surfaces.
- L. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to

priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Sandpaper to smooth finish prior to final coat.

- M. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.
- N. Plastic Surfaces: Sandpaper to rough surface, remove dust.
- O. Exposed Tar Coated Pipes and Fittings: All exposed or nonsubmerged piping and fittings which are tar coated and which are to be painted shall receive one coat of primer equal to Carbogaurd 60 @ 2.0 – 3.0 mils DFT, prior to applying finish coats.

### 3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish. Finished surface shall be uniform in finish and color and free of brush marks, sagging, corduroy and other imperfections. Should any coat be judged unsatisfactory, Contractor shall sandpaper or otherwise clean off this coat and apply another. If the undercoating is disturbed, complete refinishing will be required.
- D. Apply each coat at rate specified by manufacturer to achieve the minimum thickness recommended by manufacturer. Deficiencies in film thickness shall be corrected by application of additional coat(s) of paint.
- E. Apply paint under conditions of adequate ventilation and illumination.
- F. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- G. Finish exterior doors on tops, bottoms and side edges same as exterior faces.
- H. Omit first coat (primer) on metal surfaces, which have been shop-primed and touch-up painted, unless otherwise indicated.
- I. Edges of paint or finish adjoining other materials or colors shall be sharp and clean without overlapping. Should workmanship be found defective, proper preparatory work shall be done and additional coats applied as necessary to give a finish in accordance with specified requirements. All finish hardware, accessories, fixtures and similar items installed prior to painting and not required to be painted, shall be removed or protected during such painting. If removed, the items shall be carefully replaced and adjusted upon completion of the painting.
- J. All paint shall be airless spray roller or brush applied. Extreme care shall be exercised in spray application that no finished materials are damaged. If this condition should occur, repair or replace damaged materials.
- K. Contractor shall protect his work, work by others, adjacent work, and existing plant by carefully covering with drop cloths. Upon completion of work, remove all paint spots from the floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials. When all other trades are finished, inspect building and equipment and touch up all abrasions, scratches, etc. to the satisfaction of Engineer. Contractor shall be responsible to deliver the painting work in a clean and undamaged condition.

- L. Apply prime coat to material which is required to be painted or finished, and which has not been prime coated by others.
- M. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- N. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- O. Sand wood and metal lightly between coats to achieve required finish.
- P. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- Q. Allow applied coat to dry before next coat is applied.
- R. Prime concealed surfaces of interior and exterior woodwork with primer paint.
- S. Paint complete surface of all exposed pipes and valves.

#### 3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Engineer shall provide schedule of color coding and identification banding of equipment, duct work, piping, and conduit. See color schedule at end of section.
- B. Paint shop primed equipment. Any equipment shop primed with an epoxy-based primer must be finish coated with a compatible epoxy product.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports except where items are prefinished, with either baked enamel, stainless steel, or aluminum.
- E. Paint exposed electrical equipment same color as adjacent wall.
- F. Paint both sides and all edges of plywood backboards for electrical and telephone equipment before installing equipment.
- G. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements of Engineer. Color band and identify with flow arrows and names for each exposed pipeline. Provide names and numbers in each item of equipment. All pipe and equipment banding and identification will be in corresponding colors selected by Engineer.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

#### 3.05 PROTECTIVE PAINTING

- A. Aluminum: Aluminum surfaces shall be prevented from direct contact with dissimilar materials or concrete by one of the following methods:
  - 1. Dissimilar metals, except stainless steel, white bronze, and solid zinc, shall be painted with a heavy brush or spray coat of zinc- chromate primer and one coat of aluminum paint; or shall be painted with one heavy brush coat of alkali-resistant bituminous paint;

or shall be separated from the aluminum by a heavy coat of mastic caulking compound, or by a non-absorptive tape or gasket.

2. Dissimilar metals used in locations where drainage from those metals passes over aluminum shall be painted to prevent staining of aluminum.

B. Copper:

1. Copper piping shall be prevented from direct contact with concrete surfaces with a complete coating of a coal tar epoxy.
2. For copper pipe penetrations through walls or floors or other concrete surfaces, the protective coating shall extend no less than 2 inches from the concrete surface.

3.06 CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.07 SURFACE PAINTING REQUIREMENTS

- A. Provide painting of all interior and exterior exposed items and surfaces throughout project, except as specifically otherwise indicated.
- B. Completely paint and finish all surfaces throughout the interior and exterior of the building; exposed piping, mechanical equipment, cabinet work and to provide protective coatings on concrete structures in contact with liquid and earth.
- C. Contractor shall become completely familiar with the specifications of various trades and other prime contractors and all surfaces left unfinished by the requirements of their specifications shall be painted or finished as part of this Contract with the exception of the following:
1. Aluminum Work
  2. Ceiling Tile
  3. Primer coat on items specified to be primed at the shop
  4. Electrical Panels
  5. Stainless Steel Items
  6. Other non-ferrous metal such as brass, bronze, copper, etc., unless specifically indicated.
- D. Unless otherwise indicated on the Drawings, the painting shall include all new surfaces installed as a part of this project, specifically including, but not necessarily limited to, the following items:
1. All interior masonry concrete walls and ceilings.
  2. All interior woodwork.
  3. All miscellaneous metal work other than aluminum fabrications.
  4. All machinery and equipment, including HVAC and electric equipment furnished by others.

5. All piping, valves and appurtenances.
6. All structural steel and metal roof decks.
7. Dissimilar metals protection.
8. Protection of copper from concrete.
9. Exterior reinforced concrete building and tank walls shall not be painted above grade.
10. The omission of minor items not described herein shall not relieve the Contractor of his obligation to include such items where they come within the general intent of these Specifications.

### 3.08 PAINT SCHEDULE

All such notations "2.0 – 3.5" refers to dry film mills. The Authority shall select color from manufacturer's standard colors, unless otherwise noted.

- A. Masonry Surfaces (Interior Walls & Ceilings above grade cast-in-place or precast)
  1. Surface Preparation: 28 day cure. Prepare surfaces in accordance with 3.02.I. Surfaces shall be clean and dry.
  2. First Coat: N69 Epoxoline / Carboguard 60 @ 2-3 mils DFT.
  3. Second Coat: 1075 Endurashield / Carboline Sanitile 655 @ 3-5 mils. DFT.
- B. Masonry Surfaces (Interior Walls & Ceilings – Porous Block)
  1. Surface Preparation: Surface shall be clean and dry.
  2. Primer/Block Filler: 130 Envirofil / Sanitile 100 @ 75 – 85 sqft/gal. (Fill voids wider than ¼" with Series 63-1500 / Carboguard 501).
  3. Second Coat: Series N69 / Carboguard 60 @ 225 sqft/gal.
  4. Third Coat: Series 84 / Sanitile 655 @ 225 sqft/gal.
- C. Interior Non-Submerged / Exterior Non-Submerged Ferrous Metals
  1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
  2. Shop Primer: Tnemec N69-1211 / Carbogaurd 60 @ 3.0 - 5.0 mils DFT.
  3. Field First Coat: Tnemec N69 / Carbogaurd 60\* @ 3.0 - 5.0 mils DFT.
  4. Field Finish Coat: Interior: Series N69 / Carbogaurd 60 \*\* @ 3.0 – 5.0 mils DFT.  
Exterior: Series 1075 Endurashield / Carbothane 133 VOC @ 3.0 – 5.0 mils DFT.

\* Color same as finish.  
\*\* For exterior, use Tnemec 1075 Endurashield / Carbothane 133 VOC.
- D. Ferrous Metal – Immersion or Wet conditions – Not Shop Primed
  1. Surface Preparation: SSPC-SP10 Near White Metal.

2. First Coat: N69-1255 Epoxoline / Carbogaurd 60 @ 6.0 – 8.0 mils DFT.
  3. Finish Coat: 104 HS Epoxy / Carbogaurd 890 @ 6.0 – 8.0 mils DFT.
- E. Ferrous Metal – Immersion or Wet conditions – Shop Primed
1. Surface Preparation: SSPC-SP10 Near White Metal.
  2. Shop Prime: N69-1211 / Carbogaurd 60 @ 4.0 – 6.0 mils DFT.
  3. Intermediate Coat: Series N69 / Carboguard 60 @ 4.0 – 6.0 mils DFT.
  4. Finish Coat: Series 104-HS / Carbogaurd 890 @ 8.0 – 10.0 mils DFT.
- F. Metal Equipment and Machinery (Interior)
1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
  2. Shop Prime: N69 Epoxoline / Carbogaurd 60 @ 3.0 – 5.0 mils DFT.
  3. Field Touch-up: N69 Epoxoline / Carbogaurd 60 @ 2.0 – 3.0 mils DFT.
  4. Finish Coat: 1080 Endurashield / Carbothane 134 WB @ 3.0 – 5.0 mils DFT.
- G. Ferrous Metal (Exterior)
1. Surface Preparation: SSPC-SP6 commercial Blast Cleaning.
  2. Shop Prime: 90-97 Tneme-Zinc/Carbozinc 859 @ 3.0 – 5.0 mils DFT.
  3. Field Touch-Up: 90-97 Tneme-Zinc/Carbozinc 859 @ 2.0 – 3.0 mils DFT.
  4. Intermediate Coat: N69 Epoxoline/Carbogaurd 60\* @ 2.0 – 3.0 mils DFT (Light Grey Color).
  5. Finish Coat: 1075 Endurashield/Carbothane 133VOC @ 2.0 – 3.0 mils DFT.
- H. Galvanized Metal (Exterior)
1. Surface Preparation: SSPC-SP1 Solvent Cleaning. Use a pretreatment similar in performance to Great Lakes Chemical Clean & Etch.
  2. First Coat: N69 Epoxoline/Carbogaurd 60 @ 2.5 – 3.5 mils DFT.
  3. Finish Coat: 1075 Endurashield/Carbothane 133VOC @ 2.0 – 3.0 mils DFT.
- I. Mill Finish Aluminum (Exterior)
1. Surface Preparation: Surface shall be clean and dry/SSPC-SP1.
  2. First Coat: N69 Epoxoline / Carbogaurd 60\* @ 1.0 – 2.0 mils DFT.
  3. Finish Coat: 1075 Endurashield/Carbothane 133VOC @ 2.0 – 3.0 mils DFT.
- J. Galvanized Metal (Interior)
1. Surface Preparation: Surface shall be clean and dry/SSPC-SP1. Use a pretreatment

similar in performance to Great Lakes Chemical Clean & Etch.

2. First Coat: N 69 / Carboguard 60 @ 2.0 – 3.0 mils DFT.
  3. Finish Coat: N69 Epoxoline / Carboguard 60 @ 2.0 – 3.0 mils DFT.
- K. Mill Finish Aluminum (Interior)
1. Surface Preparation: Surface shall be clean and dry/SSPC-SP1.
  2. First Coat: N69 Epoxoline / Carboguard 60 @ 2.0 – 3.0 mils DFT.
  3. Finish Coat: 114 Tuf Coat / Sanitile 555 @ 2.0 – 3.0 mils DFT.
- L. Generator Exhaust Pipe
1. Surface Preparation: SSPC-SP6 commercial Blast Cleaning.
  2. First Coat: 90-E-92 / Carbozinc 11 @ 1.0 – 2.0 mils DFT.
- M. Copper
1. Surface Preparation: Surface shall be clean and dry.
  2. First Coat: N69 Epoxoline/ Carboguard 60 @ 3.0 – 5.0 mils DFT.
- N. Insulated Piping
1. Surface Preparation: Surface shall be clean and dry.
  2. First Coat: 28 Tufcryl / Carbocrylic 3359 @ 2.0 – 3.0 mils DFT (Light Grey Color).
  3. Finish Coat: 28 Tufcryl / Carbocrylic 3359 @ 2.0 – 3.0 mils DFT
- O. Plaster and Gypsum Wallboard
1. Surface Preparation: Surface shall be clean and dry (lime plaster, 28 day cure).
  2. First Coat: 51 – 792 / Carbocrylic 120 @ 2.0 – 3.0 mils DFT.
  3. Second Coat: 113 Tneme-Tufcoat / Sanitile 555 @ 3.0 – 4.0 mils DFT.
  4. Third Coat: 113 Tneme-Tufcoat / Sanitile 555 @ 3.0 – 4.0 mils DFT, Color to be chosen by Owner.
- P. Tar-Dipped Piping
1. Surface Preparation: Surface shall be clean and dry.
  2. First Coat: N69 Epoxoline / Carboguard 60 @ 2.0 – 3.0 mils DFT.
  3. Finish Coat: N69 Epoxoline / Carboguard 60 @ 2.0 – 3.0 mils DFT.
- Q. Galvanized Steel (mild exposure such as ducts and chain link fences)
1. Surface Preparation: Surface shall be clean and dry. SSPC-SP2 or SSPC-SP3 all

rusted areas.

2. Spot Prime: 22-Color Galv-Gard / Galvanox @ 2.0 – 3.0 mils DFT.
3. Finish Coat: 22-Color Galv-Gard / Galvanox @ 2.0 – 3.0 mils DFT.

R. High Temperatures (steel)

39-661: Dry continuous 600F  
39-1061: Dry continuous 1,000F  
39-1261: Dry continuous 1,200F

1. Surface Preparation: SSPC-SP10 Near-White Blast Cleaning.
2. First Coat: Carbozinc CZ 11 HS @ 2.0-3.0 mils DFT.
3. Second/Third Coat: Thermaline 4700 VOC @ 1.0 – 2.0 mils/ct.

S. Exterior Existing Latex Coatings (Concrete or CMU)

1. Surface Preparation: High Pressure wash to remove chalk and loose existing coating. Feather all edges.
2. First Coat: 151-Elasto-Grip / Carbocrylic 120 @ 1.5 – 2.0 mils DFT.
3. Finish Coat: 156-Enviro-Crete / Carboline Flexide\* @ 6.0. – 8.0 mils DFT.

\* If rolled or brushed, may require two coats for complete hiding and to attain DFT.

T. Chemically Resistant Coating for Chemical Storage Sumps

1. Surface Preparation; Abrasive brush blast or diamond cup wheel grind to create surface similar in texture to 30-40 grit sandpaper. Apply Series 218 MortarClad / Carboguard 510 (Epoxy Modified Concrete) with trowel blade to thickness required to fill voids in excess of pinholes. Surfaces should pass ASTM Plastic Sheet and anhydrous calcium chloride moisture tests (< 3.5 lbs pressure) and demonstrates a pH between 7-11.
2. Primer: 201 Epoxoprime / Semstone 110 @ 6-8 mils DFT.
3. First Coat: 282-Tneme Glaze / Semstone 140 @ 10.0- 14 mils DFT.
4. Finish Coat (Joints Only): 265- TG / Semstone 805 @ 60.0 + mils DFT.

U. Interior Concrete Sealer

1. Surface Preparation: Acid Etch or brush-off blast @ 2.0 – 3.5 (28 day cure).
2. First Coat: 203 Epoxoprime / Carboguard 1340 @ 2.0 – 3.0 mils DFT.

V. Wood Surfaces (interior and exterior)

1. Surface Preparation: Surface shall be clean and dry.
2. Primer: Tnemec 51-792 / Carbocrylic 120 @ 1.0 – 2.0 mils DFT.



3. Intermediate Coat: Tnemec 29 / Carbocrylic 3359 (LT Gray) @ 2.0 – 3.0 mils DFT.
4. Finish Coat: Tnemec 29 / Carbocrylic 3359 @ 2.0 – 3.0 mils DFT (color as chosen by Owner)

W. Exterior Concrete Sealer

1. Surface Preparation: High pressure wash to remove dust, dirt and salt. Do not apply over wet surfaces. The material to be treated shall be dry.
2. First Coat: Endur-O-Seal USA, Inc., CS-20 Plus (180 ft<sup>2</sup>/gal) or approved equal.
3. Finish Coat: Endur-O-Seal USA, Inc., CS-20 Plus (180 ft<sup>2</sup>/gal) or approved equal.”

X. Submerged Concrete

Surface Preparation: All surfaces will be abrasive brush blasted in accordance with SSPC SP 7 Brush Blast methods removing dirt, laitance, and other contaminants which would compromise coating adhesion. Surface preparation should provide a surface profile similar to 30-40 grit sandpaper. All surfaces will be clean and dry. Surfaces should pass ASTM plastic sheet test for moisture and demonstrate a pH between 7-11.

Option 1: Epoxy Lining w/ Trowel Grade Filler to amend bugholes.

Primer: Series 69 / Carboguard 60 @ 6.0 – 8.0 mils DFT. Spray and backroll to force material into voids.

Surfacer: Fill holes in excess or ¼” with broad knife applied Series 63-1500 / Carboguard 501.

Finish: Series 104 HS Epoxy / Carboguard 890 or 890 LT @ 10 – 12 mils DFT. Spray and backroll to force material into voids.

Option 2: Flexible Polyurethane Lining.

Series 69 / Carboguard 60 @ 3.0 – 4.0 mils DFT. Spray and backroll.

Series 406 / Polyclad 708 @ 30 – 50 mils DFT.

Note: Coordinate steel primer (shop) with appropriate steel section, such as Division 5 (Structural Steel) and miscellaneous metals such as equipment, etc.

3.09 COLOR CODING AND LETTERING OF PIPING

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition. The system shall include the application of color coding to all new and altered plant piping. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor.
- B. In addition to the legends specified herein the Engineer may order the Contractor to furnish and install additional identification legends and arrows at no additional cost to the Owner. Such additional signs may be requested near completion of the work and shall be limited to no more than five (5) signs for each type specified herein. The legends and color combinations for additional signs shall conform to the requirements specified herein.
- C. The Contractor shall submit a schedule of the colors and designations proposed in accordance with Division 1 and this Section. A minimum of four (4) color charts with cross-references to the colors listed herein shall be included with the Submittal.

- D. Piping Band: All new and altered piping shall receive identification bands. Such bands shall be 6-inches wide, neatly made by masking, and spaced at intervals of 30-inches on centers regardless of the diameter of the pipe being painted. The Contractor may use approved precut and prefinished metal bands on piping, in lieu of the masked and painted bands, where approved by the Engineer.
- E. Piping Identification Legend: The Contractor shall apply identification legends to all types and sections of piping as shown on the Drawings or as designated by the Engineer. Where there is existing piping of identical service as provided herein, the Contractor shall provide identification labels to match the existing identification labels. Such legends shall be in the form of plain block lettering giving the name of the pipe content in full or abbreviated form, and showing the direction of flow by arrows. Identification lettering shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen (15) feet in pipe length, and shall be properly inclined to the pipe axis to facilitate easy reading. In the event lettering and arrow identifications are required for piping less than 3/4-inch in diameter, the Contractor shall furnish and attach approved color coded tags where instructed. All lettering and arrows shall be of the plastic snap-on type, or they shall be formed by stenciling in an approved manner using white or black as directed and shall have an overall height in inches in accordance with the following table:

<u>DIAMETER OF PIPE OR PIPE COVERING</u>	<u>HEIGHT OF LETTERING</u>
3/4 to 1-1/4 inches	1/2-inches
1-1/2 to 2-inches	3/4-inches
2-1/2 to 6-inches	1-1/4-inches
8 to 10-inches	2-1/2-inches
Over 10-inches	3-1/2-inches

- F. Color Schedule

<u>SERVICE</u>	<u>LEGEND</u>	<u>COLOR</u>
Reclaimed Water	Reclaimed	Purple
Raw Sewage	Raw Sewage	Gray
Natural Gas	Natural Gas	Yellow

### 3.10 COLOR CODING OF INTERIOR

- A. The Contractor shall effect approved color coding of all interior finishes by application of a finish enamel in accordance with the colors selected by the Authority.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 19 – ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

1.02 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For each type of product indicated.
- C. Field quality-control test reports.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

2.01 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Insulated Wire Corp.; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Southwire Company.
  - 4. Approved equal.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN and XHHW.

2.02 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. O-Z/Gedney; EGS Electrical Group LLC.
  2. 3M; Electrical Products Division.
  3. Tyco Electronics Corp.
  4. Approved equal.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### **PART 3 - EXECUTION**

#### **3.01 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper, Stranded
- B. Branch Circuits: Copper. Solid for No. 14 AWG and smaller; stranded for No. 12 AWG and larger.

#### **3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Type THW, THHN-THWN, or XHHW single conductors in raceway.
- B. Type XHHW shall be used for all conductors from VFDs.

#### **3.03 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- D. Identify and color-code conductors and cables according to Division 26 Section "Electrical Identification."

#### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 20 – CABLES FOR INSTRUMENTATION**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Instrumentation Cables

1.02 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit for each type of product to be used.
- C. Field quality control test reports.
- D. Submit fiber optic cable installation plan
  - 1. Cable pulling plan that specifies the sequence of work tasks, materials, and equipment.
  - 2. Provide an optical link analysis for each fiber optic link.
    - a. Calculate point-to-point (transmit/receive) optical power loss of each fiber link using proposed installed cable lengths.
    - b. Include all losses through connectors.
    - c. Submit calculated values including sketches graphically showing the proposed cable route.

**PART 2 - PRODUCTS**

2.01 INSTRUMENTATION CABLES

- A. These cables shall be used for all analog signal wiring.
- B. Single Pair or Triad - Overall Shield
  - 1. Conductors shall be single twisted pair or triad tinned copper with an overall shield. The insulation shall be rated at 300V. Conductors shall be bare soft annealed copper, Class B, 19 strand concentric. Insulation shall be 15 mil nominal thickness, 90 C temperature rating and flame retardant.
  - 2. Cable shield shall be 1.35 mil blue aluminum-polyester tape overlapped to provide 100% coverage, and a 7 strand tinned copper drain wire, two sizes smaller than the conductor.
  - 3. Overall jacket shall be flame retardant, 90 C temperature rated and UL listed.

4. The minimum size conductor shall be 18 AWG for shielded instrumentation cable unless otherwise noted.
- C. Multi Pairs or Triads - Overall Shield
1. Conductor shall be tinned copper, 19-strand concentric. Insulation shall be flame retardant PVC insulation, 15 mils nominal thickness and a nylon jacket, 4 mil nominal thickness rated 300 volts. Insulation shall have 90 C temperature rating per UL 1277.
  2. Cable shield shall be 2.35 mil blue aluminum polyester tape overlapped to provide 100% coverage and a 7-strand tinned cover drain wire same as conductors.
  3. Overall jacket shall be flame retardant, 90 C temperature rated and UL listed.
  4. The minimum size conductor for shielded pairs or triad shall be 18 AWG unless otherwise noted.
- D. Acceptable Manufacturer
1. All instrumentation cable and conductors shall be as manufactured by Okonite Company, Belden Electronic Wire and Cable Company or equal. All instrumentation cable and conductors to be installed in cable trays shall be NEC approved for this use.

## 2.02 ETHERNET CABLE

- A. Unshielded Twisted-Pair Cabling
1. No. 24 AWG, 100 ohm, four pair.
  2. Cable Jacket Color: Gray.
  3. Comply with TIA/EIA-568-B.2, Category 5e
  4. Comply with UL 444.
  5. Belden Inc.; General Cable Technologies Corp, or Approved Equal
- B. Terminal Connectors: Modular, color-coded, RJ-45 plug.
1. AMP Company, Cooper Wiring Devices; or approved equal

## PART 3 - EXECUTION

### 3.01 SIGNAL AND CONTROL CABLE

- A. General
1. Size cable and its conduit to keep pulling tension within manufacturer's recommended limits.

2. Use cable of sufficient length to make a continuous run. Splicing of shielded signal cable will not be permitted.
3. Furnish a separate raceway system for shielded signal cable. Do not run in the same conduit with power cable.
4. Where telemetry cables are run in the same duct bank with power cables, use galvanized steel conduit. Use junction boxes and "LB" fittings in manholes to maintain a continuous steel raceway system for signal cables.
5. Ground cable shield at termination of instrumentation cabinet only using a soldered pigtail with spade lug for ground connection. Solder joint and ground connection should be visible.

B. Telemetry and Instrumentation Signal Systems

1. Separate conduit and wireway runs are required for this category. All wiring is to be isolated from all power systems.

C. Control Wiring

1. Control wiring may be pulled in the power conduits and wireways providing the highest voltage of the adjacent wires is not more than 120 volts.

D. Power Control Systems

1. The wiring of this category (single conductor, or multiple conductor) is to be installed in accordance with the NEC.

3.02 ETHERNET CABLE

A. Installation

1. Comply with NECA 1.

B. Cable Installation:

1. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
2. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.



5. Install UTP cables using techniques, practices, and methods that are consistent with Category 5e rating of components and that ensure Category 5e performance of completed and linked signal paths, end to end.
  - a. Do not untwist more than 1/2 inch of Categories 5e and 6 cables at connector terminations.
6. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:
  - a. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
    - 1) Electrical Equipment Rating Less Than 2 kVA: 5 inches.
    - 2) Electrical Equipment Rating between 2 and 5 kVA: 12 inches.
    - 3) Electrical Equipment Rating More Than 5 kVA: 24 inches.
  - b. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
    - 1) Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
    - 2) Electrical Equipment Rating between 2 and 5 kVA: 6 inches.
    - 3) Electrical Equipment Rating More Than 5 kVA: 12 inches.
  - c. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
    - 1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - 2) Electrical Equipment Rating between 2 and 5 kVA: 3 inches.
    - 3) Electrical Equipment Rating More Than 5 kVA: 6 inches.
  - d. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
  - e. Fluorescent Fixtures: 5 inches.
- C. Conduit:
  1. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.
  2. Use manufactured conduit sweeps and long-radius ells whenever possible.

- D. Testing
1. Perform the following field tests and inspections and prepare test reports:
  2. Category 5e UTP Cabling Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
    - c. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
    - d. Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
  3. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
  4. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
  5. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section Includes:
  - 1. Methods and materials for grounding systems and equipment.

1.02 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For each type of product indicated.
- C. Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Bonding to water pipes.
  - 3. Bonding to foundation reinforcing steel.
- D. Field quality-control test reports.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**PART 2 - PRODUCTS**

2.01 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

## PART 3 - EXECUTION

### 3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors.
  - 3. Connections to Structural Steel: Welded connectors.
  - 4. Connection to Foundation Reinforcing Steel: Welded connectors.

### 3.02 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Signal and Communication Equipment: For alarm, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.03 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
  2. For grounding electrode system, install a sufficient number of ground rods to obtain desired ground resistance, spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
    - a. At service entrance, provide a minimum of three ground rods buried in ground roughly 10 feet apart from each other forming an triangle and connecting them with copper conductors.
- C. Bonding to Concrete Foundation Reinforcing Steel: Use exothermic-welded connectors to bond to 20 ft or more of 1/ 2 in. foundation and/or footing reinforcing steel at each buildings and structure. Where 20 ft of reinforcing steel is not available, imbed 20 ft or more of bare copper not smaller than 4 AWG.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Install insulated copper grounding conductors, in conduit, from building's main service equipment or electrical grounding bus to metal piping entrances to building. Connect grounding conductors to metal water pipes using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### 3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  3. Prepare dimensioned drawings locating each ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed 10 ohms and include recommendations to reduce ground resistance.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

**1.02 DEFINITIONS**

- A. RNC: Rigid non-metallic conduit.
- B. RMC: Rigid metal conduit.

**1.03 SYSTEM DESCRIPTION**

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

**1.04 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For the following:
  - 1. Steel slotted support systems.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Steel slotted channel systems. Include Product Data for components.
  - 2. Equipment supports.

**1.05 QUALITY ASSURANCE**

- A. Comply with NFPA 70.

**1.06 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

## **PART 2 - PRODUCTS**

### **2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper B-Line, Inc.; a division of Cooper Industries.
    - b. Thomas & Betts Corporation.
    - c. Unistrut; Tyco International, Ltd.
    - d. Approved equal.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.



- 3) Hilti Inc.
  - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 5) MKT Fastening, LLC.
- 
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  5. Toggle Bolts: All-steel springhead type.
  6. Hanger Rods: Threaded steel.

### **PART 3 - EXECUTION**

#### **3.01 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RNC and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

#### **3.02 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, Spring-tension clamps.
  5. To Light Steel: Sheet metal screws.

- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

**3.03 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section - Cast-in-Place Concrete.
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

**3.04 PAINTING**

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section includes:
  - 1. Raceways
  - 2. Fittings
  - 3. Boxes
  - 4. Enclosures
  - 5. Cabinets

**1.02 DEFINITIONS**

- A. IMC: Intermediate metal conduit.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. RNC: Rigid nonmetallic conduit.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.
- C. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. For handholes and boxes for underground wiring, including the following:
    - a. Duct entry provisions, including locations and duct sizes.
    - b. Frame and cover design.
    - c. Grounding details.
    - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    - e. Joint details.
- D. Source quality-control test reports.

**1.04 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

**2.01 METAL CONDUIT AND TUBING**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. O-Z Gedney; a unit of General Signal.
  - 4. Wheatland Tube Company.
  - 5. Approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- D. Fittings for Conduit: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- E. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

**2.02 NONMETALLIC CONDUIT**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 2. CertainTeed Corp.; Pipe & Plastics Group.
  - 3. Condux International, Inc.
  - 4. RACO; a Hubbell Company.
  - 5. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit type and material.

2.03 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Hoffman.
  - 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 5. O-Z/Gedney; a unit of General Signal.
  - 6. RACO; a Hubbell Company.
  - 7. Robroy Industries, Inc.; Enclosure Division.
  - 8. Thomas & Betts Corporation.
  - 9. Approved equal.
- B. Sheet Metal Outlet and Device Boxes: NEMA 4X.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA 4X.
- D. Hinged-Cover Enclosures: NEMA 4X, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- E. Cabinets:
  - 1. NEMA 4X, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

2.04 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
  - 1. Color of Frame and Cover: Gray.

2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
  3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  5. Cover Legend: Molded lettering, as indicated for each service.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Power Systems Quazite or a comparable product by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation.
    - d. NewBasis.

### **PART 3 - EXECUTION**

#### **3.01 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
  2. Underground Conduit, Direct Buried: Rigid Nonmetallic conduit, PVC coated.
  3. Boxes and Enclosures, Aboveground: NEMA 4X.
  4. Application of Handholes and Boxes for Underground Wiring:
    - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

### 3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 26 Section "Hangers and Supports."
- D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- F. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- H. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- I. Raceways for Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
  1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
  2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
  3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- J. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

### 3.03 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install PVC coated rigid steel conduit elbows at all stub-up locations.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

### 3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.



3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- H. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL**  
**SECTION 26 05 53 - ELECTRICAL IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Identification for raceway.
  - 2. Identification for conductors and communication and control cable.
  - 3. Underground-line warning tape.
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.

**1.02 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For each electrical identification product indicated.
- C. Wire and cable labeling scheme.
  - 1. Submit table detailing wire scheme for each control circuit installed under this Contract.
  - 2. Table shall include each terminating end point with terminal number, signal type, conduit number, and a unique wire identification number.

**1.03 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

**1.04 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.

## **PART 2 - PRODUCTS**

### **2.01 RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
  - 1. Power Circuits: Black letters on an orange field.
  - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

### **2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

### **2.03 UNDERGROUND-LINE WARNING TAPE**

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
  - 1. Not less than 6 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend shall indicate type of underground line.

### **2.04 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

#### 2.05 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

#### 2.06 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

### PART 3 - EXECUTION

#### 3.01 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label.
- B. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.
- D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- E. Control Circuit Point to Point Identification and Labeling:
1. Wire label to contain unique wire number and shall identify each terminating end point.
  2. Wire Label shall be applied at each end of each circuit, and shall include:
    - a. Each terminating end point with terminal number.
    - b. Signal type (DI, DO, AI or AO)
    - c. Conduit number
    - d. A unique wire identification number.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
  2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- H. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
  2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting,

control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
  - a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
  - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
  - a. Panelboards, electrical cabinets, and enclosures.
  - b. Transformers.
  - c. Disconnect switches.
  - d. Enclosed circuit breakers.
  - e. Motor starters.
  - f. Power transfer equipment.
  - g. Power-generating units.
  - h. Monitoring and control equipment.

### 3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Color-Coding for Phase Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
  2. Colors for 240/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

**END OF SECTION**

**DIVISION 26 – ELECTRICAL**  
**SECTION 26 05 73 – SHORT-CIRCUIT/COORDINATION/ARC FLASH STUDY**

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes

1. Short-Circuit, Protective Device Coordination and Arc Flash Studies
2. Labels

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
5. IEEE 1015 – Recommended Practice for Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584-2004a, IEEE Guide for Performing Arc Flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage ac Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for ac High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
5. ANSI C37.5 – Methods for Determining the rms Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents.



- C. The National Fire Protection Association 70, National Electrical Code, latest edition.

#### 1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 01 33 00.
- B. The short-circuit, protective device coordination and arc flash studies shall be submitted to the Authority prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Authority may be obtained for preliminary submittal of sufficient study data to ensure that the selection of devices and characteristics will be satisfactory.
- C. The results of the short circuit, coordination and arc flash studies shall be summarized in a final report. Submit three (3) bound copies of the final report. Additional copies, where required, shall be provided on CD in PDF format.
- D. Reports:
  - 1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations.
  - 2. Descriptions, purpose, basis and scope of the study.
  - 3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
  - 4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
  - 5. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
  - 6. Incident energy level (calories/cm<sup>2</sup>) for each equipment location and recommended PPE.
  - 7. Comments and recommendations for system improvements, where needed.
  - 8. Executive summary.

#### 1.04 QUALITY ASSURANCE

- A. Qualifications:
  - 1. The short-circuit and coordination studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

## **PART 2 – PRODUCT**

### **2.01 STUDIES**

- A. Contractor to furnish short-circuit, protective device coordination and arc flash studies as prepared by equipment manufacturer.

### **2.02 DATA COLLECTION**

- A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit and coordination studies shall furnish the Contractor with a listing of required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source contribution may include present and future utility supply, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

### **2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**

- A. Use typical conductor impedances based on IEEE Standard 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
  - 1. Calculation methods and assumptions.
  - 2. Selected base per unit quantities.
  - 3. One-line diagram of the system being evaluated.
  - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
  - 5. Typical calculations.
  - 6. Tabulations of calculated quantities.
  - 7. Results, conclusions and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
  - 1. Electric utility's supply termination point.
  - 2. Incoming switchgear.

3. Unit substation primary and secondary terminals.
  4. Low voltage switchgear.
  5. Motor control centers.
  6. Standby generators and automatic transfer switches.
  7. Branch circuit panelboards.
  8. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective device evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings.
  2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
  3. Adequacy of transformer windings to withstand short-circuit stresses.
  4. Cable and busway sizes for ability to withstand short-circuit heating.
  5. Notify Owner in writing of existing circuit protective devices improperly rated for the calculated available fault current.

#### 2.04 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay and instantaneous settings recommended.
- E. Plot the following characteristics on the curve sheets, where applicable:
1. Electric utility's protective device.
  2. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  3. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.
  4. Conductor damage curves.
  5. Ground fault protective devices, as applicable.

6. Pertinent motor starting characteristics and motor damage points.
  7. Pertinent generator short-circuit decrement curve and generator damage point.
  8. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

## 2.05 INCIDENT ENERGY STUDY

- A. An incident study shall be done in accordance with the IEEE 1584-2004A, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70, "Standard for Electrical Safety in the Workplace", 2008 Revision, in order to quantify the hazard for selection of Personal Protective Equipment (PPE). Simply using the table values from NFPA 70E and assuming fault current levels and clearing times for proper PPE selection is not acceptable. The manufacturer shall assist in selecting appropriate combinations of PPE prior to the final analysis and preparation of equipment labels.

## 2.06 REPORT SECTIONS

- A. Input Data:
1. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
  2. Short-circuit reactance of rotating machines with associated X/R ratios.
  3. Cable type, construction, size, # per phase, length, impedance and conduit type.
  4. Bus duct type, size, length and impedance.
  5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance and X/R ratio.
  6. Reactor inductance and continuous ampere rating.
  7. Aerial line type, construction, conductor spacing, size, # per phase, and length.
- B. Short-Circuit Data:
1. Source fault impedance and generator contributions.
  2. X to R ratios.
  3. Asymmetry factors.
  4. Motor contributions.
  5. Short circuit kVA.
  6. Symmetrical and asymmetrical fault currents.
- C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
  - a. Current transformer ratio.
  - b. Current setting.
  - c. Time setting.
  - d. Instantaneous setting.
  - e. Specialty non-overcurrent device settings.
  - f. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
  - a. Adjustable pickups and time delays (long time, short time, ground).
  - b. Adjustable time-current characteristic.
  - c. Adjustable instantaneous pickup.
  - d. Recommendations on improved trip systems, if applicable.
3. Incident energy level (calories/cm<sup>2</sup>) for each equipment location and recommended PPE.

## 2.07 LABELS

- A. Based on the results of the incident energy study, the supplier shall produce and install danger labels for each piece of equipment as specified in Paragraphs 1., 2. and 3. of Section B above, in accordance with ANSI Z535.4-2002. The labels must be readable in both indoor and outdoor environments for at least 3 years and contain the following information as appropriate:
  1. Arc hazard boundary (inches).
  2. Working distance (inches).
  3. Arc flash incident energy at the working distance (calories/ cm<sup>2</sup>).
  4. PPE category and description including the glove rating.
  5. Voltage rating of the equipment.
  6. Limited approach distance (inches).
  7. Restricted approach distance (inches).
  8. Prohibited approach distance (inches).
  9. Equipment/bus name.
  10. Date prepared.
  11. Supplier name and address.

### **PART 3 – EXECUTION**

#### **3.01 FIELD ADJUSTMENT**

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short-circuit and protective device coordination studies.
- C. Notify Authority in writing of any required major equipment modifications.
- D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

#### **3.02 SAFETY TRAINING**

- A. The supplier shall provide one day of arc flash safety training that contains the requirements referenced in OSHA 1910.269, OSHA 1910 Subpart S and NFPA 70E. This shall include:
  - 1. Proper use of the system analysis data.
  - 2. Interpretation of hazard labels.
  - 3. Selection and utilization of personal protective equipment.
  - 4. Safe work practices and procedures.
- B. The supplier shall provide an outline of the one day training course including training materials at time of quotation. The owner, at its discretion, may require a needs assessment and/or additional training customized to its specific needs. The supplier shall be capable of developing and presenting customized training for approval as required.
- C. The supplier shall provide a training certificate to record satisfactory completion by owner's employees for continuing education credits and re-licensing requirements. Satisfactory completion is defined as the student obtaining a minimum of 70% on the post training examination and the ability to work safely if a hands on performance evaluation is provided.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL  
SECTION 26 24 16 – PANELBOARDS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Lighting Panelboard with transformer

**1.02 SUBMITTALS**

**A. Submit in accordance with requirements of Section 01 33 00.**

**B. Product Data:** Submit for each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

**C. Shop Drawings:** For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for NEMA Rating.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

**D. Field Quality-Control Reports:**

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

**E. Panelboard Schedules:** For installation in panelboards.

**F. Operation and Maintenance Data:** For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

#### 1.05 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### PART 2 - PRODUCTS

#### 2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Outdoor: NEMA 250, Type 3R.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.



- 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top.
- C. Transformer:
  - 1. Provide kVA rating required for specific project.
  - 2. Built in primary and secondary circuit breakers.
- D. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.02 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
  - 5. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or lugs only as indicated.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
  - 5. Approved equal.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install panelboards and accessories according to NEMA PB 1.1.

### 3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Electrical Identification."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

### 3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

### 3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated

### 3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

## END OF SECTION

**DIVISION 26 - ELECTRICAL  
SECTION 26 27 26 - WIRING DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Snap switches.

**1.02 DEFINITIONS**

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- C. RFI: Radio-frequency interference.
- D. TVSS: Transient voltage surge suppressor.
- E. UTP: Unshielded twisted pair.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit for each type of product indicated.
- C. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data.

**1.04 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  3. Leviton Mfg. Company Inc. (Leviton).
  4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
  5. Approved equal.

### **2.02 STRAIGHT BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).
    - e. Approved equal.

### **2.03 GFCI RECEPTACLES**

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; GF20.
    - b. Pass & Seymour; 2084.
    - c. Approved equal.

### **2.04 SNAP SWITCHES**

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
  - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
  - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
  - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
  - e. Approved equal.

#### 2.05 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

#### 2.06 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  1. Wiring Devices Connected to Normal Power System, unless otherwise indicated or required by NFPA 70 or device listing.
    - a. In process areas: Brown

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section – Identification for Electrical Systems.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

**END OF SECTION**



**DIVISION 26 - ELECTRICAL  
SECTION 26 29 23 – VARIABLE FREQUENCY MOTOR CONTROLLERS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections:
  - 1. Division 26
  - 2. Division 40

**1.01 REFERENCES**

- A. National Fire Protection Association
  - 1. NFPA 70 - US National Electrical Code.
- B. National Electrical Manufacturers Association
  - 1. NEMA 250 - Enclosures for Electrical Equipment.
- C. Underwriters Laboratory Inc.
  - 1. UL 508.
- D. Canadian Standards Association International
  - 1. CAN/CSA-C22.2 No. 14-05.
- E. International Electrical Code
  - 1. IEC 146.
- F. Institute of Electrical and Electronics Engineers, Inc.
  - 1. IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

**1.02 DEFINITIONS**

- A. CPT: Control power transformer.
- B. EMI: Electromagnetic interference.
- C. IGBT: Insulated-gate bipolar transistor.
- D. LAN: Local area network.

- E. LED: Light-emitting diode.
- F. MCP: Motor-circuit protector.
- G. NC: Normally closed.
- H. NO: Normally open.
- I. OCPD: Overcurrent protective device.
- J. PCC: Point of common coupling.
- K. PWM: Pulse-width modulated.
- L. RFI: Radio-frequency interference.
- M. TDD: Total demand (harmonic current) distortion.
- N. THD(V): Total harmonic voltage demand.
- O. VFD: Variable-frequency drive motor controller.

1.03 SYSTEM DESCRIPTION

- A. Design VFDs to control a specific piece of equipment. Use constant torque drives where required.
- B. Where incoming power is limited to 240 V, single phase, the drive shall convert single phase to three phase and be oversized per the manufacturer's recommendations to support phase conversion.

1.04 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit data for each type and rating of VFD. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- C. Shop Drawings: Submit for each VFD. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
  - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of enclosed unit.
    - f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
  - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

- D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- E. Product Certificates: For each VFD, from manufacturer.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
  - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

#### 1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. VFD and all associated optional equipment shall be UL listed or recognized and labeled accordingly.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle in accordance with manufacturer's instructions.
- B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside drives and install temporary electric heating, with at least 250 W per drive.
- C. Protect from dirt, water, construction debris and traffic.

#### 1.07 PROJECT/SITE CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 14 deg F and not exceeding 120 deg F.

2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Not exceeding 3300 feet.

#### 1.08 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
  1. Torque, speed, and horsepower requirements of the load.
  2. Ratings and characteristics of supply circuit and required control sequence.
  3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

#### 1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fails in materials or workmanship within specified warranty period.
  1. Warranty Period: 12 months from date of being energized.

#### 1.10 MAINTENANCE

- A. Extra Materials: Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Spare Variable Frequency Drive (one for each size installed).
  2. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  3. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  4. Indicating Lights: Two of each type and color installed.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURED UNITS

- A. Manufacturers:
  1. Rockwell Automation, Inc.; Allen-Bradley Brand, Powerflex 400

DIVISION 26 – ELECTRICAL

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SECTION 26 29 23 – VARIABLE FREQUENCY MOTOR CONTROLLERS

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- B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: variable torque.
- D. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
  - 1. For new Submersible Pumps:
    - a. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  - 2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- E. Design and Rating: Match load type and type of connection used between motor and load.
- F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- G. Unit Operating Requirements:
  - 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFD input voltage rating.
  - 2. Input AC Voltage Unbalance: Not exceeding 5 percent.
  - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
  - 4. Minimum Efficiency: 97 percent at 60 Hz, full load.
  - 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
  - 6. Minimum Short-Circuit Current (Withstand) Rating: 35 kA.
  - 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 120 deg F. Oversize VFD to allow for 120 deg F operation.
  - 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
  - 9. Humidity Rating: Less than 95 percent (noncondensing).
  - 10. Altitude Rating: Not exceeding 3300 feet.
  - 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
  13. Speed Regulation: Plus or minus 5 percent.
  14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
  15. Stop Modes: Programmable; includes fast and free-wheel.
- H. Inverter Logic: Microprocessor based, isolated from all power circuits.
- I. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- J. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 0.1 to 999.9 seconds.
  4. Deceleration: 0.1 to 999.9 seconds.
  5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- K. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  3. Under- and overvoltage trips.
  4. Inverter overcurrent trips.
  5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
  6. Critical frequency rejection, with three selectable, adjustable deadbands.
  7. Instantaneous line-to-line and line-to-ground overcurrent trips.
  8. Loss-of-phase protection.
  9. Reverse-phase protection.

- 10. Short-circuit protection.
- 11. Motor overtemperature fault.
- L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- N. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

## 2.02 CONTROLS AND INDICATION FOR PUMP CONTROL PANEL

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
  - 1. Power on.
  - 2. Run.
  - 3. Drive fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
  - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.
  - 3. Historical Logging Information and Displays:
    - a. Real-time clock with current time and date.
    - b. Running log of total power versus time.
    - c. Total run time.
    - d. Fault log, maintaining last four faults with time and date stamp for each.

4. Drive Parameter Indicating Displays:
  - a. Output frequency (Hz).
  - b. Motor speed (rpm).
  - c. Motor status (running, stop, fault).
  - d. Motor current (amperes).
  - e. Motor torque (percent).
  - f. Fault or alarming status (code).
  - g. DC-link voltage (V dc).
  - h. Set point frequency (Hz).
  - i. Motor output voltage (V ac).
- C. Control Signal Interfaces:
  1. Electric Input Signal Interface:
    - a. A minimum of two programmable analog inputs: 4- to 20-mA dc.
    - b. A minimum of six multifunction programmable digital inputs.
  2. Output Signal Interface: A minimum of one programmable analog output signal (4- to 20-mA dc), which can be configured for any of the following:
    - a. Output frequency (Hz).
    - b. Output current (load).
    - c. DC-link voltage (V dc).
    - d. Motor torque (percent).
    - e. Motor speed (rpm).
    - f. Set point frequency (Hz).
  3. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).

## 2.03 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: 5% line reactors
- B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

## 2.04 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
    - a. Push Buttons: Shrouded types; momentary.
    - b. Pilot Lights: Incandescent types; push to test.
    - c. Selector Switches: Rotary type.



- B. Cooling Fan and Exhaust System: For NEMA 250, Type 3R; UL 508 component recognized: Supply fan, with composite Insert material intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- D. Verify that the disconnect operating handles of the proposed drive will not be higher than 79 inches above finished floor.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Coordinate layout and installation of VFDs inside the pump control panel, along with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Panel Mounted Drives: Install VFDs inside the pump control panel.
- C. Install fuses in control circuits if not factory installed.
- D. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

#### **3.03 IDENTIFICATION**

- A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified.
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFD with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

3.04 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices and facility's central-control system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
  - 1. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts and high-temperature cutouts.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner or Owner's Construction Representative before starting the motor(s).
  - 5. Test each motor for proper phase rotation.
  - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

- 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  - E. VFDs will be considered defective if they do not pass tests and inspections.
  - F. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- 3.06 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
    - 1. Complete installation and startup checks according to manufacturer's written instructions.
- 3.07 ADJUSTING
- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
  - B. Set field-adjustable circuit-breaker trip ranges
- 3.08 PROTECTION
- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until drives are ready to be energized and placed into service.
  - B. Replace VFDs whose interiors have been exposed to water or other liquids prior to Final Completion.
- 3.09 DEMONSTRATION
- A. Engage a factory-authorized service representative to train the Authority's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

**END OF SECTION**

**DIVISION 26 - ELECTRICAL  
SECTION 26 32 00 - PACKAGED GENERATOR ASSEMBLIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Packaged Generator Assembly with the following features:
    - a. Unit-mounted cooling system
    - b. Unit-mounted control and monitoring
    - c. Base mounted fuel oil tank
    - d. Sound attenuated outdoor enclosure
- B. Related Sections include the following:
  - 1. Section 26 36 23 – Automatic Transfer Switches.

**1.02 DEFINITIONS**

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

**1.03 SYSTEM DESCRIPTION**

- A. System shall be appropriately sized to power all equipment, including ancillary receptacles and lighting. Size in accordance with manufacturers recommendations.
- B. Fuel shall be natural gas, where available. If natural gas cannot be obtained, fuel shall be diesel. Consult with the Authority for site specific requirements.
- C. Generator shall not be oversized. Do not design an electrical generator that will operate at less than 30% of rated load. Provide load banks to supplement the regular loads when loading is below the recommended value.
- D. Coordinate design of generator assemblies with voltage, phase, motor sizes, motor starters, lighting loads, UPS loads and all other loads.
- E. For natural gas fueled assemblies, properly size the fuel line to the assembly to prevent fuel starvation and generator full rating.

**1.04 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 01 33 00.
- B. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
  2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
  3. Wiring Diagrams: Power, signal, and control wiring.
  4. EPA Emissions Certification
- D. Qualification Data: For installer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- G. Warranty: Special warranty specified in this Section.

#### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. The Contractor shall submit a Request for Determination (RFD) for the generator unit selected for the project. The determination of eligibility for exemption from plan approval and/or operating permit must be rendered from DEP prior to the approval of the generator. A Request for Determination shall be completed before the unit is delivered to the site. The PA DEP can reject the usage of a genset for a particular application; therefore, it is critical that the Request for Determination is completed before the genset is installed. The Contractor is responsible for complying with all PA DEP requirements as identified during Request for Determination process.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

- 2. Engineering Responsibility: Preparation of data for vibration isolators, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  - C. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
  - D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
  - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - F. Comply with ASME B15.1.
  - G. Comply with NFPA 37.
  - H. Comply with NFPA 70.
  - I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
  - J. Comply with UL 2200.
  - K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Packing, shipping, handling, and unloading shall be in accordance with the manufacturer's instructions.
  - B. Store packaged generator assembly in doors until it is ready to be set permanently in place on the concrete pad.
- 1.07 SEQUENCING
- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- 1.08 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period
    - 1. Warranty Period: 2 years from date of Substantial Completion.

1.09 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

**PART 2 - PRODUCTS**

2.01 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
- C. Capacities and Characteristics:
  - 1. Power Output Ratings: As required for project specific load.
  - 2. Output Connections: As required for specific project.
  - 3. Nameplates: Each major system component shall identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
  - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
  - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
  - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
  - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

## 2.02 ENGINE

- A. Emissions: EPA Nonroad Tier 3
- B. Standby Rating: As required for project specific load.
- C. Fuel: Natural gas, if available. Diesel as an alternate.
- D. Alternator Data:
  1. 105 Degree C Temperature Rise.
  2. Surge kW: 91.
  3. Motor Starting kVA (at 90% sustained voltage): 423.
  4. Full load current amps: 180 at 240V.
- E. Rated Engine Speed: 1800 rpm.
- F. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- G. Lubrication System: The following items are mounted on engine or skid:
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- H. Engine Fuel System:
  1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
  2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- I. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Heater pre-wired to factory installed AC distribution panel.



- J. Governor: Adjustable isochronous, with speed sensing.
- K. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
  - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  - 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non-collapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- L. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
- M. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- N. Starting System: 12-V electric, with negative ground.
  - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
  - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
  - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
  - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  - 6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  - 7. Battery Charger

2.03 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank for Diesel Alternative: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
  - 1. Tank level indicator.
  - 2. Capacity: Minimum two (2) days.
  - 3. Vandal-resistant fill cap.
  - 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.04 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls:
  - 1. AC voltmeter.
  - 2. AC ammeter.
  - 3. AC frequency meter.
  - 4. DC voltmeter (alternator battery charging).
  - 5. Engine-coolant temperature gage.
  - 6. Engine lubricating-oil pressure gage.
  - 7. Running-time meter.
  - 8. Ammeter-voltmeter, phase-selector switch(es).
  - 9. Generator-voltage adjusting rheostat.
  - 10. Start-stop switch.

11. Overspeed shutdown device.
  12. Coolant high-temperature shutdown device.
  13. Coolant low-level shutdown device.
  14. Oil low-pressure shutdown device.
  15. Generator overload.
- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- E. Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel for the following alarms:
1. Generator running.
  2. Generator failure.
  3. Fuel failure, if natural gas.
  4. Spare, if natural gas.
  5. Fuel tank low, if diesel.
  6. Fuel tank rupture, if diesel.
  7. Oil pressure alarm.
  8. Overcrank shutdown.
  9. Coolant high-temperature alarm.
  10. Coolant low-temperature alarm.
  11. Coolant low-level alarm.
  12. Block heater ON/OFF.
  13. Control switch not in auto position.
  14. Battery-charger malfunction alarm.
  15. Battery low-voltage alarm.

#### 2.05 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

#### 2.06 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip proof.
- G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
  1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point. Heater pre-wired to factory installed AC distribution panel.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- J. Subtransient Reactance: 12 percent, maximum.

#### 2.07 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof Level 2 sound attenuated steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Prefabricated or pre-engineered skin-tight enclosure with the following features:
  1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.

2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
  3. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
  4. Hinged Doors: With padlocking provisions.
  5. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
  6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
  7. Muffler Location: Within enclosure.
  8. 72 dB(A) sound pressure level average at 23 feet from enclosure.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
  2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
- D. Interior Lights with Switch: Factory-wired, vapor proof-type fixtures within housing; arranged to illuminate controls and accessible interior.
1. AC lighting system for operation when remote source is available.
  2. DC lighting system for operation when remote source and generator are both unavailable.
- E. Convenience Outlets: Factory wired, GFCI.

## 2.08 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator on concrete base. Secure sets to anchor bolts installed in concrete bases.

### 3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

### 3.04 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Electrical Identification."

### 3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions.

- Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  - 6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  - 7. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

### 3.06 TRAINING

- A. Engage a factory-authorized service representative to train the Authority's maintenance personnel to adjust, operate, and maintain packaged engine generators. Provide one full working day of training.

**END OF SECTION**



**DIVISION 26 - ELECTRICAL  
SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCHES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Automatic transfer switches (rated 600 V and less).
- B. Related Sections
  - 1. Packaged Generator Assemblies

**1.02 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- C. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  - 1. Features and operating sequences, both automatic and manual.
  - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.

- F. Comply with NFPA 110.
- G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.04 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

**PART 2 - PRODUCTS**

2.01 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Electrical Identification."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- J. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
  1. Service equipment section containing the service (utility source) disconnect circuit breaker, grounding and bonding provisions.
  2. Non service section containing the power transfer switch and controls.

## 2.02 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, with delayed open transition or intermediate open position stop.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- E. Automatic Transfer-Switch Features:
  1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals.
  3. Adjustable from zero to six seconds, and factory set for one second.
  4. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of

nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

5. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
6. Test Switch: Simulate normal-source failure.
7. Switch-Position Pilot Lights: Indicate source to which load is connected.
8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
  - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
11. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is not available.

## 2.03 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage,

frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Identify components according to Division 26 Section "Electrical Identification."
- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

#### **3.02 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

#### **3.03 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
  - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    - a. Check for electrical continuity of circuits and for short circuits.
    - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    - c. Verify that manual transfer warnings are properly placed.
    - d. Perform manual transfer operation.
  - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

- b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.

#### 3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.
- B. Coordinate training of Automatic Transfer Switch with Packaged Generator Assembly.

**END OF SECTION**

**DIVISION 31 - EARTHWORK**  
**SECTION 31 10 00 - CLEARING AND GRUBBING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Clearing
  - 2. Grubbing
  - 3. Stripping and stockpiling topsoil
  - 4. Debris disposal

**1.02 DEFINITIONS**

- A. Clearing is defined as the removal of trees, brush, down timber, rotten wood, rubbish, any other vegetation, and objectionable material at or above original ground elevation not designated to be saved. Clearing also includes removal and replacement of fences, walls, guideposts, guide rail, signs, and other obstructions interfering with the proposed work.
- B. Grubbing is defined as the removal from below the surface of the natural ground of stumps, roots and stubs, brush, topsoil, organic materials and debris.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Permits for Disposal of Debris:
  - 1. Arrange for disposal of debris resulting from clearing and grubbing to locations outside the Owner's right-of-way comply with all laws applicable for this work.
  - 2. Submit two copies of the agreement with each property owner releasing the Owner from responsibility in connection with the disposal of the debris.

**1.04 QUALITY ASSURANCE**

- A. Regulatory Requirements
  - 1. Comply with applicable Federal, State, and Local requirements for disposal of debris.
  - 2. As required by regulatory agencies, obtain and comply with a NPDES Permit for Stormwater Discharges Associated with Construction Activities.
  - 3. Develop and comply with an approved Erosion and Sedimentation Control Plan.
  - 4. No clearing and grubbing is permitted until best management practices are in place.
  - 5. Comply with conditions of any issued PennDOT Highway Occupancy Permits for the clearing, grubbing, stockpiling, and disposal.

1.05 PROJECT/SITE CONDITIONS

A. Project/Site Environmental Requirements

1. Use all means necessary to control dust on and near the work and on and near all off-site borrow areas. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent work being formed on the site.
2. Do not track dirt, mud, or debris onto streets or state highways.

B. Existing Conditions

1. Protect existing utilities, trees, vegetation, and features designated to remain after project completion.
2. Protect bench marks, property pins and existing structures from damage or displacement.
3. Protect fences, guide rails, shrubbery, trees, signs and any other items removed and designated to be preserved for reuse.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Temporary Fencing:

1. Undamaged picket snow fence, 4' high, formed of wooden slats, tightly woven with wire cable or plastic fencing specifically manufactured for this use.
2. Soil-set fence posts, studded "T" type, 6' high.

B. Tree Wound Dressing:

1. Antiseptic and waterproof, asphalt base.

**PART 3 - EXECUTION**

3.01 PREPARATION

- A. Notify the Authority at least 48 hours prior to beginning any clearing work.
- B. Protect benchmarks, utilities, existing trees, shrubs and other landscape features designated for preservation with temporary fencing or barricades satisfactory to the Engineer. No material shall be stored or construction operation carried on within 4 feet of any tree to be saved or within the tree protection fence.
- C. When a private enclosure fence encroaches on the work area, notify the property owner at least 10 days in advance of the clearing/grubbing operations to permit the owner to remove it, construct a supplemental fence, or make such other arrangements as may be necessary for security purposes. Upon failure of the property owner to reasonably proceed with the work required to secure his property, carefully remove the fence, in whole or in part, and neatly pile the materials onto the owner's property.



3.02 UTILITY RELOCATIONS

- A. Inform all companies, individuals and others owning or controlling facilities or structures within the limits of the work which have to be relocated, adjusted or reconstructed in sufficient time for the utility to organize and perform such work in conjunction with or in advance of the Contractor's operations.
- B. Comply with the provisions of PA Legislature Act 187 (1996) or as amended.

3.03 CLEARING

- A. Confine clearing to within the limits of the right-of-way or easement. All damage sustained to property resulting from the Contractor's operations shall be repaired, without cost to the Authority, to the satisfaction of the property owner.
- B. No trees are to be removed until they have been tagged by the Contractor and reviewed and tagged by the Authority.  
  
Fell trees in a manner that will avoid damage to trees, shrubs, and other installations, which are to be retained.
- C. Remove trees and shrubbery only when authorized by the Authority.
  - 1. Perform authorized tree removal, including stumps and debris, by methods meeting Authority's approval and at no expense to the Authority.
  - 2. Perform authorized shrubbery removal; store shrubs in protected manner and replant or replace such shrubbery at no expense to the Authority.
  - 3. When directed by the Authority, trim merchantable timber of limbs and tops, saw timber into eight-foot lengths. Stockpile timber at locations designated on the site by the Authority. Merchantable timber is timber larger than six inches in smallest diameter from which saw logs, pulpwood, posts, poles, ties or cordwood can be produced.
  - 4. The disposal of the stockpiled timber will not form a part of the contract obligations and the stockpiled merchantable timber will remain the property of the property owner.
  - 5. Dispose of tree removal debris in a lawful manner.

3.04 TREE TRIMMING

- A. With approval, trees can be trimmed to remove branches or roots which interfere with construction.
- B. Trim branches back to main stem.

3.05 MISCELLANEOUS OBJECTS

- A. The Contractor shall carefully remove and protect for reinstallation all fences, guide rails, signs, lawn decorations, etc. which interfere with the work required inside the right-of-way.
- B. All items damaged during removal, storage, and reinstallation shall be replaced by the Contractor at no cost to the Authority.

3.05 GRUBBING

- A. Grub areas within the construction limits to remove roots and other objectionable material to a minimum depth of 8" below the existing ground.
- B. Remove all stumps within the cleared areas to a depth of at least one (1) foot below subgrade unless otherwise authorized by the Authority.

3.05 STRIPPING AND STOCKPILING TOPSOIL

- A. Strip topsoil to whatever depth it may occur from areas to be excavated, filled, or graded and stockpile at a location in accordance with the Stormwater Pollution Prevention Plan for use in finish grading.
- B. The topsoil is the property of the Authority and shall not be used as backfill or removed from the property.

3.06 DEBRIS DISPOSAL

- A. Unless informed otherwise by the owner, debris resulting from clearing and grubbing operations shall become the property of the Contractor and shall be disposed of legally.
- B. Do not deposit or bury on the site debris resulting from the clearing and grubbing work.
- C. Debris may be burned on site if local ordinances allow open-air burning, if required permits are obtained, and if burning operations are conducted in compliance with local ordinances and regulations.
- D. The Authority uses hardwood chips in its composting operation. Consult with the Authority as an option for hardwood material.

3.07 RESTORATION

- A. Repair all injuries to bark, trunk, limbs, and roots of remaining plants by properly dressing, cutting, tracing and painting, using approved arboricultural practices and materials.
- B. Replace trees, shrubs and plants designated to be saved which are permanently injured or die during the life of the Contract and subsequent correction period as a result of construction operations with like species acceptable to the property owner.
- C. Remove protective fences, enclosures and guards upon the completion of the project.
- D. Restore guard posts, guard rail, signs and other interference's to the condition equal to that existing before construction operations.

**END OF SECTION**

**DIVISION 31 – EARTHWORK**  
**SECTION 31 23 00 – EXCAVATION AND FILL**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Excavation, backfill and compaction for structure foundations.
  - 2. Excavation, backfill and compaction for paving.
- B. Related Sections
  - 1. Section 31 23 19 – Dewatering.
  - 2. Section 31 40 00 – Shoring and Underpinning.

**1.02 REFERENCES**

- A. American National Standard Institute
  - 1. ANSI/ASTM D698 – Test methods for moisture-density relations of soils and soil aggregate mixtures, using 5.5 lb rammer and 12 inch drop.
  - 2. ANSI/ASTM D1556 – Test methods for density of soil in place by the sand-cone method.
- B. American Society of Testing and Materials
  - 1. ASTM D2167 – Test method for density and unit weight of soil in place by the rubber balloon method.
  - 2. ASTM D2922 – Test methods for density of soil and soil-aggregate in place by nuclear methods (shallow depth).
  - 3. ASTM D3017 – Test methods for moisture content of soil and soil-aggregate mixtures.
- C. Pennsylvania Department of Transportation (PennDOT)
  - 1. Specifications Publication 408, latest edition.

**1.03 DEFINITIONS**

- A. Unclassified Excavation: Removal of all materials of any kind or nature encountered in completion of the Work, including rock, to the elevations required and subsequent disposal of materials removed.

- B. Subgrade: Areas upon which the planned bottoms of foundations, footers, slabs, paving base courses or sidewalks shall rest; or where subbase is to be utilized, the surface upon which the subbase shall rest; or if structural fill is to be utilized, the surface upon which the structural fill shall rest.
- C. Subbase: Compacted aggregate material utilized under sidewalks, manholes, and paving sections.
- D. Structural Fill: Specified fill material to be utilized beneath structure foundations, where required to replace unsuitable soil or rock encountered.
- E. Structure Backfill: Select, open-graded free-draining material used to backfill against structure walls, including tank walls, foundation walls, and retaining walls.
- F. Random Backfill: Non-select backfill material used where special backfill is not specified.

#### 1.04 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Submit qualifications of proposed independent testing agency to Authority for approval.
- C. Provide testing required by Specifications.
  - 1. Reports of independent testing laboratory shall be considered as sufficient evidence of noncompliance with specifications.
  - 2. Authority reserves right to accept PennDOT certification from supplier of aggregate materials that the supplier is an approved PennDOT source and material conforms to PennDOT Specifications in lieu of actual material testing.
- D. Submit certification from independent testing agency for all soil and aggregate materials, certifying materials to meet specified standards.

#### 1.05 PROJECT/SITE CONDITIONS

- A. Existing Utilities and Services
  - 1. Known underground services and utilities must be indicated on Drawings. Although, no guarantee can be given to completeness or accuracy. Contractor shall be responsible for verifying the location and/or depth of all utilities and services indicated within the areas of work.
  - 2. Maintain existing utilities which must remain in service in the area of the excavation.
  - 3. Record locations of underground utilities encountered.
- C. Unclassified Excavation: No consideration will be given to the nature of materials encountered in excavating operations for structures. Therefore, as unclassified excavation, no additional payment will be made for difficulties occurring in excavating and handling of

materials.

- D. The Authority reserves the right to order cessation of the work during inclement weather, if, in the opinion of the Authority, the safety of the workman is endangered or if the work quality is endangered.
- E. All work of this section is subject to inspection by the Authority or its representative. Full access shall be granted.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Subbase Material (Paving Areas): Coarse aggregate consisting of naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or crushed slag meeting the requirements of PennDOT Publication 408 for No. 2A material.
- B. Structural Fill: Select fill material meeting the requirements of PennDOT Publication 408 for No. 2A material.
- C. Structure Backfill: Open-graded, free-draining coarse aggregate meeting the requirements of PennDOT Publication 408 for AASHTO No. 57.
- D. Random Backfill: Suitable material conforming to the requirements of PennDOT Publication 408 Section 206.2(a) reasonably free of organic matter such as leaves, grass, roots, sod, sewage, coal or coal blossom, or other unsuitable material. Frozen material shall not be utilized.

## **PART 3 – EXECUTION**

### **3.01 PREPARATION**

- A. Install sediment and erosion control facilities.
- B. Perform excavation support and protection.
- C. Perform dewatering, as required.

### **3.02 REQUIREMENTS AND RESTRICTIONS**

- A. Keep excavations free from water. Build dams and all other devices necessary. If required, lower water table below excavation bottom by deep wells. Dispose of water removed from excavations in a manner that will not cause injury to the public health, to public or private property, to the work of other contractors, to any portion of the Work completed or in progress, or to produce impediment to the use of highways, roads, lanes and streets by the public. All discharges from the dewatering must comply with an approved Sediment and Erosion Control Plan.

- B. Maintain sewers, drains and ditches free of debris to convey surface drainage. No damming or ponding of water in gutters or other waterways will be permitted. Do not direct flow of water across pavements except through approved pipes or properly constructed troughs. Provide pipes or troughs of such sizes and lengths as may be required. Control grading in the vicinity of excavations so the ground surface is properly pitched to prevent water from running into excavated areas.
- C. Control groundwater and surface water during construction in order to maintain soil stability. Maintain the water table elevation sufficiently below the levels of excavations that slopes will remain stable and bottoms of excavations will not become loosened by flow of water. If the foundation material loses its strength due to improper dewatering techniques, over excavate the material and replace it with Structural Fill.
- D. Do not perform excavating, backfilling or compacting when weather conditions or the condition of materials are such, that in the opinion of the Authority, the Work cannot be completed in accordance with the Specifications.
- E. Do not use as backfill frozen materials or wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
- F. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
- G. Prevent spread of dust during performance of work by thoroughly moistening excavation areas by sprinkling or other methods approved by Engineer.
- H. If the required quantity of backfill exceeds the quantity of suitable material excavated within the limits of the project site, easements, or rights-of-way, obtain sufficient material to complete the backfill at no additional cost to Authority. If borrow excavation is needed, notify Engineer sufficiently in advance of borrow excavation requirements to permit Engineer to verify the need for such borrow excavation and to view the proposed borrow pit and determine the suitability of the material to be provided. Use of borrow excavation from offsite must be approved by Engineer. Any tests required by Engineer to assist in determining suitability of the borrow materials shall be responsibility of Contractor and completed at no increase in Contract Price.
- I. No right of ownership of excavated materials is granted to Contractor prior to backfilling. This provision does not relieve Contractor of his responsibility to remove and dispose of surplus excavated material.
- J. Assume sole responsibility for the condition and results of excavations. Slides and cave-ins shall be removed without additional compensation at whatever time and under whatever circumstances they may occur.
- K. Protect all pipes, conduits, walls, buildings and other structures or property whether above or below ground, or that may appear in the excavation. Maintain sufficient quantity of material and equipment on the site and for use as necessary for sheeting, sustaining and supporting any pipes, conduits, walls, building, structure or property.

3.03 EXCAVATION

A. General Procedures:

1. Perform excavation using machinery, except where hand excavation may be required to protect existing structures, existing sanitary sewer or force main piping, electrical conduits, utilities or private or public properties. No additional compensation will be paid for hand excavation instead of machine excavation as may be necessary from any cause whatever.
2. Perform excavation of every description and of whatever substances encountered to the elevations indicated by the Contract Drawings and as specified herein.
3. Where work space is limited, remove excavated material from the limited area and replace the material after the work has been completed. No additional compensation will be made for such removal and replacement of the excavated material.
4. Extend excavation a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

B. Remove rock that has been shattered due to rock removal operations and in the opinion of the Authority is unfit for foundations to an elevation below subgrade. Fill to subgrade with Structural Fill those areas where shattered rock has been removed. Perform such backfilling to the satisfaction of the Authority. No separate or additional payment will be made for such removal and backfill.

C. Excavation below Planned Subgrade:

1. Do not excavate below depths indicated on the Drawings or such depths as required for the proper installation of the Work, unless otherwise directed by the Authority.
2. Excavation below depths indicated on the Drawings or as required for the proper installation of the Work through the fault of the Contractor, shall be restored to the indicated or required depths with Structural Fill.
3. If the foundation for any structure is required by the Authority to be carried lower than the planned subgrade elevation shown on the Contract Drawings, the voids caused by this excavation shall be backfilled with Structural Fill up to subgrade elevation.

D. Storage of Approved Materials:

1. Store on site all unused approved materials.
2. Do not mix unused approved materials of differing types.
3. Do not mix unused approved materials with unapproved materials.

### 3.04 SUBGRADE PREPARATION

#### A. General Procedures:

1. Where subgrade consists of an excavated soil surface, thoroughly machine-tamp or proof-roll the existing material. Compact the exposed soils until no movement is observed or as directed by the Authority. Remove and replace soft, loose, and disturbed zones disclosed by the tamping or proof-rolling. Overexcavate to the depth directed by the Authority and replace with Structural Fill; compact as indicated in these specifications.
2. Where subgrade consists of an excavated rock surface, thoroughly inspect the bedrock bearing surfaces, and clean any exposed soil-filled seams with water jets or compressed air to a minimum depth of two (2) times the seam width. Fill the open joints with concrete during placement of the structure foundation.
3. Do not place fill materials on surfaces that are muddy, frozen, or contain frost.
4. Trim bottoms to indicated lines and grades to leave solid base to receive other work.
5. Place geotextile material on the subgrade prior to placing fill materials.

### 3.05 STRUCTURAL FILL

#### A. Placement and Compaction:

1. Spread material uniformly without segregation of coarse and fine material.
2. Place material in 8-inch maximum loose lifts if full-size compaction equipment will be used, and 6-inch maximum loose lifts if hand compaction equipment will be used.
3. Maintain the moisture content of the material within 2% plus or minus of the optimum moisture content as determined by the Standard Compaction Test, ASTM D698.
4. Compact the material to at least 100% of the maximum dry density as determined by ASTM D698.

### 3.06 SUBBASE

#### A. General:

1. Do not place subbase material on soft, muddy or frozen subgrades. Satisfactorily correct irregularities or soft zones in the prepared area.

#### B. Placement and Compaction:

1. Place subbase material in maximum 8" lifts. When using PennDOT No. 2A material, compact to 100% of the maximum dry-weight density. When using PennDOT No. OGS material, satisfactory compaction will be based on non-movement of the material.



### 3.07 BACKFILLING

#### A. General Procedures:

1. Perform backfilling using machinery, except where hand backfilling is required to prevent damage to walls, foundations, utilities, electrical conduits, sanitary sewer or force main piping. No additional compensation will be paid where backfilling by hand is required.
2. Clean excavation free of trash and debris prior to backfilling.
3. Do not place backfill material prior to seven days after completion of structure walls, and then only if the concrete has achieved 80% of the specified 28-day compressive strength.
4. Do not place backfill material on wet or frozen areas.
5. Do not operate heavy equipment closer to walls than a distance equal to the height of backfill material above the top of the structure footing.
6. Do not place backfill material against exterior walls until supporting floors, other reinforcing or supporting members, or slabs at top of walls are in place.
7. Do not place backfill material against water-containing concrete structures or manholes until water testing has been satisfactorily completed.
8. Perform compaction using power driven tampers or compactors suitable for material being placed.

#### B. Random Backfill:

1. Use random backfill where structure backfill is not required or specified. Use of structure backfill in lieu of random backfill is allowed.
2. Place backfill in loose, uniform horizontal layers not exceeding eight inches in depth.
3. Maintain moisture content of backfill at compaction within 2% plus or minus of optimum moisture as determined by ASTM D698.
4. Compact backfill to at least 95% of the maximum dry density based on ASTM D698.

#### C. Structure Backfill:

1. Place structure backfill behind structure walls. Place structure backfill in 12-inch lifts and thoroughly compact each lift with a vibratory compactor to the satisfaction of Engineer.

### 3.08 FIELD QUALITY CONTROL

#### A. Testing

1. All testing to be completed by independent testing agency and paid for by Contractor.
  2. Pre-cast concrete structures subgrade: Make at least one field density test of subgrade for every 500 sq. ft. of liner area or structure base, but in no case less than 3 tests.
- B. Corrective Measures:
1. Whenever tests indicate that the field moisture or density does not meet specified requirements, take corrective action as approved by the Authority.
  2. Corrective measures may include loosening the soil and wetting or drying it prior to recompaction, additional compaction, or removing and replacing the material.
  3. Retest material that did not meet the moisture and density requirements after corrective measures have been performed.
- C. Retesting: The Authority may at any time require retesting of any material, whether in stockpiles or being placed, if it appears that the material differs from that which has previously been approved for use.

**END OF SECTION**

**DIVISION 31 – EARTHWORK  
SECTION 31 23 19 – DEWATERING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section includes
  - 1. Control of groundwater and surface run-off for construction period.
  - 2. Discharge of drainage water from construction site.
  - 3. Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operations.

**1.02 DEFINITIONS**

- A. Subgrade: Surface to which excavations are necessarily made for the purpose of construction of the Work. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain desired foundation conditions.

**1.03 SYSTEM DESCRIPTION**

- A. Identify and obtain all required permits for the management of groundwater and surface run-off encountered during the construction period. Develop any required Erosion and Sedimentation Control Plans. Comply with all requirements.
- B. Design and Performance Requirements
  - 1. Design, construct, and maintain a dewatering system.
  - 2. Install and operate dewatering systems, in coordination with the design and construction of excavation shoring systems, excavation and backfilling operations, to meet performance requirements.
  - 3. Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation. Do not allow silt laden run-off water to enter water courses. Direct run-off flows to siltation ponds or catchment areas.
  - 4. Dewater and keep excavations free of water to permit placing geotextiles, granular filter blankets, underdrains, granular construction working surface, concrete, and similar items, on firm dry subgrade.
  - 5. Maintain groundwater level a minimum of 12 inches below the subgrade or lower as may be required to fulfill the requirements of the specifications.
  - 6. Prevent destabilization, heaving and shear failure of the bottom of excavation by depressurizing and dewatering groundwater.
  - 7. Prevent damage to or displacement of structures from groundwater pressures.

8. Maintain groundwater a minimum of 12 inches below the subgrade until backfilling to final grade has been completed and underdrains and other permanent devices, which protect the structures against buoyancy, are operational. Where designed self weight of structure resists the buoyancy forces, make sure that the structure is completely built before allowing groundwater level to rise.
9. Obtain the Design Engineer's and the Authority's written consent prior to allowing a rise in groundwater level or prior to shutting down the dewatering operation.
10. Repair or replace any structure or Works damaged due to dewatering.

B. Dewatering Discharge Requirements

1. Provide appropriate filter screens so that no soil or foundation material is removed.
2. Provide a discharge siltation pond, or similar method, of required size to allow sufficient detention time so that the decanted water will meet state regulations. Discharge water from run-off collection and dewatering operations to a siltation pond located on site as directed by the Engineer.
3. Maintain siltation pond during construction period by removing silt build-up from time to time to keep siltation pond functional.
4. The Authority may carry out chemical analysis of drainage water to establish conformance with state regulations. If required, treat the drainage water to meet the state regulation before discharging into a watercourse.
5. Discharge drainage water to existing water courses or storm drainage system. If discharging to water course, prevent erosion of existing banks.

1.04 SUBMITTALS

A. Shop Drawings

1. Submit a general plan of dewatering scheme which includes:
  - a. Location of generators and other noise producing equipment and anticipated decibel levels.
  - b. Relationship between dewatering equipment, new structures, and the excavation plan.
  - c. Location of dewatering discharge points.
  - d. Location and dimensions of siltation pond.
  - e. Details of screens and filter media.
2. These submittals are for record purposes only and will not be reviewed for adequacy.

B. Dewatering Equipment Approval

1. Apply and obtain dewatering equipment approval from local conservation authority if required.
- C. Dewatering Discharge Approval
  1. Apply and obtain dewatering discharge approval from local conservation authority if required.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications
  1. Specialist dewatering contractor who has a minimum of 8 years experience in the design and construction of dewatering systems for projects of similar size and complexity.

### PART 2 – PRODUCTS

#### 2.01 EQUIPMENT

- A. Dewatering Equipment
  1. Pipes, wells, deep wells, well points, pumps, electrical generators, and other equipment.
  2. Standby pumps and a generator with effective muffling devices to keep noise levels to a minimum.

### PART 3 – EXECUTION

#### 3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
  1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding areas.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- A. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used structures or buildings.
  1. Do not close or obstruct streets, walks, or other occupied or adjacent buildings without permission from the Authority and the agencies having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required.

3.01 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material, valves, appurtenances, water disposal, and surface water controls.
- B. Before excavation below ground water level, place system into operation to lower water to specified levels. Operate system continuously until sewers and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundation, sewer, and other excavations.
  - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, sewers, and other excavations.
  - 1. Maintain piezometric water level sufficiently below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that does not endanger public health, property, and portions of the work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow control devices as required.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional cost to Authority.
  - 1. Remove dewatering system from site upon completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36" below grade. Restore areas affected by dewatering system to original condition at no additional cost to Authority.
- G. Damages: Promptly repair all damages to adjacent structures, property, and facilities caused by dewatering operations at no additional cost to the Authority.

3.02 FIELD QUALITY CONTROL

- A. Monitoring Groundwater Level (If necessary)
  - 1. Take readings of groundwater level two times a day for the duration of the dewatering period. Keep a written record of groundwater levels.

**END OF SECTION**

**DIVISION 31 - EARTHWORK  
SECTION 31 23 33 - TRENCHING, BACKFILLING AND COMPACTING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes**

1. Excavating trenches for utilities and site piping.
2. Backfilling and compaction of utility and site piping trenches.

**1.02 REFERENCES**

**A. American Association of State Highway and Transportation Officials:**

1. AASHTO T 99, Moisture-Density Relations of Soils, Using a 5.5-lb Rammer and a 12-inch Drop.
2. AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand Cone Method.

**B. American Society for Testing and Materials:**

1. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
2. ASTM D1556 - Test method for Density and Unit Weight of Soil in Place by Sand Cone Method.
3. ASTM D 2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
4. ASTM D2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
5. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
6. ASTM D3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
7. ASTM D4643 - Test Method for Determination of Water Moisture Content of Soil by the Microwave Oven Method

**C. Pennsylvania Department of Transportation:**

1. PennDOT Publication 408, latest edition
  - a. PennDOT Section 703.2, Coarse Aggregate
  - b. PennDOT Section 703.3, Select Granular Material
  - c. PENNDOT Section 220, Flowable Backfill
  - d. PENNDOT Section 601, Pipe Culverts
2. PennDOT Chapter 459, Occupancy of Highways by Utilities, latest edition

3. PennDOT Chapter 203, Temporary Traffic Control Guidelines, latest edition

#### 1.03 DEFINITIONS

A. Definitions:

1. Unclassified Excavation: Removal of materials of any kind in the excavation, including rock excavation.
2. Miscellaneous Unclassified Excavation: Unclassified Excavation required by the Engineer and not included in other items for payment.
3. Miscellaneous Aggregate Backfill: Aggregate backfill required by the Engineer and not included in other items of payment.
4. Miscellaneous Earth Backfill: Earth backfill required by the Engineer and not included in other items of payment.
5. Subgrade: Trench bottom prepared as specified to receive first class bedding, concrete cradle or concrete encasement or the bottom of excavations prepared to receive pipe line structures.
6. Utility: Any buried pipe, duct, conduit or cable.
7. Final Surfacing Elevation: Elevation of bottom of final surfacing operation such as bottom of topsoil depth or paving subgrade.

#### 1.04 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit data for each type of aggregate proposed.
- C. Samples: Submit aggregate samples when requested by the Authority and other required submissions to the Engineer's field office.
- D. Test Reports:
1. Submit testing laboratory aggregate test reports based on requirements stated in Source Quality Control.
  2. Compaction density test reports based on method of density determination as specified in Reference Standards and the method as approved by the Authority.
- E. Certificates: Submit certificate from aggregate supplier based on requirements stated in Source Quality Control.
- F. Bonds and Licenses: Submit evidence of bonds, licenses, and experience prior to commencement of any blasting operations.

#### 1.05 QUALITY ASSURANCE

A. Source Quality Control:

1. Laboratory Tests: Aggregate materials specified require advance examination or



testing according to methods referenced, or as required by the Authority.

- a. Testing laboratory shall furnish two copies of test result reports to the Authority. Same reports will be considered as sufficient evidence of acceptance or rejection of materials represented.
- b. Conduct aggregate quality tests in accordance with requirements of appropriate Referenced Standard for such materials.
- c. The Authority reserves the right to accept aggregate materials based on certification from supplier that the aggregate originates from a source approved by PennDOT and that the aggregate complies with specified PennDOT requirements.
- d. The Contractor shall pay for all testing required by this section.

B. Regulatory Requirements

1. Work performed within Township rights-of-ways shall be completed according to all requirements of the Township.
2. Work performed within PennDOT rights-of-ways shall be completed according to all requirements of PennDOT.

1.06 PROJECT/SITE CONDITIONS

A. Classification of Excavated Materials: Unclassified excavation as defined herein this Section. No consideration will be given to the nature of the materials encountered in trenching operations or for difficulties encountered during excavating or handling of materials.

B. Removal of Obstructions:

1. Remove, realign or change the direction of above or below ground utilities and their appurtenant supports, if such is required in the opinion of the Authority. Perform work as extra work unless work is done by the Authority of the obstruction without cost to the Contractor. However, Contractor shall uncover and sustain the obstruction at own expense prior to the final disposition of obstruction. The Contractor is not entitled to claims for damage or extra compensation due to the presence of such obstruction or delay in the removal or rearrangement of same. Additional precautions concerning obstructions are as follows:
  - a. Do not interfere with persons, firms, corporations or utilities employing protective measures, removing, changing or replacing their property or structures, but allow said persons, firms, corporations or utilities to take such measures as they may consider necessary or advisable under the circumstances; which shall not relieve the responsibilities of the Contract.

C. Environmental Requirements:

1. Do not perform trenching, backfilling or compacting when weather conditions or the condition of materials, in the opinion of the Engineer, are not suitable for the work to be performed satisfactorily.
2. Do not use frozen materials as backfill nor wet materials containing moisture in excess of the amount necessary for satisfactory compaction.
3. Prior to use, moisten dry backfill material not having sufficient moisture to obtain satisfactory placement or compaction.
4. Plan work so as to provide adequate protection during storms with provisions

available for preventing flood damage. Protect installed piping and other work against damage from uplift due to high ground water levels.

5. Accommodation of Drainage: Keep gutters, storm sewers, drains and ditches open for surface drainage. No damming or ponding of water in gutters or other waterways will be permitted, except where stream crossings are necessary and then only to an extent which the Authority shall consider necessary. Do not direct water flows across or over pavements except through approved pipes or properly constructed troughs. When so required, provide pipes or troughs of such sizes and lengths as required, and place the same as required at no expense to the Authority. Perform grading in the vicinity of trenches so that the ground surface is properly pitched to prevent water running into the trenches.
  6. Pumping: Keep excavations free from water during the performance of the work. Build dams and other devices necessary for this purpose, and provide and operate pumps of sufficient capacity for dewatering the excavations. Provide for the disposal of the water removed from excavations in such manner as not to cause injury to the public health, to public or private property, to the work of others, to the portion of the work completed or in progress or produce an impediment to the use of streets, roads and highways. Comply with all requirements of the projects approved Erosion and Sedimentation Control Plan.
  7. When it is necessary to haul soft or wet soil material over roadways, use suitably tight vehicles to prevent spillage. Clear away spillage of materials caused by hauling on roadways.
  8. Provide effective dust and mud control.
  9. Do not dispose of water in trenches by draining through completed portions of utility piping.
- D. Protection: The Contractor assumes the risks presented due to the presence or proximity of overhead or underground public utility and private lines, pipes, conduits and support work, existing structures and property of whatever nature. Damages and expenses for direct or indirect injury to structures or to any person or property by reason of them or by reason of injury to them; whether such structures are or are not shown, by work of this Contract, rests solely with the Contractor.
1. Outside Rights-of-Way: Take necessary precautions to protect trees, shrubs, lawns and such other landscaping from damage. Complete restitution work for damages at no additional cost to Authority.
  2. Pipe Supports: Adequately support underground pipes or conduits exposed as a result of excavations. Provide adequate support along the entire exposed length. Install supports in a manner that backfilling may be performed without dislodging pipes or conduits. Place and carefully compact aggregate backfill around the supports and leave supports in place as a guard against breakage due to backfill settlement.
  2. Temporary Protective Construction:
    - a. Temporary Fence Barricade: Erect and maintain substantial temporary fences surrounding excavation to prevent unauthorized persons from entering such areas.
    - b. Barricades: Furnish and erect substantial barricades at crossings of trenches, or along trenches, to protect the traveling public.

- c. Excavation Covers: Cover open excavation when work is suspended or left unattended, including the end of a work day. For covers, use materials of sufficient strength and weight to prevent removal by unauthorized persons.
  - d. Remove temporary protective construction at the completion of work on the Project.
  - e. Comply with Township and PennDOT requirements.
- E. Structure Supports: Where passing buildings or any structure which by construction or position might bring a great pressure upon the trenches, the right is reserved by the Authority to require that buildings or structures be underpinned or supported and protected, or special sheeting be driven or that short lengths of trench be opened at one time. Failure of the Authority to recommend protection shall not relieve the Contractor of his responsibility to protect structures near the construction.
- F. Accommodation of Traffic: DO NOT OBSTRUCT FIRE HYDRANTS or FIRE FILL STATIONS, if existing in the project area. Employ traffic control measures in accordance with PennDOT, Title 67, Chapter 203, latest edition and in accordance with Township requirements.
- G. Explosives and Blasting:
  - 1. Blasting is only permitted with the written authorization of the Authority.
  - 2. Blasting will not be permitted in areas where the proximity of structures, underground facilities or public safety precludes the use of explosives.
  - 3. The use of explosives shall be governed by the "Regulations for the Storage, Handling and the Use of Explosives" of the Pennsylvania Department of Labor and Industry and any other applicable federal, state, local codes that may have jurisdiction, or utility company requirements.
  - 4. All blasts shall be properly matted and securely covered. The Contractor shall be solely responsible for injury to persons or property located within or beyond the area or scope of the project that may result from use of explosives.
  - 5. Blasting work shall be supervised by personnel licensed and experienced in this type of work.
  - 6. Explosives shall be stored in state-approved magazine off the job site and shall be delivered to the site in vehicles clearly marked to indicate cargo.
  - 7. The Contractor shall obtain any necessary federal, state, or local blasting permits or approvals and blasting bonds and/or insurance, as required. The Contractor shall be solely responsible for damage to streets located within or beyond the area or scope of the project that may result from the use of explosives.
  - 8. All Blasting shall conform to the requirements of the adjacent applicable utilities, railroad and PennDOT requirements.
  - 9. Blasting operations shall only be conducted during hours approved by the Authority and as conditioned through permits or approvals.
- H. Removal of Rock by Means Other Than Blasting: Where removal of rock by means other than blasting is required, in accordance with the requirements of State and local laws, rules and regulations, and utility owner requirements, remove by the use of mechanical surface impact equipment, or by drilling and hydraulic rock splitting equipment, or by other methods.

- I. Responsibility for Condition of Excavation: Condition and results of excavation are solely the responsibility of the Contractor. Remove slides and cave-ins at whatever time and under whatever circumstance they occur.
- J. Excess Materials: No right of property in materials is granted to the Contractor of excavated materials prior to backfilling. This provision does not relieve the Contractor of his responsibility to remove and dispose of surplus excavated materials.
- K. Borrow Material: When the required quantity of backfill material exceeds the quantity of suitable on site material, provide borrow material. If borrow material is needed, notify the Authority sufficiently in advance to permit validation of the need and to view the proposed borrow pit to determine the material suitability. Borrow excavation will be subject to the Authority's approval whose written consent shall be obtained prior to its use. Contractor shall be responsible for all sampling and testing required by the Authority to determine suitability.
- L. Change of Trench Location or Depth:
  - 1. Should a change in trench location from that indicated on the approved drawings be required due to the presence of an obstruction, or from other cause, the Authority shall be notified and a corrective action plan shall be submitted for review and approval. No work deviating from approved drawings shall proceed without the Authority's approval.
  - 2. Minor changes may be field approved provided that the resulting work complies with minimum design and construction standards established by the Authority.
- M. Advance Trenching: Where existing Utilities or other suspected underground obstructions as indicated on the Drawings are within close proximity of proposed pipelines, uncover and verify the exact location of Utilities and other underground obstructions far enough in advance of pipe laying to allow any changes in pipe alignment or grade required to bypass the obstructions to avoid removing sections of pipe already installed. If any sections of installed pipe must be removed and reinstalled as a result of not verifying Utilities or other underground obstructions far enough in advance, the Contractor shall remove and reinstall the pipe at no additional cost to Owner.
- N. The Authority reserves the right to order cessation of the work during inclement weather, if, in the opinion of the Authority, the safety of the workman is endangered or if the work quality is endangered.
- O. All work of this section is subject to inspection by the Authority or its representative. Full access shall be granted.

#### 1.07 SEQUENCING

- A. Verify work associated with lower elevation Utilities is complete before placing higher elevation Utilities.

### PART 2 - PRODUCTS

#### 2.01 FILL MATERIAL

- A. Backfill
  - 1. Suitable Trench Backfill Material: On site excavated soil or soil-rock mixed materials free of topsoil, vegetation, lumber, metal and refuse; and free of rock or similar hard

objects larger than six inches in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.

2. Clean Organic Material Backfill: One site excavated material free of vegetation, lumber, metal and refuse, and free of rocks or similar hard objects larger than one inch in greatest dimension. Rock to soil ratio shall not exceed one part rock to three parts soil.
3. Aggregate Backfill: PennDOT 2A Coarse Aggregate conforming to PennDOT Publication 408, Section 703.
4. Flowable Backfill: Type A or B: In accordance with PENNDOT Section 220 – Flowable Backfill

**B. Pipe Bedding**

1. First Class Bedding: Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2
  - a. For piping having a diameter of 24 inches and less use AASHTO No. 8 Coarse Aggregate.
  - b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.
2. Initial Backfill: Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2
  - a. For piping having a diameter of 24 inches and less, use AASHTO No. 8 Coarse Aggregate.
  - b. For pipes having a diameter greater than 24-inches use AASHTO No. 57 Coarse Aggregate.

- C. Concrete Cradle, Encasement and Backfill: Conforming to PennDOT 408 Section 704, Class A Concrete with a 28-day compressive strength of 3,000 psi.
- D. Unsuitable Bearing Replacement Material: AASHTO No. 3 Coarse Aggregate conforming to PennDOT Publication 408, Section 703.2.

**PART 3 - EXECUTION**

**3.01 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities which are to remain.

**3.02 EXCAVATING**

- A. Perform soil erosion and sedimentation control work in accordance with the approved Erosion and Sedimentation Control Plan.
- B. General:
  - 1. Excavation shall be performed to the lines and grades indicated on the Drawings or as directed by the Authority.
  - 2. Perform excavation and backfilling using machinery except where hand excavation and backfilling is required or is necessary to protect existing structures, utilities, or other private or public properties.
  - 3. Begin excavation in trenches at the control point having the lower invert and proceed upward.
  - 4. Remove pavement according to requirements of Section 32 12 00 – Flexible Paving and Surfacing.
  - 5. Remove rock to subgrade at least twenty-five (25) feet in advance of pipe laying.
  - 6. Do not interfere with 45 degree bearing splay of foundations.
- C. Subgrade Preparation:
  - 1. Do not excavate below depths indicated or specified except where unsuitable material is encountered at subgrade.
  - 2. Remove unsuitable material found below subgrade to a depth determined by the Authority and backfill with Suitable Bearing Replacement Material or as directed by the Authority to required Subgrade.
  - 3. Remove rocks or other hard matter protruding through trench bottom at Subgrade which could damage pipe or impede consistent backfilling or compaction. Backfill with first class bedding to required Subgrade. Compact in four (4) inch lifts.
  - 4. Remove rock below subgrade if shattered due to excessive drilling impact or splitting operations and in the opinion of the Authority is unfit for foundations. Backfill to Subgrade with Concrete or other material acceptable to the Authority.
- D. Excavated Material Storage:
  - 1. Separate and stockpile in designated area, excavated materials suitable for use as backfill. Remove from the site, excess materials and excavated materials not suitable for backfill.
  - 2. In no case shall excavated materials be stockpiled outside of the construction easements or the permanent right-of-way if construction easements are not in place.
- E. Trench Width:
  - 1. From subgrade elevation to an elevation at least twelve inches above the top of the outside barrel of the pipe, excavate trench banks to vertical lines and not less than the minimum nor more than the maximum widths specified in Table A. If shoring is required, the following Table A dimensions apply to the inside face of sheeting.

TABLE A		
Diameter of Pipe	Minimum Trench Width (Outside Diameter of Pipe at the Barrel Plus)	Maximum Trench Width (Outside Diameter of Pipe at the Barrel Plus)
4 through 24 inches	12 inches	16 inches
27 through 36 inches	20 inches	24 inches
42 through 72 inches	26 inches	30 inches
Larger than 72 inches	30 inches	36 inches

3. From a point twelve inches above the top of the outside barrel of the pipe, maintain trench banks as follows:
  - a. Vertical as possible for trenches in paved or unpaved roadways.
  - b. In open areas, trenches may be sloped at angles required to make trench stand; however, in no case shall angle exceed one-half horizontal to one vertical.
  - c. Top of trench shall not exceed limits of right of way or construction easement if such is in place.
  - d. Maintain trenches such that there is no conflict with State or OSHA regulations.

F. Length of Open Trench:

1. Complete trench excavation at least twenty-five (25) feet but not more than one hundred (100) feet in advance of pipe laying and keep trenches free from obstructions, except that at the end of a work day or at the discontinuance of work, the pipe laying may be completed to within five feet of the end of the open trench.
2. The Contractor shall limit all trench openings to a distance commensurate with all rules of safety.
3. If the work is stopped either totally or partially, the Contractor shall refill the trench and temporarily restore over the same at his expense. The trench shall not be opened until he is ready to proceed with the construction of the pipeline.
4. The Authority reserves the right to request trench refilling over completed pipe if in its judgement, such action is necessary.

### 3.03 PIPE BEDDING

- A. Place First Class Pipe Bedding and Initial Backfill as specified unless otherwise approved in writing by the Authority. Place material in trench for full width. Place on each side of pipe and fittings simultaneously.
- B. First Class Bedding: Carefully place on undisturbed subgrade or compacted subgrade as approved by the Authority, pipe bedding material from six (6) inches below outside of pipe barrel to pipe springline. Work pipe bedding material by hand under pipe haunching to

provide adequate side support. Place in three (3) inch layers.

- C. Initial Backfill: From pipe springline to twelve (12) inches above outside of pipe barrel carefully place initial backfill in four (4) inch layers. Place carefully so as not to disturb pipe.

#### 3.04 BACKFILL

- A. Unless otherwise required, backfill trenches to existing contours and elevations. The Contractor should record existing contours prior to starting work. A copy of this information should be forwarded to the Authority for record purposes
- B. Maintain optimum moisture content of fill materials to attain required compaction density.
- C. Do not use frozen backfill materials or place backfill on frozen subgrades or trench subgrades.
- D. Perform backfilling by methods which will result in thorough compaction of backfill material.
- E. Backfill to Final Restoration Elevation: Backfill from one (1) foot above the top of pipe to Final Restoration Elevation using backfill materials specified in Schedule at end of this Section. Consolidate backfill materials evenly from center to side of trench to prevent arching.
- F. If there is a deficiency of backfill material, provide borrow material as required at no additional cost to Owner

#### 3.05 FLOWABLE BACKFILL

- A. Provide Flowable Backfill for abandonment of existing sanitary sewer facilities and for backfill material within PennDOT right-of-way where required by PennDOT.
  - 1. Do not place Flowable backfill at a material temperature below 10°C (50° F).

#### 3.06 AGGREGATE BACKFILL

- A. Provide Aggregate Backfill material under all paved services, where required by the Authority, in accordance with Section 459.8 (G)(2) and Section 703.2 of PennDOT Publication 408, and as required by conditions of a PennDOT highway occupancy permit.

#### 3.06 CLAY DIKES

- A. Clay Dikes shall be installed at the midpoint of all gravity sewer runs, where indicated on the Contract Drawings, and where directed by the Authority based on field conditions.

#### 3.07 COMPACTION

- A. Solidly tamp each layer of bedding around the pipeline and above pipeline using proper tamping tools made especially for this purpose. Compact each layer to the densities specified in the Schedule contained at the end of this Section using ASTM D698 Standard Proctor Test Methods determined at maximum density at optimum moisture content as determined by AASHTO T 99.
- B. Do not use rolling equipment or heavy tampers to consolidate backfill until at least two (2) feet of backfill is placed over the top of the pipe.
- C. The use of HYDRA-HAMMER for compacting backfill in trenches is prohibited.



- D. The use of puddling or jetting for compacting backfill in trenches is prohibited.
- E. Compaction Tests: During the course of backfilling and compacting, the Authority may at various locations and depths of trenches request that the Contractor make field tests to verify that specified compactions are being achieved. Perform field density tests according to AASHTO T 191 or ASTM D2922 and ASTM D3017. Payment for testing will be responsibility of the Contractor. At a minimum, the following will apply:
  - 1. Conduct compaction tests within the PennDOT right-of-way as required by PennDOT.
  - 2. One compaction test shall be performed at every two vertical feet of backfill every 200 linear feet in roadways, paved areas, and driveways, etc.
  - 3. One compaction test shall be performed at every four vertical feet of backfill every 2,000 linear feet in all other areas.
- F. If compaction tests indicate that Work does not meet specified requirements, remove Work, replace, compact and retest.

3.08 CLEAN-UP AND MAINTENANCE

- A. General: During construction, the surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition. Streets shall be swept and flushed after backfilling, and re-cleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates.
- B. Remove surplus excavated materials, rubbish and other construction debris from the site after backfilling is completed.
- C. Construction site shall be left clean at end of each working day to satisfaction of the Authority.

3.09 RESTORATION SCHEDULE

Surfacing ID. No.	Description	Backfill and Compaction per Section 31 23 33		SURFACING PER SECTION 32 12 00				
		Type	Compaction % (Note 1)	Temporary		Permanent		
				Base	Surface	Sub-Base (Note 4)	Base (Note 4)	Surface (Note 4)
1.00	<b>Vegetation</b>							
1.01	Roadside, Mowed	Suitable	90	(Note 2)	(Note 2)	N/A	(Note 3)	(Note 3)
1.02	Lawns	Suitable	90	(Note 2)	(Note 2)	N/A	(Note 3)	(Note 3)
1.03	Open Fields, Pasture	Suitable	90	(Note 2)	(Note 2)	N/A	(Note 3)	(Note 3)
1.04	Woods	Suitable	90	(Note 2)	Note (2)	N/A	(Note 3)	(Note 3)
2.00	<b>Private</b>							
2.10	<b>Paved</b>							
2.11	Paved Driveway	Aggregate	100	N/A	Note 6	N/A	Note 6	Note 6
2.20	<b>Improved</b>							
2.21	Improved Surface	Suitable	90	N/A	N/A	N/A	N/A	6" 2A
2.31	Concrete Driveway	Aggregate	100	N/A	N/A	N/A	Note 5	Note 5
2.41	Stream Bottom	Aggregate	100	N/A	N/A	N/A	Note 5	Note 5
3.00	<b>Municipal</b>							
3.11	Paved Street	Aggregate	100	2A	Note 6	6" 2A	Note 6	Note 6
3.21	Improved Surface, Road	Aggregate	95	N/A	N/A	N/A	N/A	6" 2A
4.00	<b>PennDOT</b>							
4.01	Paved Road	Aggregate	100	2A	Note 6	6" 2A	Note 6	Note 6
4.02	Paved Shoulder	Aggregate	100	2A	Note 6	6" 2A	Note 6	Note 6
4.03	Improved Shoulder	Aggregate	100	N/A	N/A	6" 2A	N/A	Oil and Chip
4.04	Outside Existing Shoulder	Suitable	95	N/A	N/A	N/A	N/A	(Note 3)
Note 1	Percent (minimum) of maximum dry density as determined by Standard Proctor Test.							
Note 2	Comply with requirements of Erosion & Sedimentation Section.							
Note 3	Comply with requirements of Section 32 92 00.							
Note 4	Minimum depths required or match existing depth if greater.							
Note 5	Restore to original condition.							
Note 6	Comply with restoration details shown on drawings.							

END OF SECTION

**DIVISION 31 – EARTHWORK**  
**SECTION 31 40 00 – SHORING AND UNDERPINNING**

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes

1. Temporary excavation support and protection systems for utilities and structures.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Shoring materials and installation work shall conform to Federal, State and local laws, rules, regulations, requirements, precautions, orders and decrees.
2. Provide material for sheet piling, sheeting, bracing and shoring, and drive or set in place in accordance with Federal, State and local laws for excavations and construction; and as required to protect the workers and the public, or to maintain the trench widths specified regardless of whether it is or is not considered necessary by the Contractor.
3. The Contractor shall submit to the Authority, if requested, design plans, details, and computations for supporting of the excavations signed and sealed by a Registered Professional Engineer licensed in the Commonwealth of Pennsylvania for review and approval prior to the start of construction on as required.

1.03 PROJECT/SITE CONDITIONS

A. Responsibility for Condition of Excavation:

1. The failure or refusal of the Authority to suggest the use of bracing or sheeting, or a better quality, grade, or section, or larger sizes of steel or timber, or to suggest sheeting, bracing, struts, or shoring to be left in place; shall in no way or extent relieve the Contractor of his responsibility concerning the condition of excavation or of his obligations under the Contract, nor impose liability on the Engineer or the Authority; nor shall a delay, whether caused by an action or want of action on the part of the Contractor, or by an act of the Engineer, the Authority, or their agents, or employees, resulting in the keeping of an excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from his obligations under the Contract relating to injury to persons or property, nor entitle him to claims for extra compensation.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Wood Materials: Use wood sheeting, sheet piling, bracing and shoring which is in good serviceable condition and timbers of sound condition, free from large or loose knots and of proper dimensions.
- B. Steel Materials: Steel sheet piling and bracing of equal strength may be substituted for wood.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Using skilled labor, drive or set sheeting, sheet piling, braces or shores in place and arrange such that they may be withdrawn as the excavations are backfilled, without injury to piping and structures, and without injury to or settlement of adjacent structures and pavements.
- B. When tight plank or steel sheeting is required, drive such sheeting in advance of the excavation. Make joints of tongue and groove or interlocking type and as watertight as possible.
- C. Where the maximum width of trench may be exceeded under these Specifications and where permitted by Federal and State regulations, the sides of the trench may be sloped in lieu of providing sheeting and bracing. If the sloping of trench banks is permitted, the slope shall begin at a point of 12" above the top of the pipe. Install sheeting to support the vertical part of the excavation as required by Federal and State regulations.
- D. Remove sheeting, bracing and shores as trenches and other excavations are being backfilled, except where and to such an extent as the Engineer shall require, in writing, that same be left in place or where he shall permit the Contractor to leave same in place at the Contractor's own request and cost.
  - 1. In withdrawing sheeting and sheet piling, exercise care to ensure that all voids or holes left by planks as they are withdrawn are backfilled and thoroughly rammed with thin rammers provided especially for that purpose.
  - 2. Exercise care to carry backfill up evenly on all sides of items installed in excavations.
- E. Cut off sheeting or sheet piling left in place whenever and at such points as the Engineer shall require and remove from the work the portion cut off. No additional compensation will be allowed for such cutting and removal.

**END OF SECTION**

**DIVISION 32 – EXTERIOR IMPROVEMENTS**  
**SECTION 32 12 00 – FLEXIBLE PAVING AND SURFACING**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. Section Includes:
1. Paving Surfacing.
  2. Driveway/Parking Lot Surfacing.
  3. Concrete Curbing

1.02 REFERENCES

- A. The "PennDOT Sections" noted herein refer to sections contained in the current Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented or revised. The references pertain only to materials, construction, equipment, methods and labor. The payment provisions do not apply to work to be performed under this Contract.
- B. Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, latest edition.
1. PennDOT Section 210 – Subgrade.
  2. PennDOT Section 212 – Geotextiles.
  3. PennDOT Section 305 – Bituminous Concrete Base Course.
  4. PennDOT Section 309 – Superpave Asphalt Mixture Design, HMA Base Course (Standard).
  5. PennDOT Section 350 – Subbase.
  6. PennDOT Section 401 – Conventional Mixture Design, Standard and RPS Construction of Plant-Mixed HMA Courses.
  7. PennDOT Section 409 – Superpave Mixture Design, Standard and RPS Construction of Plant-Mixed HMA Courses.
  8. PennDOT Section 460 – Bituminous Tack Coat.
  9. PennDOT Section 470 – Bituminous Seal Coat.
  10. PennDOT Section 480 – Bituminous Surface Treatment.
  11. PennDOT Section 491 – Milling of Bituminous Pavement Surface.

- 12. PENNDOT Section 630 Plain Cement Concrete Curb.
- 13. PennDOT Section 703 – Aggregates.
- 14. PennDOT Section 704 – Cement Concrete.
- 15. PennDOT Section 735 – Geotextiles.
- 16. PennDOT Section 962 – Waterborne Pavement Markings.
- C. Commonwealth of Pennsylvania Department of Transportation Bulletin 25.
- D. Commonwealth of Pennsylvania Department of Transportation Bulletin 27.
- E. Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities, as supplemented or revised.
- F. Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 213, Temporary Traffic Control Guidelines, latest edition (PennDOT Chapter 213).

#### 1.03 DEFINITIONS

- A. Street: Unless otherwise specifically qualified herein, the term "Street" as used in this Section shall be understood to mean a street, highway, avenue, boulevard, road, alley, lane, driveway, parking lot, or any other area used as a way for vehicles.

#### 1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00.
- B. Product Data: Submit data identifying materials proposed for use.
- C. Certificates: Furnish current certification from bituminous and aggregate producer attesting that materials conform to requirements of PennDOT Specifications.
- D. Material Slips: Furnish certification of the amount of materials utilized from the producer in accordance with PennDOT specifications.

#### 1.05 QUALITY ASSURANCE

- A. Source Quality Control:
  - 1. Use materials conforming to PennDOT Publication 408, latest edition and supplementary bulletins thereto.
  - 2. The quality of the work shall be maintained by using the products of a qualified bituminous concrete producer and qualified plant operating workmen.

3. The bituminous concrete producer shall be a bulk producer regularly engaged in production of hot-mix, hot-laid bituminous concrete conforming to the standards referenced herein.

B. Workmen Qualifications:

1. Provide at least one person thoroughly trained and experienced in the skills required who readily understands the design and is completely familiar with the application of bituminous concrete paving work. Said person shall be present at all times during progress of bituminous concrete paving work and shall direct the performance of said work.
2. For actual finishing of bituminous concrete surfaces and operation of the equipment, use only personnel thoroughly trained and experienced in the skills required.

C. Requirements of Regulatory Agencies:

1. Removal, protection and replacement of paving on State Highways must be performed in accordance with the requirements of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways By Utilities, latest edition.
2. Removal, protection and replacement of paving on roadways other than state highways must be performed in accordance with the requirements of the municipality in which the work is performed. The Contractor is responsible to meet the requirements of all permits and approvals from the municipality.
3. Employ traffic control measures in accordance with PennDOT, Title 67, Chapter 213.

1.06 PROJECT/SITE CONDITIONS

A. Protection:

1. Protect paved surfaces outside of the pavement removal limits as indicated on Pavement Restoration Details in Contract Drawings. Repair pavement outside removal limits damaged by construction operations to PennDOT or Township specifications at no additional expense to Owner.
2. Use all means necessary to protect and maintain pavement materials before, during, and after installation. Protect installed work and materials of all other contractors.

B. Environmental Requirements:

1. Do not install aggregate courses when ambient temperature is below or is expected to fall below freezing.
2. Do not use aggregate containing frost nor place aggregate courses on frozen subgrade.
3. Terminate placement of bituminous mixtures or courses between October 31, and do not resume placement prior to April 15. Placement of bituminous mixtures or

courses between the dates referenced above requires prior approval.

4. Do not place bituminous paving mixtures or courses when surfaces are wet or when the temperature of either air or the surface on which the mixture or course is to be placed is 40 Deg F or lower. When work is halted because of weather conditions, limited quantities en route to the project may be placed, if permitted by the Engineer.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

#### **A. Bituminous Materials:**

1. Asphalt Cement: PG 64 – 22 conforming to PennDOT Bulletin 25.
2. Asphalt Rubber Sealing Compound: Conforming to PennDOT Bulletin 25.
3. Superpave Asphalt Mixture Design: HMA Base Course, Conforming to PennDOT Section 309. HMA Binder Course and HMA Wearing Course Conforming to PENNDOT Section 409.
4. Bituminous Tack Coat: Class E-1, E-6 or E-8 emulsified asphalt conforming to PennDOT Bulletin 25.
5. Bituminous Surface Treatment: Two (2) applications of bituminous material each followed by application of coarse aggregate conforming to PennDOT Section 480.
6. Bituminous Seal Coat: Single application of bituminous materials followed by application of aggregate conforming to PennDOT Section 470.

#### **B. Aggregate Base/Subbase: Type C or better, No. 2A, Section 703.2, placement per Section 350.**

#### **C. Traffic Paint - State Highways and Township Roads: Conforming to PennDOT Section 962.**

#### **D. Cement Concrete:**

1. Curbs, gutters, and sidewalks: 3,000 PSI 28-day compressive strength as specified for Class A Concrete in PennDOT Section 704.
2. Collars and driveways: 3,500 PSI 28-day compressive strength as specified for Class AA Concrete in PennDOT Section 704.

#### **E. Select Granular Material: Select Granular Material (2RC) conforming to PennDOT Section 703.3.**

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**



- A. Verify that backfill to surfacing subgrade as required by the regulating agency has been properly completed.

### 3.02 PREPARATION

- A. Materials and thicknesses shall, at a minimum, match existing, unless otherwise directed in writing by the respective regulating agency (e.g, PennDOT, Township, etc.).
- B. Existing Pavement Removal:
  - 1. Municipal and Private Pavement
    - a. Sawdust existing pavement using a mechanical saw to neat lines equidistant from the centerline of the trench.
    - b. Remove pavement to width equal to maximum excavated trench width plus not less than one foot on each side of the trench. If pavement is removed or disturbed for a greater width without written authorization of the Authority, the Contractor will be required to replace such pavement without compensation.
- C. Manhole Covers and Valve Boxes:
  - 1. Ensure that manhole covers and valve boxes to be within the paved surface are at the correct finished elevation and slope.
  - 2. Coordinate the raising of all valve boxes and manhole covers owned by other utilities in accordance with the respective utilities requirements.
  - 3. Comply with requirements of Section 33 39 13 for manhole cover adjustment.

### 3.03 INSTALLATION

- A. General: Restore streets, driveways, parking areas and other areas according to details, existing conditions, or as required by the regulating agency.
- B. Temporary Surfacing:
  - 1. In the event the permanent pavement cannot be placed due to the weather limitations set forth herein for placing bituminous material for the permanent base and surface courses, provide a temporary surface. The temporary surface shall consist of compacted select granular material with a surface of 2-inch bituminous material. If the existing pavement structure includes a course of subbase material, it shall be replaced to a depth equal to the existing course depth with material meeting the requirements of Section 350.2 of Publication 408. The Contractor shall be responsible for the maintenance and protection of all temporary surfacing, as well as manholes, frame and covers, and other facilities or structures located within the areas of the temporary surfacing until such time as that the permanent pavement or surface can be placed. Permanent surfacing must be placed no later than thirty (30)

days following the placement of temporary surfacing. In the event that environmental conditions do not allow for placement of permanent surfacing within the thirty days specified, permanent surfacing must be placed as soon as conditions allow.

2. Prior to placement of final surfacing, the Contractor, Authority, and Engineer shall inspect all areas to be restored. The Contractor shall be responsible for any replacement of material, regrading, or addition of material deemed necessary by the Engineer in any areas found to be unacceptable for receipt of final surfacing.
3. Contractor shall be responsible for the removal and disposal of the temporary surfacing to the grade required for the placement of the final sub-base, base, and surface at the specified depths.
4. The Contractor shall be responsible for any necessary adjustments to grade for manholes, frame and covers, and other facilities or structures prior to final surfacing.
5. Temporary surfacing shall be placed where directed by the Engineer.

C. Paved Surfaces:

1. Superpave Asphalt Mixture Design: HMA 25 mm Base Course. Construct in accordance with PennDOT Section 309.
  - a. Install the HMA Base Course with the top surface below the surface of the adjacent pavement a distance equal to the thickness of the HMA Wearing Course.
2. Superpave Asphalt Mixture Design: HMA 9.5 mm Wearing Course. Construct in accordance with PennDOT Section 409.
  - a. Install HMA Wearing Course at the required thickness and with the top surface flush with the surface of the adjacent undisturbed pavement.
3. Aggregate Base/Subbase: Construct and place in accordance with the requirements of PennDOT Section 350.
  - a. Install on prepared subgrade as specified in this Project Manual and in PennDOT Section 210.
  - b. Install subbase to underside of base course as specified in this Project Manual.
4. Bituminous Tack Coat: Apply according to PennDOT Section 460.
5. Asphalt Rubber Sealing Compound: Apply according to PennDOT Bulletin 25. All joints between the new paving and the existing paving and where the new paving abuts other materials such as curbs, manhole frames, valve boxes, inlets, etc. shall be sealed. Width shall be 12 inches for pavement joints and where curb acts as a gutter. Other shall be six (6) inches.

- 6. Roadway Traffic Lines and Markings: Apply in accordance with PennDOT Section 962. Provide satisfactory barrier cones for at least 30 minutes, or until the paint is dry and track free from vehicular traffic. Repaint marked or damaged areas.

D. Unimproved Surfaces:

- 1. Restore earth surfaces to original condition.

3.04 BITUMINOUS DRIVEWAYS AND SIDEWALK RESTORATION

- A. The materials and construction practices shall be as specified.
- B. Aggregate base shall be as specified using six (6) inch depth.
- C. Base course shall be four (4) inch depth (minimum) and wearing course shall be a minimum 1-1/2" depth or match existing.

3.04 CONCRETE DRIVEWAY AND SIDEWALK RESTORATION

- A. Restore driveways and sidewalks damaged by construction to match existing grade and finish.
- B. Saw cut and reconstruct driveways and sidewalks to the first expansion joint on either side of the damaged portion, or to a greater width if indicated in on the Drawings.
- C. Saw cut and reconstruct sidewalks to 4" thickness of concrete reinforced with 6 x 6 x w 1.4 /w1/4 wire mesh, placed on 4" base of compacted PENNDOT 2B.
- D. Saw cut and reconstruct driveways to 6" thickness of concrete reinforced with 6 x 6 x w 1.4 /w1/4 wire mesh, placed on 4" base of compacted PENNDOT 2B.

3.05 CONCRETE CURB RESTORATION

- A. Restore curbs damaged by construction to match existing shape and finish.
- B. Saw cut and reconstruct curbs to the first expansion joint on either side of the damaged portion or to a greater width if indicated in on the Drawings.
- C. Construct in accordance with PENNDOT Publication 408, latest edition.
- D. Aggregate backfill is required.

3.06 CLEAN-UP

- A. During construction, surfaces of all areas including, but not limited to, roads, streets, and driveways shall be maintained on a daily basis to produce a safe, desirable, and convenient condition.
  - 1. Streets shall be swept and flushed after backfilling, and recleaned as dust, mud, stones and debris caused by the work, or related to the work again accumulates.
  - 2. Failure of the Contractor to perform this work shall be cause for the Authority to order the work to be done by others, and backcharge all costs to the Contractor.

- B. Repair or Correction of Unsatisfactory Conditions: All unsatisfactory conditions resulting from the work shall be corrected.
- C. Dust Control: Provide effective dust control by sprinkling water, by the use of calcium chloride or by any other methods approved by the Authority. Use dust control measures where, when and in a manner required by the Authority.

3.07 MAINTENANCE

- A. Continuously maintain temporary paving without additional compensation until it is replaced with permanent paving.
- B. Maintain without additional compensation, such work of this Section done under this Contract for a period of twenty-four (24) months after the date of Authority's approval of the final Completion Certificate issued by Engineer, including the repair or removal and replacement of such work which has failed or has been damaged or wherever surface depressions have been developed. Materials and methods used to repair or replace such work shall conform to the applicable requirements of this Section.
- C. Should Contractor fail to perform required maintenance or repairs within three days after written notice from the Authority, the Authority may perform such maintenance or repairs and deduct the cost thereof from any monies due or to become due Contractor.

**END OF SECTION**

**DIVISION 32 – EXTERIOR IMPROVEMENTS**  
**SECTION 32 92 00 – TURF AND GRASSES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes: Restoration of disturbed, non-paved areas including the following:
  - 1. Placing topsoil
  - 2. Soil conditioning
  - 3. Finish grading
  - 4. Seeding
  - 5. Sodding
  - 6. Maintenance

**1.02 REFERENCES**

- A. American Association of State Highways and Transportation Officials (AASHTO).
  - 1. Pennsylvania Department of Transportation Publication 408 Specifications.
  - 2. Pennsylvania Seed Act of 1965, Act 187, as amended.
  - 3. Agricultural Liming Materials Act of 1978, P.L. 15, No. 9 (3 P.S. 132-1), as amended.
  - 4. Pennsylvania Soil Conditioner and Plant Growth Substance Law, Act of December 1, 1977, P.L. 258, No. 86 (3 P.S. 68.2), as amended.
  - 5. Rules for Testing Seeds of the Association of Official Seed Analysts.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Samples:
  - 1. When directed, furnish three strips of sod, 4-1/2 feet long by 12" wide, laid on 3" of topsoil and tamped in place. The samples shall be representative of the sod and workmanship to be provided.
  - 2. Advise the Engineer of the location of the field, and area within the field, from which the sod is to be taken for approval.
- B. Certificates:
  - 1. Prior to use or placement of material, submit certifications of material composition of the following for approval:
    - a. Topsoil analysis
    - b. Fertilizer
    - c. Lime

d. Seed mixture(s)

2. If soil tests are performed to justify decreased liming and fertilizer rates, submit certified soil sample analyses, including laboratory's recommended soil supplement formulation.

#### 1.04 QUALITY ASSURANCE

A. Testing Agency:

1. The Contractor has the option to use soil testing to justify decreasing lime and fertilizer rates. When soil testing is selected by the Contractor, the soil and soil supplement testing shall be performed by a Soils Testing Laboratory engaged and paid for by the Contractor and approved by the Authority. Collect soil samples under the direction of the Authority.

#### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Seed:

1. Deliver seed fully tagged and in separate packages according to species or seed mix. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

B. Sod:

1. Deliver sod to the project site within 24 hours after being cut and place sod within 36 hours after being cut. Do not deliver small, irregular, or broken pieces of sod.
2. During wet weather, allow sod to dry sufficiently to prevent tearing during handling and placing. During dry weather, moisten sod to ensure its vitality and to prevent dropping of the soil during handling. Sod which dries out will be rejected.

#### 1.06 PROJECT CONDITIONS

- A. Restore unpaved surfaces to a condition similar to that prior to excavation.
- B. Refer to seeding requirements at each specific location of Work.

### PART 2 - PRODUCTS

#### 2.01 TOPSOIL

- A. Topsoil shall have a pH of between 6.0 and 7.0; containing not less than 2% nor more than 10% organic matter as determined by AASHTO T194.
- B. Fertile friable loam, sand loam, or clay loam which will hold a ball when squeezed with the hand, but which will crumble shortly after being released.
- C. Free of clods, grass, roots, or other debris harmful to plant growth.
- D. Free of pests, pest larvae, and matter toxic to plants.

#### 2.02 FERTILIZER

A. Basic Dry Formulation Fertilizer:

1. Analysis 0-20-20 and as defined by the Pennsylvania Soil Conditioner and Plant Growth

Substance Law.

B. Starter Fertilizer:

1. Analysis 10-5-5 or 12-6-6 and as defined by the Pennsylvania Soil Conditioner and Plant Growth Substance Law.

2.03 LIME

- A. Raw ground limestone conforming to Section 804.2(a), Publication 408 Specifications.

2.04 SEED

- A. Fresh, clean, dated material from the last available crop and within the date period specified, with a date of test not more than 9 months prior to the date of sowing. Percentage of pure seed present shall represent freedom from inert matter and from other seeds distinguishable by their appearance. All seeds will be subject to analysis and testing.

**TABLE 1 - GRASS AND AGRICULTURAL SEEDS**

SPECIES	MINIMUM GUARANTEED PURITY (PERCENT)	MAXIMUM WEED SEED (PERCENT)	MINIMUM GUARANTEED GERMINATION (PERCENT)
Kentucky Bluegrass ( <i>Poa pratensis</i> ) Domestic Origin; min. 21 lb. per bushel	90	0.20	80
Perennial Ryegrass ( <i>Lolium perenne</i> , var. Pennfine)	95	0.15	90
Kentucky 31 Fescue ( <i>Festuca elatior</i> arundinacea)	98	0.25	85
Crownvetch ( <i>Coronilla varia</i> , var. Penngift)	99	0.10	70
Pennlawn Red Fescue ( <i>Festuca rubra</i> , var. Pennlawn)	98	0.25	90
Annual Rye Grass ( <i>Lolium multiflorum</i> )	95	0.25	95
Timothy ( <i>Phleum pratense</i> )	98	0.25	95

2.05 SEED MIXTURES

- A. See "Seeding Table" at end of this Section.

2.06 INOCULANT

- A. Inoculate leguminous seed before seeding with nitrogen fixing bacteria culture prepared specifically for the species.
- B. Do not use inoculant later than the date indicated by the manufacturer.
- C. Protect inoculated seed from prolonged exposure to sunlight prior to sowing.

- D. Reinoculate seed not sown within 24 hours following initial inoculation.

## 2.07 MULCHING MATERIALS

- A. Mulches for seeded areas shall be one, or a combination of, the following:

1. Hay:
  - a. Cured to less than 20% moisture content by weight.
  - b. Contain no stems of tobacco, soybeans, or other coarse or woody material.
  - c. Timothy hay or mixed clover and timothy hay.
2. Straw:
  - a. Cured to less than 20% moisture content by weight.
  - b. Contain no stems of tobacco, soybeans, or other coarse or woody material.
  - c. Wheat or oat straw.
3. Wood Cellulose:
  - a. No growth or germination inhibiting substances.
  - b. Green, air dried. Packages not exceeding 100 pounds.
  - c. Requirements:  
  
Moisture content:  $12\% \pm 3\%$   
Organic Matter:  $98.6\% \pm 0.2\%$  on the oven dry basis.  
Ash content:  $1.4\% \pm 0.2\%$   
Minimum Water-Holding Capacity: 1000%
4. Mushroom Manure:
  - a. Organic origin, free of foreign material larger than 2" and substances toxic to plant growth.
  - b. Organic Matter: 20% minimum
  - c. Water-Holding Capacity: 120% minimum
  - d. pH: 6.0

## 2.08 SOD

- A. At least three year old, well-rooted Kentucky Bluegrass (*Poa pratensis*) sod containing a growth of not more than 10% of other grasses and clovers.
- B. Free from noxious weeds such as bermuda grass, wild mustard, crab grass, and kindred grasses.

## PART 3 - EXECUTION

### 3.01 TIME OF OPERATIONS

- A. Spring Seeding:
1. Preliminary operations for seed bed preparation may commence as soon after February 15 as ground conditions permit.
- B. Fall Seeding:
1. Preliminary operations for seed bed preparation may commence after July 15.



3.02 PREPARATION OF SUBGRADE

- A. "Hard pan" or heavy shale:
  - 1. Plow to a minimum depth of 6".
  - 2. Loosen and grade by harrowing, discing, or dragging.
  - 3. Handrake subgrade. Remove stones over 2" in diameter and other debris.
- B. Loose loam, sandy loam, or light clay:
  - 1. Loosen and grade by harrowing, discing, or dragging.
  - 2. Handrake subgrade. Remove rocks over 2" in diameter and other debris.

3.03 PLACING TOPSOIL

- A. Replace topsoil and spread over the prepared subgrade to obtain the required depth and grade elevation. Final compacted thickness of topsoil shall not be less than 4".
- B. Handrake topsoil and remove all materials unsuitable or harmful to plant growth.
- C. Do not place topsoil when the subgrade is frozen, excessively wet, or extremely dry.
- D. Do not handle topsoil when frozen or muddy.

3.04 TILLAGE

- A. After seed bed areas have been brought to proper compacted elevation, thoroughly loosen to a minimum depth of 5" by discing, harrowing, or other approved methods. Do not work topsoiled areas when frozen or excessively wet.
- B. Liming:
  - 1. Distribute limestone uniformly at a rate of 100 pounds per 1,000 square feet.
  - 2. Thoroughly incorporate into the topsoil to a minimum depth of 4".
- C. Basic Fertilizer:
  - 1. Distribute basic fertilizer uniformly at a rate of 50 pounds per 1,000 square feet.
  - 2. Incorporate into soil to depth of 4" by approved methods.
  - 3. Incorporate as part of tillage operation.
- D. Liming and Fertilizer rates may be decreased if lesser rates are indicated by soil tests provided by the Contractor.

3.05 FINISH GRADING

- A. Remove unsuitable material larger than 2" in any dimension.
- B. Uniformly grade surface to the required contours without the formation of water pockets.
- C. Rework areas which puddle by the addition of topsoil and fertilizer. Rerake.

- D. Distribute starter fertilizer at the following rates:

10-5-5: 50 pounds per 1,000 square feet.  
12-6-6: 33 pounds per 1,000 square feet.

- E. Incorporate starter fertilizer into the upper 1" of soil.

### 3.06 SEEDING

- A. Uniformly sow specified seed mix by use of approved hydraulic seeder, power-drawn drill, power-operated seeder, or hand-operated seeder or by hand. Do not seed when winds are over 15 mph.
- B. Upon completion of sowing, cover seed to an average depth of 1/4" by hand reraking or approved mechanical methods.

### 3.07 MULCHING

- A. Mulching within 48 hours of seeding.
- B. Place hay and straw mulch in a continuous blanket at a minimum rate of 1,200 pounds per 1,000 square yards.
1. Anchor hay or straw mulch by use of twine, stakes, wire staples, paper, or plastic nets.
  2. Emulsified asphalt may be used for anchorage provided it is applied uniformly at a rate not less than 31 gallons per 1,000 square yards.
  3. Apply approved chemical mulch binders at the manufacturer's recommended rate.
- C. Chemical mulch binders or a light covering of topsoil may be used for anchorage when the size of the area precludes the use of mechanical equipment.
- D. Apply wood cellulose fiber hydraulically at a rate of 320 pounds per 1,000 square yards.
1. Incorporate as an integral part of the slurry after seed and soil supplements have been thoroughly mixed.
- E. Spread mushroom manure uniformly to a minimum depth of 2" or to the depth indicated on the drawings.
- F. When mulch is applied to grass areas by blowing equipment, the use of cutters in the equipment will be permitted to the extent that a minimum of 95% of the mulch is 6" or more in length. For cut mulches applied by the blowing method, achieve a loose depth in place of not less than 2".
- G. When mulching by the asphalt mix method, apply the mulch by blowing. Spray the asphalt binder material into the mulch as it leaves the blower. Apply the binder to the mulch in the proportion of 1.5 to 2.0 gallons per 45 pounds of mulch.
1. Protect structures, pavements, curbs, and walls to prevent asphalt staining.
  2. Erect warning signs and barricades at intervals of 50 feet or less along the perimeter of the mulched area.
  3. Do not spray asphalt and chemical mulch binders onto any area within 100 feet of a stream or other body of water.

3.08 SODDING

- A. Prior to sod placement, complete soil preparation or topsoiling.
- B. Apply lime and fertilizer as specified. Work into the soil a minimum of 2".
- C. Do not place sod when the temperature is lower than 32 degrees F.
- D. Place sod by hand with tight joints and no overlap. Transverse joints shall be broken or staggered.
- E. Place sod so that the top of the sod is flush with the surrounding grade.
- F. Use of tools which damage the sod or dumping of sod from vehicles will not be permitted.
- G. Water sod to the saturation point immediately after placement.
- H. After watering, tamp with an approved tamper to close all joints and ensure close contact between sod and sod bed. After tamping, the sod shall present a smooth, even surface free from bumps and depressions. If so directed, use a light roller, weighing not more than 65 pounds per foot of roller width to complete firming and smoothing the sod.
- I. When placing sod in ditches, place the strip with the long dimension at right angles to the flow of water. At any point where water will start flowing over a sodded area, the upper edge of the sod strips shall be turned into the soil below the adjacent area and a layer of compacted earth placed over this juncture to conduct the water over the edge of the sod.
- J. In ditches and on slope areas, stake each strip of sod securely with at least 1 wood stake for each 2 square feet of sod. Stakes shall be 2" by 1" with a length of 8" to 12". Drive stakes flush with the top of the sod, with the long face parallel to the slope contour.

3.09 MAINTENANCE

- A. Maintenance includes watering, weeding, cleanup, edging and repair of depressions, washouts or gullies.
- B. Those areas which do not show a prompt catch or grass within 14 days of seeding or sodding shall be reseeded or resodded until complete grass catch occurs.
- C. Mow sod in the field to a height of not more than 2-1/2" within 5 days prior to lifting.
- D. Cut sod to a depth equal to the growth of the fibrous roots, but in no case less than 1-1/2", exclusive of grass and thatch. Do not cut sod when the ground temperature is below 32 degrees F.

3.10 SEEDING RESTORATION SCHEDULE

DESCRIPTION	TOPSOIL	LIME*	BASIC FERTILIZER	STARTER FERTILIZER	SEED MIX & SOWING RATE (% BY WEIGHT)
Temporary Cover (**)	N/A	N/A	N/S	N/A	100% Annual Ryegrass Sow 9# per 1000 Sq. Yds. Mar. thru May/Aug. thru Sept.
Roadside, Non-Mowed	Yes	100# per 1000 Sq. Ft.	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	80% Kentucky 31, Fescue 20% Pennlawn Red Fescue Sow 21# per 1000 Sq.Yds. Mar. thru May/Aug. thru Sept.
Roadside, Mowed	Yes	100# per 1000 Sq.Ft.	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	50# Kentucky Bluegrass 30% Pennlawn Red Fescue 20% Perennial Ryegrass Sow 21# per 1000 Sq.Yds. Mar. thru May/Aug. thru Sept.
Slopes	Yes	100# per 1000 Sq.Ft.	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	45% Crownvetch 55% Annual Ryegrass Sow 9# per 1000 Sq. Yds. Anytime except Sept. & Oct.
Lawns	Yes	100# per 1000 Sq.Ft.	0-20-20 @ 50# per 1000 Sq.Ft.	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	50% Kentucky Bluegrass 30% Pennlawn Red Fescue 20% Perennial Ryegrass Sow 21# per 1000 Sq.Yds. Mar. thru May/Aug. thru Sept.
Open Fields Non/Cultivated, Pasture	No	No	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	100% Timothy Sow 9# per 1000 Sq. Yds. Mar. thru May/Aug. thru Sept.

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Open Fields Cultivated	No	No	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	100% Annual Ryegrass Sow 9# per 1000 Sq.Yds. Mar. thru May/Aug. thru Sept.
Woods	No	No	No	10-5-5 @ 50# per 1000 Sq.Ft. or 12-6-6 @ 33# per 1000 Sq.Ft.	100% Red Fescue Sow 36# per 1000 Sq.Yds. Mar. thru May/Aug. thru Sept.

\* Unless lesser rate indicated by soils test.

\*\* Unless otherwise specified in the Erosion and Sedimentation Control Plan.

NOTE: Refer to Drawings and Special Conditions for seeding restoration requirements at each specific location of work.

**END OF SECTION**

**DIVISION 32 – EXTERIOR IMPROVEMENTS**  
**SECTION 32 93 00 - PLANTS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section includes:
  - 1. Trees.
  - 2. Shrubs.
  - 3. Perennials.
  - 4. Ground Cover.
  - 5. Soil Amendments
  - 6. Initial Maintenance of Landscape Materials.
- B. Related Sections:
  - 1. Standard details.

**1.02 REFERENCES**

- A. American National Standards Institute
  - 1. ANSI Z60.1, American Standard for Nursery Stock.

**1.03 SYSTEM DESCRIPTION**

- A. Wastewater and Reclaimed Water Facilities and/or sites may require special plantings due to zoning or aesthetic requirements of the Authority. Consult with the Authority for planting requirements prior to finalization of the project design.
- B. Aboveground facilities shall be as contextual as reasonably possible.

**1.04 QUALITY ASSURANCE**

- A. Work shall be completed by a single firm specializing in landscape work.
  - 1. The Contractor shall have been actively and directly engaged in contracting, installing and maintenance of planting, landscapes and lawns for a period of five (5) years or more, and provide proof of five (5) or more installations completed by them which have been in use for three (3) or more years.
- B. Source Quality Control:
  - 1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
  - 2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to the Authority, together with proposal of use of equivalent material.

3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
  4. Topsoil: If topsoil from off site is proposed, furnish a written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past two (2) years.
  6. Trees, Shrubs and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
  7. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.
    - a. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
  8. Inspection: The Authority may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Authority retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.
- C. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three (3) representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  3. Report suitability of tested soil for plant growth.
    - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

1.05 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Plant and Material Certifications:
  - 1. Certificates of Inspection as required by governmental authorities.
  - 2. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
  - 3. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.
- C. Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- D. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one (1) full year. Submit prior to expiration of required maintenance period(s).

1.04 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
- B. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Authority. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
- C. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than six (6) hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture.
- D. Do not remove container-grown stock from containers until planting time.

1.05 JOB CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Authority before planting.

1.06 SEQUENCING AND SCHEDULING

- A. Planting Season: Planting shall be done only within the following dates specified or as on the Drawings. If special conditions exist which may warrant a variance in the planting dates, a written request shall be submitted to the Authority stating the special conditions and the proposed variance. Permission for the variance will be given if, in the opinion of the Authority, the variance is warranted. Planting installed outside the given dates shall remain under the Contractor's one-year warranty.



1. Deciduous Trees and Shrubs: March 1 to May 15, or September 1 to December 1.
  2. Evergreen Trees and Shrubs: March 1 to May 15, or September 1 to Nov. 15.
  3. Perennials and Groundcovers: Plant frost-tender perennials and groundcover only after danger of frost is past or at least six weeks before frost season to allow for establishment before first frost. Do not plant in frozen ground.
- B. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Authority. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

#### 1.07 SPECIAL PROJECT WARRANTY

- A. Warranty trees and shrubs, for a period of one (1) year after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Authority, abuse or damage by others, or unusual phenomena or incidents which are beyond Contractor's control.
- B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Authority, it is advisable to extend warranty period for a full growing season.
1. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

### PART 2 - PRODUCTS

#### 2.01 TOPSOIL

- A. Stockpiled topsoil shall be for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work, at no cost to the Authority.
- B. If required, provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than two inches (2") in any dimension, and other extraneous or toxic matter harmful to plant growth.
1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than eight inches (8"). Do not obtain from bogs or marshes.
  2. Acceptable topsoil structure content consists of sand (50%-80%), silt (15%-50%), clay (10%-20%). A list of herbicides applied during the past year should be provided.

#### 2.02 SOIL AMENDMENTS

- A. Lime: Natural dolomitic limestone containing not less than eighty-five percent (85%) of total carbonates with a minimum of thirty percent (30%) magnesium carbonates, ground so that not less than ninety percent (90%) passes a ten (10) mesh sieve and not less than fifty percent (50%) passes a one-hundred (100) mesh sieve.

- B. Aluminum Sulfate: Commercial grade.
- C. Compost Humus: finely divided peat, so completely decomposed and free of fibers that its biological identity is lost, pine fines, leaf mold or other suitable compose. Provide in loose form, free of hard lumps and with pH range suitable for intended use.
- D. Bonemeal: Commercial, raw, finely ground; four percent (4%) nitrogen and twenty percent (20%) phosphoric acid.
- E. Superphosphate: Soluble mixture of treated minerals; twenty percent (20%) available phosphoric acid.
- F. Sand: Clean, washed sand, free of toxic materials.
- G. Perlite: Conforming to National Bureau of Standards PS 23.
- H. Vermiculite: Horticultural grade, free of toxic substances.
- I. Mulch:
  - 1. Double shredded hardwood mulch for all planted areas.
- J. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:
  - 1. For trees and shrubs, provide fertilizer with not less than five percent (5%) total nitrogen, ten percent (10%) available phosphoric acid and five percent (5%) soluble potash.

## 2.03 PLANT MATERIALS

- A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1.
- B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
  - 1. Provide balled and burlapped (B&B) deciduous trees.
    - a. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.
- C. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
  - 1. Provide balled and burlapped (B&B) deciduous shrubs.
    - a. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.
- D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes required. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well balanced form complying with requirements for other size relationships to the primary dimension shown.

1. Provide balled and burlapped (B&B) evergreens.
  - a. Container grown evergreens will be acceptable, subject to specified limitations for container grown stock.
- E. Container Grown-Stock: Where specified as acceptable, provide healthy, vigorous, well-rooted trees, shrubs or perennials established in container in which they are sold. Provide balled and burlapped stock when required trees or shrubs exceed maximum size recommended by ANSI Z60.1 for container-grown stock.
  1. Established container stock is defined as a tree, shrub or perennial transplanted into container and grown in container for a length of time sufficient to develop new fibrous roots, so that root mass will retain its shape and hold together when removed from container.
  2. Containers: Use rigid containers that will hold ball shape and protect root mass during shipping. Provide trees, shrubs and perennials established in containers of not less than minimum sizes recommended by ANSI Z60.1 for kind, type, and size of trees, shrubs or perennials required.
- F. Ground Cover: Provide plants established and will rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.
- G. Perennials: Provide healthy, vigorous, well rooted container grown or field potted plants of sizes indicated in accordance with ANSI Z60.1 Plants shall be free of disease, mildew, mold and insects.

#### 2.04 IMPORTED TOPSOIL

- A. Topsoil may be stockpiled for re-use in landscape work. If quantity or quality of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
- B. New Topsoil:
  1. Provide topsoil which is fertile, friable, naturally loamy, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter and free of roots, stumps, stones larger than one inch (1") in any dimension, and other extraneous or toxic matter harmful to plant growth. Topsoil to be a loam or sandy loam soil consisting of fifty to eighty (50 - 80%) sand, fifteen to fifty percent (15 - 50%) silt, ten to twenty percent (10 – 20%) clay.
  2. Obtain topsoil from local sources or from areas having similar soil characteristics to those found at site of work. Obtain topsoil from naturally well-drained sites where topsoil occurs in depth of not less than six inches (6"), do not obtain from bogs or marshes. Before delivery of topsoil, furnish the Authority with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, crops grown and herbicide applications during past two (2) years. Submit a sample for review and approval. Contractor will be responsible to test new topsoil to determine the soil amendments necessary for lawns or planting areas. Copies of test results to be submitted to the Authority for review and approval.

#### 2.05 SOIL AMENDMENTS

- A Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve.

- B. Aluminum Sulfate: Commercial grade.
- C. Peat Humus: Composed of mosses (other than sphagnum) or reed-sedge peat of a coarse fibrous texture and with pH of 6.0 to 7.5.
  - 1. For acid-loving trees and shrubs, provide moss peat with pH of 3.2 to 4.5, coarse, fibrous texture, medium-divided sphagnum moss peat or reed-sedge moss peat.
- D. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
- E. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.
- F. Sand: Clean, washed sand, free of toxic materials.
- G. Perlite: Conforming to National Bureau of Standard PS 23.
- H. Vermiculite: Horticultural grade, free of toxic substances.
- I. Fertilizers: Provide complete commercial controlled release fertilizer, of neutral character, with some elements derived from organic sources, containing at least 10 percent available phosphoric acid, 3 percent to 5 percent total nitrogen, and 3 percent to 5 percent soluble potash.
- J. Compost: The Authority produces UAJA Compost that has been observed to improve soil structure, reduce soil compaction, increase water infiltration, increase soil aeration, increase moisture holding capacity, and to provide a slow release of nutrients. Consult with the Authority for analytical data, availability and pricing.

#### 2.06 PERENNIAL/GROUNDCOVER BED SOIL MIX

- A. Soil mix shall consist of, but necessarily be limited to the following ingredients in proportions determined from a soil test analysis by a qualified agronomist or soil testing agency.
  - 1. Topsoil as specified in paragraph 2.4 above.
  - 2. Organic matter of well rotted vegetative material.
  - 3. Ground limestone.
  - 4. Complete fertilizer, 5-10-5

#### 2.07 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Anti-Desiccant: Emulsion type, film-forming agent designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.
- B. Pre-emergent herbicide: Provide granular herbicide, snapshot or equal. EPA registered and approved.
- C. Mulch: Organic mulch free of deleterious materials and suitable for top dressing of trees, shrubs, or plants and consisting of one of the following:
  - 1. Double shredded hardwood.
  - 2. Pine Bark Mini-nuggets (1/2" to 1" size).

- D. Non-woven Fabric: Non-woven polypropylene fabric. Product No. 1120N as manufactured by Nicolon MIRAFI Group or equivalent.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION - GENERAL**

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Authority's acceptance before start of planting work. Make minor adjustments as may be required.

#### **3.02 PREPARATION OF PLANTING SOIL**

- A. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
  - 1. For planting areas, all mulched beds shall be treated with herbicide such as Treflan, Snapshot or equal. All topsoil to be used for planting shall be thoroughly and uniformly rototilled with peat humus in the proper proportion by volume of one part peat humus to six (6) parts topsoil. Fertilize each plant with nursery recommended started fertilizer.
- B. Cooperate with other contractors and trades working in and adjacent to landscape work areas. Examine drawings that show development of entire site and become familiar with scope of other work required.
- C. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Authority's acceptance before start of planting work. Make minor adjustments as may be requested by Authority.
- D. Layout location of trees and shrubs as directed by Authority.
- E. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- F. Excavation:
  - 1. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
    - a. For balled and burlapped trees and shrubs, make excavations approximately 1-1/2 times as wide as ball diameter and equal to ball depth.
    - b. For container-grown stock, excavate as specified for balled and burlapped stock, except conform to container width and depth.
    - c. Where drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
- G. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- H. Obstructions: If rock, underground construction, or other obstructions are encountered in excavation for planting of trees or shrubs, notify Authority. New locations may be selected by Authority, or change order may be issued to direct removal of obstructions at least 6 inches below required planting depth.
- I. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with ½ inch stone (AASHTO No. 8).

- J. Drainage: If subsoil conditions indicate retention of water in planting areas, as shown by seepage or other evidence indicating presence of underground water, notify Authority before backfilling. A change order may be issued to direct installation of drain tile or other measures beyond drainage requirements indicated.
- K. Fill excavations with water and allow to percolate out before setting trees and shrubs.
- L. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
  - 1. All topsoil to be used for planting shall be thoroughly and uniformly rototilled with peat moss and Perlite in the proper proportion by volume of one part peat, and one part Perlite to six (6) parts topsoil. Fertilize each plant with nursery recommended started fertilizer.
- M. Mix soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- N. For pit or trench backfill, mix planting soil before backfilling and stockpile at site.

### 3.03 PREPARATION OF PERENNIAL PLANT BEDS

- A. General: Preparation of perennial plant beds shall be included for all perennial plants and ground cover.
- B. Combine topsoil and organic material specified in Paragraph perennial bed soil mix, and thoroughly mix 1 part organic material to 6 parts topsoil.
- C. Install Perennial soil mix to a uniform depth of 15" upon scarified subgrade (3").
- D. Spread limestone over surface of perennial bed at rate required for specified pH of soil mix and thoroughly till into full depth of prepared mix.
- E. Apply fertilizer to prepared bed at rate required by soil test and thoroughly incorporate into soil.
- F. Soil pH shall range from 5.5 to 7.5
- G. Adjust quantities of soil mix ingredients as necessary to achieve desired pH level.

### 3.04 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped (B&B) stock on undisturbed subgrade, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets.

When excavation is approximately two-thirds (2/3) full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Set container grown stock, as specified, for balled and burlapped stock, except cut root ball on four (4) sides with a sharp knife; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
- C. Dish top of backfill to allow for mulching. Apply pre-emergent herbicide.

- D. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.
  - 1. Provide three compacted inches (3") thickness of double shredded hardwood mulch.
- E. Apply anti-desiccant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage.
  - 1. If deciduous trees or shrubs are moved when in full-leaf, spray with anti-desiccant at nursery before moving and spray again two (2) weeks after planting.
- F. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Authority, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- G. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- H. Do not guy/stake trees.

### 3.05 PLANTING GROUNDCOVER AND PERENNIAL PLANTS

- A. Space groundcover and plants as indicated in a uniform manner.
- B. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not too cover plant crowns with wet soil.

### 3.06 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain trees, shrubs, and other plants until final acceptance, but in no case, less than following period:
  - 1. Sixty (60) days after substantial completion of planting.
- C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

### 3.07 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

### 3.08 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, the Authority will, upon request, make an inspection to determine acceptability.

1. Landscape work may be inspected for acceptance in portions as agreeable to Authority, provided each portion of work offered for inspection is complete, including maintenance.
- B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Authority and found to be acceptable. Remove rejected plants and materials promptly from project site.

**END OF SECTION**



**DIVISION 33 – UTILITIES**  
**SECTION 33 01 30 – OPERATION AND MAINTENANCE OF SEWER UTILITIES**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. By-pass pumping of sanitary sewers.

**1.02 SYSTEM DESCRIPTION**

- A. The work covered by this section consists of furnishing all labor, equipment, tools, appliances, and materials necessary to perform all operations to implement a temporary pumping system for the purpose of diverting existing sewage flow around various sections of the work for the duration of the work and at other periods as determined by the Contractor to prevent sewage overflows and provide reliable sewer service to the users of the sanitary sewer system at all times. The Contractor shall maintain sewage flow in the construction area in order to prevent backup and/or overflow into upstream pipe segments and laterals, adjacent ditches, storm sewers, and waterways.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility.
- C. Bypass pumping system shall have sufficient capacity to pump the flow around the sanitary sewer section. The Contractor has the option of installing temporary flow metering equipment to verify existing flow.
- D. Plan Review – The Contractor shall submit to the Engineer for the Authority and Engineer's review, a bypass pumping system plan a minimum of seven (7) days prior to the commencement of bypass pumping operations. The plan shall include, at a minimum, detailed information on sequencing, set-up, operation, piping, pumps, etc.
- E. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle the flow, temporary discharge piping, and fittings to ensure that the total flow of the sewer can be safely diverted around the work.
  - 1. Pumps shall be selected per the results of the flow calculations and per site requirements as determined by the Contractor. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range without surging, cavitation, or vibration. Rotative components shall be statically and dynamically balanced and shall be suitable for use with raw unscreened sewage and trash. The pump shall be a self-contained unit, designed for temporary use, and shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of sewage flows. Pumps shall be critically silenced to prevent excessive noise pollution during temporary bypass pumping. Contractor shall provide the necessary start/stop controls for each pump.

2. Plugs shall be inflatable plugs constructed of specially treated industrial fabric and reinforced neoprene. Plugs shall be equipped with steel pull rings and aluminum end clamps. All plugs shall be firmly attached to a stationary object at ground level by a steel cable in order to prevent loss of plug in the pipeline.
  3. Piping: In order to prevent the accidental spillage of flows, all discharge system must be constructed of rigid pipe with positive, leak-proof connections. Pipe 12-inches and larger shall be high density polyethylene pipe with fused joints for a leak-proof piping system.
- F. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of emergency or breakdown. One (1) standby pump for each size pump utilized shall be installed at the mainline flow bypassing location, ready for use in the event the primary pump fails.
- G. The bypass pumping systems shall be manned at all times, or provided with an alarm system with an autodialer, capable of storing, at a minimum, three (3) 24 hour phone numbers direct to a human. Alarm system shall be checked daily to confirm proper operation. The automatic dialing system shall provide call-out for the following alarms, at a minimum:
1. High wet well level
  2. Primary pump failure
  3. Secondary pump start
  4. Secondary pump failure
  5. Low fuel level
- H. The bypass pumping system shall be capable of bypassing the flow around the work area and of returning any amount of flow up to full available flow into the sanitary sewer system as necessary for satisfactory performance of the work.
- I. The bypass pumping system shall adhere to all local, state, and federal codes and regulations as required by the regulatory agencies having jurisdiction.
- J. The Contractor shall maintain flows around the work area in a manner that will protect and not cause surcharging of sewers, drains, damage or flooding to public and private property.
- K. The Contractor shall protect water resources, wetlands, and other natural resources during the work.
- L. The bypass pumping system shall provide provisions for avoiding damage to public and private property, preventing leakage from hoses and minimizing noise from pumps. The pumping equipment shall be sound attenuated (66 dba @ 20 feet) for overnight operations.

- M. It shall be the responsibility of the Contractor to provide protection for the entire bypass pumping system including but not limited to piping, piping connections, pumps and ancillary equipment. Materials utilized for bypass pumping shall be appropriate for the intended operation and service. The Contractor shall be responsible for any damage caused by the Contractor's failure to provide adequate protection to the bypass pumping system.
- N. Temporary Installation and Operations: Equipment specified in this Section shall be installed in strict accordance with the manufacturer's instructions and recommendations. Installation shall include furnishing oil, fuel, grease, lubricants, tools, and spare parts that may be required to maintain the operation of the pump throughout the construction period, as recommended by the manufacturer. The Contractor shall be solely responsible for maintaining the temporary pumps and appurtenances. At the end of the construction period, the Contractor shall remove the pump and appurtenances. The temporary pumping system shall be placed in service a minimum of 24 hours before any work may begin. It shall remain operable until removal is approved by the Authority in writing.

#### 1.03 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Submit by-pass pumping plan detailing, equipment sizing, layout, and controls.
- C. Product Data: Submit product data and material cut sheets for all components of the by-pass pumping system.

#### 1.04 PROJECT/SITE CONDITIONS

- A. Project/Site Environmental Requirements
  - 1. It shall be the responsibility of the Contractor to notify the Pennsylvania Department of Environmental Protection in the event of a sanitary sewer overflow onto the ground or backup into a customer's building. The Contractor shall promptly clean any sanitary sewer overflow and remedy the situation causing the sanitary sewer overflow or backup. Any cost associated with such events, including, but not limited to, notification, cleaning, and fines, shall be the sole responsibility of the Contractor.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. The Contractor shall provide and maintain adequate pumping equipment, force mains, and other necessary appurtenances in order to maintain reliable sanitary sewer service in all sanitary sewers during the course of construction. The Contractor shall have backup pump(s), force main(s) and appurtenances ready to deploy immediately. Appurtenances and discharge point shall be approved by the Authority.

### **PART 3 – EXECUTION**

#### **3.01 PREPARATION**

- A. The Contractor shall provide bypass pumping of sewage and wet weather flows around each segment(s) of the Work area. The Contractor shall be responsible for all required bulkheads, pumping equipment, piping, etc., to accomplish the sequence of pumping. The Contractor shall cease bypass pumping operations and return flows to the pump station and/or pipe segment when directed by the Authority. During bypass pumping, no sewage shall be leaked, dumped, or spilled in or unto, areas outside of the existing sanitary sewer system. When bypass pumping operations are complete, pumps and piping shall be drained into the sanitary sewer prior to disassembly.

#### **3.02 INSTALLATION**

- A. The Contractor shall plug off and pump down the sewer manhole or pipe segment in the immediate work area and shall maintain the sanitary sewer system so that surcharging does not occur.
- B. The Contractor shall ensure that no damage will be caused to private property, Township, or state right-of-way as a result of bypass pumping operations. Ingress and egress to adjacent properties shall be maintained. Ramps, steel plates or other methods shall be deployed by the Contractor to facilitate traffic over surface piping.
- C. The Contractor shall complete the work as quickly as possible and satisfactorily pass tests, inspections and repair deficiencies prior to discontinuing bypass pumping operations and returning flow to the siphon structures.
- D. The Contractor shall immediately notify the Authority should a surcharge occur that results in an overflow of sewage. If the Contractor is unable to remedy the situation, then he should suspend or terminate the work until such time as the overflows have been controlled. Should such surcharge damage the materials, equipment, or adjacent property, it shall be corrected at no additional cost to the Authority. In the event that sewage accidentally drains into the drainage system or street, the Contractor shall immediately stop the overflow, notify the Authority and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Pennsylvania Department of Environmental Protection. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the satisfaction of the Pennsylvania Department of Environmental Protection.
- E. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways and alleys. In cases where the suction and or discharge lines are required to be buried for vehicle / pedestrian traffic, cost for this work is incidental and includes complete restoration of any surface features disturbed.
- F. The Contractor shall not intentionally damage or remove portions of existing sanitary sewer structures for the purpose of installing bypass pumping system without specific approval from the Authority. If a structure is damaged, it shall be reconstructed or replaced to the satisfaction of the Authority at no additional cost to the Authority.

- G. The Authority shall not be responsible for damage to the bypass pumping system sustained by the Contractor directly or indirectly as a result of stormwater runoff within streets, ditches. The Contractor shall be responsible for damage that results directly or indirectly from the interference of stormwater runoff to bypass pumping equipment, piping and/or appurtenances.
- H. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow conditions.

3.03 CLEANUP AND REMOVAL

- A. The Contractor shall restore the bypass pump area and the bypass piping route to pre-bypass condition including any cleanup measures necessary due to fuel, coolant, oil, and sewage leaks. The Contractor shall document any cleanup measures that were necessary. The Contractor's bypass pumping plan shall ensure that all sewage in the bypass pumps, pipes, and fittings has been emptied into the sanitary sewer system.

**END OF SECTION**

**DIVISION 33 - UTILITIES**  
**SECTION 33 05 23 – TRENCHLESS UTILITY INSTALLATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section includes
  - 1. Work associated with highway crossings and trenchless stream crossings (if applicable).

**1.02 REFERENCES**

- A. American Association of State Highway and Transportation Officials
  - 1. (H-20): (AASHTO) Loading for Conduits Installed under Streets, Road, or Highways.
- B. American Society for Testing and Materials:
  - 1. ASTM A 53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - 2. ASTM A 139, Specification for Electric-Fusion (Arc) – Welded Steel Pipe (NPS 4 in. and over).
  - 3. ASTM C 32, Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  - 4. ASTM C 33, Specification for Concrete Aggregates.
  - 5. ASTM C 150, Specification for Portland Cement.
  - 6. ASTM C 270, Specification for Mortar for Unit Masonry.
- C. American Welding Society: AWS D1.1 Structural Welding Code.
- D. PENNDOT Specifications, Publication 408, as supplemented.
  - 1. Section 703.2 Coarse Aggregate
- E. State Code: Commonwealth of Pennsylvania Code, Pennsylvania Title 67, Transportation, Department of Transportation.
  - 1. Chapter 459, Occupancy of Highways by Utilities,
  - 2. Chapter 203, Temporary Traffic Control Guidelines (PENNDOT Chapter 203).

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 01 33 00.
- B. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of Products to be installed.
- C. Certificates: Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.

1.04 QUALITY ASSURANCE

- A. Provide work of this Section in accordance with these Specifications and as shown on the Contract Drawings.
- B. Workmen Qualifications:
  - 1. Use only personnel thoroughly trained and experienced in the skills required.
  - 2. Welds shall be made only by welders, tackers and welding operators who have been previously qualified by tests as prescribed in the Structural Welding Code AWS D1.1 of the American Welding Society to perform the type of work required.
- C. Design Criteria:
  - 1. Encasing conduit under highways shall be of sufficient strength to support all superimposed loads, including an American Association of State Highway and Transportation Officials H-20 Loading with 50 percent added for impact.
  - 2. Encasing conduit under railroads shall be of sufficient strength to support all superimposed loads, including a Cooper E-80 Loading with 50 percent added for impact.
- D. Requirements of Regulatory Agencies:
  - 1. Work of this Section within State Highway right-of-way will be subject to inspection by representatives of PENNDOT, and the work must be performed in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.
- E. Source Quality Control:
  - 1. Shop Tests: The Authority reserves the right to require Contractor to perform such tests as be necessary to establish the quality of the material offered for use.

MATERIALS	TEST METHOD	NUMBER OF TESTS
Steel Pipe	ASTM A 139	As specified in ASTM A 139 or ASTM A 53
	ASTM A 53	As applicable

- 2. Laboratory Tests: The Authority reserves the right to require that laboratory tests also be conducted on materials that are shop tested.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store materials and Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

1.06 SITE CONDITIONS

- A. Classification of Materials:
  - 1. Classification of Excavated Materials: No consideration will be given to the nature of

the materials encountered in boring, tunneling, drilling, or jacking operations or for difficulties encountered during excavating or handling of materials. Remove rock encountered during the boring, tunneling or jacking operation in accordance with Section 31 23 33.

- B. Scheduling:
  - 1. Perform boring, tunneling or jacking operations continuously on a 24-hour basis if required by PENNDOT.
- C. Environmental Requirements:
  - 1. As specified in Sections 31 23 33 and an Erosion and Sedimentation Control Plan.
- D. Protection: As specified in Sections 31 23 33, and such added requirements included herein.
  - 1. Adequately support and protect utilities and facilities that are encountered in, or may be affected by, the work.
  - 2. Structure Supports: As specified in Section 31 23 33.
  - 3. Accommodation of Traffic: As specified in Section 31 23 33.
  - 4. Explosives and Blasting: Not permitted in performance of work of this Section.
  - 5. Excavation Conditions: As specified in Section 31 23 33.
  - 6. Excess Materials: As specified in Section 31 23 33.
  - 7. Borrow Material: As specified in Section 31 23 33.

## **PART 2 - PRODUCTS**

### **2.01 ENCASING CONDUIT**

- A. Steel Pipe: ASTM A 139, Grade B or ASTM A 53, Grade B.

### **2.02 TUNNEL LINER PLATE**

- A. Plates: Unless otherwise indicated on the Drawings, proposed sizes and thickness of plates shall be submitted to the Authority along with shop drawings for approval. In no event shall the liner plate thickness be less than 0.1046 inches. All plates shall be formed from one piece of metal to provide longitudinal and circumferential flanges. The shape of the plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel.
  - 1. Plates shall be accurately curved to suit the tunnel cross sections, and all dimensions shall be of such size and accuracy that plates of similar curvature will be interchangeable. All plates shall be connected by bolts on both the longitudinal and circumferential joints.
  - 2. The tunnel liner plates shall be fabricated from structural quality, hot rolled steel, suitable for cold forming in closed dies and shall conform to ASTM A 570 Grade B for sheets or ASTM A 283 Grade B for plates.



3. The tunnel liner plates shall be galvanized to meet AASHTO M167 specifications and shall be bituminous coated to meet AASHTO M190 specifications. Such coating to be a minimum thickness of 0.05 inches.
- B. Bolts and Nuts: Bolts and nuts shall be not less than 1/2 inch in diameter for 7 gauge plates and lighter, and not less than 5/8 inch diameter for liner plates heavier than 7 gauge. They shall be quick-acting coarse thread and conform to ASTM A 307, Grade A. The nuts and bolts shall be hot dip galvanized to conform to ASTM Specification A 153.

## 2.03 MISCELLANEOUS MATERIAL

- A. Concrete: As specified in Cast-in-Place: Section 03 30 00.
  1. Class B: 3,000 psi.
- B. Aggregate Backfill:
  1. PENNDOT 2A Coarse Aggregate conforming in PENNDOT Form 408, Section 703.
- C. Casing End Seals
  1. Casing pipe ends shall be sealed with brick and mortar in accordance with applicable detail.
- D. Casing Spacers
  1. The contractor shall utilize pre-manufactured casing spacers to support and center the carrier pipe within the casing pipe. The contractor shall use stainless steel casing spacers.
    - a. Stainless Steel Casing Spacers:

Casing spacers shall be bolt on style with a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. Each shell section shall have bolt flanges formed with ribs for added strength. Each connecting flange shall have a minimum of three 5/16" T-304 bolts. The shell shall be lined with a ribbed PVC extrusion with a retaining section that overlaps the edge of the shell and prevents slippage. Bearing surfaces (runners) made from UHMW polymer with a static coefficient of friction of .01-.13 and shall be attached to support structures (risers) at appropriate positions to properly locate the carrier within the casing and to ease installation. The runners shall be attached mechanically by T-304 threaded fasteners that are inserted through the punched riser section and TIG welded for strength. Risers shall be made of T-304 stainless steel of a minimum 14 gauge. Risers shall be MIG welded to the shell. All welds shall be fully passivated. Casing spacers shall be model CCS as manufactured by Cascade Waterworks Manufacturing Co. or equal.
    - b. Placement of Spacers on Carrier Pipe:
      - (1) General - One spacer shall be placed not more than two feet from each end of the casing. Subsequent spacers shall be placed at 6'-10' intervals within the casing.

2.04 CONTRACTOR OPTIONS IN PRODUCTS

- A. Contractor may install a larger diameter encasing conduit than what is agency minimum, provided that Contractor has secured the prior written approval of the applicable agencies having jurisdiction. If Contractor elects to install a larger diameter encasing conduit than is shown on the Drawing, all required clearances shall be maintained. Substitution of a larger diameter encasing conduit will be made without additional compensation over the price bid.

**PART 3 - EXECUTION**

3.01 INSPECTION

- A. Inspect Materials and Products before installing in conformance with the inspection requirements of the appropriate referenced standard.
- B. Remove rejected Materials and Products from the Project.

3.02 PREPARATION

- A. As specified in Section 31 23 33.

3.03 PERFORMANCE (All Highway Crossings)

- A. Excavation: As specified in Section 31 23 33 and such added requirements included herein:
  - 1. Should Contractor in constructing any crossing pit excavation below the subgrade for the pipes, he will be required to backfill the area excavated below the subgrade with Aggregate Backfill or with concrete as required by Engineer at his own expense and at no additional cost to Authority.
- B. Boring:
  - 1. Boring shall conform to the applicable requirements of the regulatory agency and additional requirements specified herein.
    - a. Install the encasing conduit by the boring method to the limits indicated on the Drawings or such additional limits required by Engineer or regulatory agency.
    - b. Excavate and protect boring pit.
    - c. Provide devices at the front of the pipe to prevent auger and cutting heads from leading the encasing conduit. Unsupported excavation ahead of pipe is prohibited.
    - d. Over-cut by cutting head not to exceed the outside diameter of the encasing conduit by more than one-half inch.
    - e. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
    - f. If voids develop or if bored hole diameter is more than 1 inch greater than the outside diameter of the encasing conduit, place grout to fill voids.
    - g. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
    - h. Completely bulkhead heading at interruptions in boring operation.
    - i. Completely weld joints around the circumference between sections of steel pipe encasing.

C. Jacking:

1. Jacking shall conform to all applicable requirements of the regulatory agencies and additional requirements specified herein. This operation shall be conducted without handmining ahead of the pipe and without the use of any type of boring, augering, or drilling equipment.
  - a. Install the encasing conduit by the jacking method to the limits indicated on the Drawings or such additional limits required by Engineer or the regulatory agencies.
  - b. Preliminary work shall consist of excavating and protecting an acceptable shaft on the downstream side of the crossing and the installation of a backstop and guide timbers.
  - c. Design: Bracing and backstops shall be so designed and jacks of sufficient rating used so that the jacking can be progressed without stoppage except for adding lengths of pipe.
  - d. Accurately place guide timbers on line and grade.
  - e. Support: The vertical face of the excavation shall be supported as necessary to prevent sloughing.
  - f. Use poling boards and bulkheads as required if subgrade conditions in the heading are unstable.
  - g. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than 2 inch outside the pipe at the top and sides and not less than 2 inch above subgrade at the bottom.
  - h. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
  - i. If voids develop or if jacked hole diameter is more than 1 inch greater than the outside diameter of the encasing conduit place grout to fill voids in manner approved by the regulatory agencies.
  - j. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
  - k. Completely bulkhead heading at interruptions in jacking operation.
  - l. Completely weld joints around the circumference between sections of steel pipe encasing.

D. Tunneling:

1. Liner plates shall be assembled in accordance with the manufacturer's instructions.
2. Care shall be exercised in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material.
3. Excavation shall not be advanced ahead of the previously installed liner plates any more than is necessary for the installation of the succeeding liner plates.
4. The vertical face of the excavation shall be supported as necessary to prevent sloughing.
5. At any interruption of the tunneling operation, the heading shall be completely bulkheaded.
6. Unless otherwise approved by Engineer, the tunneling shall be conducted continuously, on a 24-hour basis.

E. Grouting:

1. A uniform mixture of sand cement grout shall be placed under pressure behind the

liner plates to fill any voids existing between the liner plates and the undisturbed material.

2. Grout holes tapped for no smaller than 1-1/2 inch pipe, spaced at approximately 3 feet around the circumference of the tunnel liners, shall be provided in every third ring.
3. Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel.
4. A threaded plug shall be installed in each grout hole as the grouting is completed at that hole.
5. Grouting shall be kept as close to the heading as possible, using grout stops behind the liner plates if necessary. Grouting shall proceed as directed by Engineer, but in no event shall more than six linear feet of tunnel be progressed beyond the grouting.

F. Laying and Testing Pipe: Lay and test pipe in encasing conduit as specified in Sections 33 11 00 and 33 08 10 and such added requirements included herein.

G. Encasing Conduit Filling and Closing: After the carrier pipe has been installed in the encasing conduit and has been tested, close the end of the casing pipe in accordance with manufacturer's instructions for casing end seals.

H. Cleanup: As specified in Section 31 23 33.

#### 3.04 FIELD QUALITY CONTROL

A. Testing: After laying pipe in encasing conduit, conduct line acceptance testing as specified in Section 33 08 10.

**END OF SECTION**

**DIVISION 33 – UTILITIES**  
**SECTION 33 08 10 – TESTING OF RECLAIMED WATER UTILITY DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

A. Section Includes

1. Provisions testing of reclaimed waterlines.

B. Related Work:

1. Section 33 11 00 – Reclaimed Water Utility Distribution Piping
2. Section 33 13 00 – Disinfection of Reclaimed Water Utility Distribution

**1.02 REFERENCES**

A. American Water Works Association

1. AWWA C900, PVC Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Transmission and Distribution.
2. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch for Water Distribution and Transmission
3. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 in., Through 48 in., for Water and Other Liquids AWWA.

B. Plastic Piping Institute:

1. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings.

**1.03 SUBMITTALS**

A. Submit in accordance with requirements of Section 01 33 00.

B. Product Data: Prepare and submit schedules and procedures to the Authority for testing reclaimed water piping. Submit schedule and procedure a minimum of forty-eight (48) hours prior to each test.

C. Quality Assurance/Control Submittals

1. Test Reports: Submit test reports documenting test conditions and results. Certify all test reports with a signature and obtain a signature of the Authority's test witness.

**1.02 QUALITY ASSURANCE**

A. Design Criteria for Testing Water Mains:

1. Required Test Pressures: The reclaimed water mains shall be tested as specified.

2. Pressure shall not vary more than +/- 5 psi from the required test procedures.
3. Required test pressures shall be provided by the Authority during preparation of testing schedules.

## **PART 2 – PRODUCTS**

Not Used.

## **PART 3 - EXECUTION**

### **3.01 GENERAL REQUIREMENTS**

- A. Conduct tests specified so that each pipe line installed in the project is tested to the Engineer's satisfaction. All piping shall be properly flushed and tested unless otherwise approved by the Authority.
- B. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, pipe connection to main, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. The Contractor shall provide water for all flushing and testing of pipelines. Reclaimed water may be used for flushing and testing pipelines not connected to the potable water system.
- C. Contractor shall thoroughly clean all new pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. Obstructions remaining after flushing shall be corrected by the Contractor, at his own expense, to the satisfaction of the Authority. Pipelines shall be flushed at the rate of at least 3.0 feet per second for a duration suitable to the Authority or shall be flushed by other approved methods.

### **3.02 INSPECTION**

- A. Inspect each section of pipe, joint alignment, and each pipe fitting prior to backfilling to assure the maximum deflection present in each joint does not exceed the manufacturer's recommendations.
- B. Any and all defects shall be corrected by the Contractor at no cost to the Authority and to the satisfaction of the Authority prior to backfilling. Remove rejected pipe and/or fittings from project.
- C. Pipelines shall be inspected to assure the lines are installed at a constant or increasing grade to eliminate the possibility for air accumulation at an intermediate high point.
- D. The Authority reserves the right to control and inspect the pipe system testing procedure and to determine the acceptability of tests.

### **3.03 HYDROSTATIC TESTING**

- A. General:
  1. Conduct pressure and leakage tests specified so that each water main installed in

the Project is tested to the Authority's satisfaction.

2. The hydrostatic test shall be in accordance with the requirements of AWWA C600 for ductile iron pipe and AWWA C605 for plastic pipe. The hydrostatic test shall be in accordance with the requirement of ASTM F 2164 for PE pressure piping.
3. The hydrostatic testing equipment and installation shall be satisfactory to the Authority prior to testing.
4. Conduct the hydrostatic pressure and leakage tests in the presence of and to the satisfaction of the Authority.
5. When the length of a reclaimed water main exceeds 1,200 feet, the Authority reserves the right to require that the water main be tested in sections, the length of each section to be determined by the Authority.
6. Water for testing shall be furnished by the Contractor. The Contractor may utilize the existing reclaimed water system for the quantities required; however, the Contractor must coordinate all arrangements and conform to the reclaimed water utility's standards for use and connection.
7. The Contractor will be required to perform hydrostatic pressure testing concurrent with installation of the pipe system.
8. No testing will be authorized unless ambient air temperature is 35° or higher.
9. Any leaks or defective pipe discovered by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all piping passes the specified test.

B. Preparation:

1. The Contractor may, at his option, completely backfill the trench or partially backfill the trench over the center section of each pipe length prior to carrying out the pressure test. The Authority reserves the right, however, to direct that the entire trench be backfilled, if traffic or other local conditions require such action.
2. The section of water main being tested must be filled with water a minimum of 24 hours before the main is tested.
3. The test shall be made by closing valves, when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.
4. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
5. The pipelines shall be filled at a rate that will not cause any surges or exceed the rate at which the air can be released through the air valves or temporary vents at a reasonable velocity; all the air within the pipelines shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight

pressure for a sufficient length of time to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Authority shall be taken.

C. Pressure Test:

1. After the pipeline has been filled with water for 24 hours, conduct a pressure test, for a duration of at least two (2) hours. Test pressures for each section of water main to be tested shall equal 150% of working pressure, but not less than 125% of normal working pressure at highest elevation. The Authority shall supply the average working pressure at each area of work.
2. Apply the specified test pressure by means of a pump connected to the pipe in a manner satisfactory to the Authority. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow offs are not available at high places, Contractor shall make the necessary taps at points of highest elevation before the test is made and insert the plugs after the test has been completed, at no cost to the Authority. Extreme care must be exercised to insure that all air is expelled from the pipeline during the filling.
3. Carefully examine all exposed pipes, joints, fittings, and valves during the test, and tighten all joints showing visible leakage. Remove all defective pipe, fittings, and valves from the line and replace.
4. The section under test shall be brought back to test pressure at one-half hour intervals during the testing should re-pressurization be needed. Record both the makeup water amount and pressure at each one-half hour re-pressurization.

D. Leakage Test:

1. Conduct concurrently with the pressure test.
2. Provide suitable means to measure the leakage during the pressure test, and a record of water added to the pipeline shall be kept for a period of at least two (2) hours.
3. Leakage is defined as the quantity of water that must be supplied into the newly laid pipe, or any valve section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe filled with water.
4. All piping inside chambers, valve pits, etc. shall show no leakage.
5. **Ductile Iron Pipe**: Leakage in Ductile Iron pipelines shall be acceptable when it is less than the amount calculated by the following formula:

$$L = \frac{S * D * P^{1/2}}{148,000}$$

- L = Allowable Leakage (gph)  
S = Length of Pipeline Tested (ft)  
D = Nominal Diameter of Pipe (in)  
P = Average test pressure during test period (psig)



Allowable Leakage (GPH) per 1,000 feet of Ductile Iron Pipe is defined by the following table:

Avg. Test Pressure (psi)	4" Nom. Pipe Diameter	6" Nom. Pipe Diameter	8" Nom. Pipe Diameter	10" Nom. Pipe Diameter	12" Nom. Pipe Diameter
300	0.47	0.70	0.94	1.17	1.40
275	0.45	0.67	0.90	1.12	1.34
250	0.43	0.64	0.85	1.07	1.28
225	0.41	0.61	0.81	1.01	1.22
200	0.38	0.57	0.76	0.96	1.15
175	0.36	0.54	0.72	0.89	1.07
150	0.33	0.50	0.66	0.83	0.99
125	0.30	0.45	0.60	0.76	0.91

6. **High Density Polyethylene (HDPE) Pipe:** Leakage in HDPE pipelines shall be acceptable when it is less than the amount described below. During the initial expansion phase of the test the length of pipe being tested is pressurized to 10 psi higher than required target pressure (target pressure + 10psi) for duration of 4 hours, For the test phase of the test reduce the pressure to the target pressure. If after one hour the pressure is within 5% of the target pressure then the test pipe is determined to have no leakage.
7. **Polyvinyl Chloride (PVC) Pipe:** Leakage in PVC pipelines shall be acceptable when it is less than the amount calculated by the following formula:

$$Q = \frac{L * D * P^{1/2}}{148,000}$$

Q = Allowable Leakage (gph)  
 L = Length of Pipeline Tested (ft)  
 D = Nominal Diameter of Pipe (in)  
 P = Average test pressure during test period (psig)

Allowable Leakage (GPH) per 1,000 feet of PVC Pipe is defined by the following table:

Avg. Test Pressure (psi)	4" Nom. Pipe Diameter	6" Nom. Pipe Diameter	8" Nom. Pipe Diameter	10" Nom. Pipe Diameter	12" Nom. Pipe Diameter
300	0.47	0.70	0.94	1.17	1.40
275	0.45	0.67	0.90	1.12	1.34
250	0.43	0.64	0.85	1.07	1.28
225	0.41	0.61	0.81	1.01	1.22
200	0.38	0.57	0.76	0.96	1.15
175	0.36	0.54	0.72	0.89	1.07
150	0.33	0.50	0.66	0.83	0.99
125	0.30	0.45	0.60	0.76	0.91
100	0.27	0.41	0.54	0.68	0.81

75	0.23	0.35	0.47	0.59	0.70
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3.04 ACCEPTANCE

- A. Acceptance: Observation of successful testing of piping by the Authority does not constitute acceptance of the system or any portion thereof. Only upon final inspection by the Authority and upon written acceptance will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period will commence. If, during the final inspection, any irregularities are observed, the condition must be corrected at no cost to the Authority.

**END OF SECTION**

**DIVISION 33 – UTILITIES**  
**SECTION 33 11 00 – RECLAIMED WATER UTILITY DISTRIBUTION PIPING**

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes

1. Reclaimed Water Piping and Fittings
2. Reclaimed Waterline Detection and Marking

B. Related Work:

1. Section 33 08 10 – Testing of Reclaimed Water Utility Distribution
2. Section 33 13 00 – Disinfection of Reclaimed Water Utility Distribution

1.02 REFERENCES

A. American Society for Testing and Materials:

1. ASTM A36, Standard Specification for Structural Steel.
2. ASTM A48, Standard Specification for Gray Iron Casting.
3. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
4. ASTM A536, Standard Specification for Ductile Iron Castings.
5. ASTM A307, Carbon Steel Externally and Internally Threaded Fasteners.
6. ASTM D2657, Standard Practice for Heat Joining of Polyolefin Pipe and Fittings.
7. ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
8. ASTM D3035, Standard Specification for Polyethylene plastic Pipe Based on Controlled Outside Diameter.
9. ASTM D3261, Butt Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Pipe and Tubing.
10. ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Material.
11. ASTM F714, Standard Specification of Polyethylene Plastic Pipe Based on Outside Diameter
12. ASTM F1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

B. American Nation Standard Institute:

1. ANSI A21.4, Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. ANSI A21.10, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
3. ANSI A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
4. ANSI A21.50, Thickness Design of Ductile Iron Pipe
5. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

C. American Water Works Association:

1. AWWA C104, Cement Mortar Lining for Ductile-Iron.
2. AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 in., Through 48 in., for Water and Other Liquids.
4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
5. AWWA C150, Thickness Design of Ductile Iron Pipe
6. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
7. AWWA C153, Ductile Iron Compact Fittings for Water Service.
8. AWWA C502, Dry-Barrel Fire Hydrants
9. AWWA C509, Resilient-Seated Gate Valves for Water and Sewerage Systems.
10. AWWA C600, Installation of Ductile Iron Water Mains and their Appurtenances
11. AWWA C605, Underground Installation of PVC Pressure Pipe and Fittings for Water
12. AWWA C800, Underground Service Line Valves and Fittings
13. AWWA C900, PVC Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Transmission and Distribution
14. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch, for Water Service
15. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch for Water Distribution and Transmission

D. American Welding Society:

1. AWS D1.1, Structural Welding Code.

- E. National Electrical Manufacturers Association:
  - 1. NEMA Standard Specifications.
- F. NSF International:
  - 1. NSF-61 Listings.
- G. Plastic Pipe Institute
  - 1. PPI TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
  - 2. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings.

1.03 SYSTEM DESCRIPTION

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Where a reclaimed waterline crosses over or under another pipe, provide a minimum separation of eighteen (18) inches for pressurized lines and twelve (12) inches for gravity conveyance lines.
- E. The work shall include, but not be limited to, the following:
  - 1. Connections to existing pipelines.
  - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
  - 3. Installation of all new pipe and materials required for a complete installation.
  - 4. Cleaning, testing and disinfecting as required.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of 01 33 00.
- B. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cu sheets or other data as required to provide a complete description of piping, fittings and other appurtenances specified.
- C. Certificates:
  - 1. The Contractor shall furnish to the Authority, a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- D. Where mechanical joint restraints are to be used, submit restraint lengths with supporting calculations.
- E. Operation and Maintenance Data: Furnish operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Use only one type and class of pipe in any continuous line of waterline between structures, unless otherwise directed in writing by the Authority.
  - 2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.
- B. Source Quality Control:
  - 1. Shop Testing: Each pipe manufacturer must have facilities to perform listed tests. The Authority reserves the right to require the manufacturer to perform additional tests as may be deemed necessary to establish the quality of the material offered for use.
  - 2. Shop Tests:
    - a. Perform hydrostatic and leakage shop tests on all pipe and fittings in accordance with applicable AWWA Standards.
    - b. Perform hydrostatic and leakage shop tests on all gate, butterfly, angle and globe body valves, and check valves in accordance with appropriate AWWA Standards.
    - c. Additional Testing:

Material	Test Method	Number of Tests
1. Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51
2. Polyvinyl Chloride Pipe	ASTM D1784	As specified in ASTM D1784
3. Polyethylene Pipe	ASTM D2837	As specified in ASTM D2837

3. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. These laboratory tests will be paid for by the Contractor.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle piping and related products in accordance with specifications, manufacturer's recommendations, and as supplemented herein.
- B. Pipe and related materials to be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances drop or skid material against other products.
- C. Handle pipe and related materials at all times with care to avoid damage. Keep interior free from dirt and foreign matter. Lower or raise all pipe, and appurtenances carefully into place, with suitable equipment in a manner that will prevent damage. Do not drop or dump pipe or accessories. Do not use equipment to skid pipe across the ground.
- D. Thoroughly inspect pipe, pipe linings, fittings, and all related materials for defects prior to being unloaded and again prior to being installed. Repair or replace any defective, damaged, or unsound material, as determined by the Authority at no cost to the Authority.
- E. All lumps, blisters, and excess coating shall be removed from ends of each pipe. All joints shall be brushed and wiped clean, dry and free from oil and grease before pipe is installed.

#### 1.07 SITE CONDITIONS

- A. Environmental Requirements:
  - 1. Keep trenches dewatered until initial bedding has been placed, pipe joints have been made, and initial bedding and concrete cradle and encasement, if any, have cured.
  - 2. Under no circumstances lay pipe in water or on bedding containing frost.
  - 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.
  - 4. The Authority reserves the right to suspend work during inclement weather, if, in the opinion of the Authority, the safety of its field personnel is endangered or if the quality of the work itself is threatened.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified Section 33 08 10.
- C. All exposed exterior piping shall have flanged joints, unless otherwise specified or shown on the drawings.

### **2.02 DUCTILE IRON PIPE AND FITTINGS**

- A. Ductile iron pipe (DIP) shall conform to ANSI A21.51 (AWWA C151). Piping having a diameter of 12 inches and less shall be of Pressure Class 350. Piping having a diameter greater than 12 inches and less than 18 inches shall be of a determined based on project specific design requirements. Ductile iron pipe shall be of minimum Grade 60-42-10 for centrifugally cast in metal molds or sand-lined molds.
- B. All ductile iron pipes shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required by the Authority.
- C. Fittings and specials shall be ductile iron, conforming to the requirements of AWWA C153 and shall have a minimum rated working pressure of 350 psi. Fittings and specials shall be supplied with either restrained or mechanical joints as applicable.
- D. All pipe and fittings shall be cement mortar lined. Lining shall conform to ANSI A21.4/AWWA C104 and shall be double thickness. The mortar lining shall be protected with an asphaltic coating. All buried DIP and fittings shall have a bituminous coating on the exterior surfaces in accordance with ANSI A21.51/AWWA C151. All exposed DIP and fittings shall have a factory applied prime coat.
- E. Polyethylene encasement shall be installed for all pipe, fittings, and service lines to be encased in concrete. Polyethylene encasement shall be in accordance with AWWA C105.
- F. Pipe and fittings shall be the class that equals or exceeds the pipe class as specified herein. Requirements for various types of joints are described in the following paragraphs.
- G. Pipe joints and fittings shall be restrained where indicated on the Contract Drawings. Restrained joints shall be in accordance with these specifications
- H. Push-on Joints
  - 1. Bell and spigot pipe shall be provided with push on, O-ring rubber gasket, compression type joints and shall conform to the requirements of ANSI A21.11 /AWWA C111. Fittings and specials shall be supplied with mechanical joints.
  - 2. Mechanical joints and fittings shall conform to the requirements of ANSI A21.11, /AWWA C111 and have a minimum pressure rating of 350 psi. Joints shall



incorporate a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts. If required by installation conditions, pipe and fittings shall have cast-on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.

I.      Restrained Joints

1.      Mechanical joint restraint shall be used at all bends, tees, and changes in direction.
2.      Mechanical Restrained Joints: Mechanical joint restraint consisting of a follower gland which when actuated imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. ASTM A 536-80 ductile iron follower gland of dimensions such that it can be used with AWWA C153 mechanical joints. Restraining devices shall be ductile iron, heat treated to a minimum hardness of 370 BHN. Twist-off nuts shall be used to insure proper actuating of the restraint device. Restraint device shall have a 250 psi minimum working pressure with 2:1 minimum safety factor. Coating for restraint devices shall consist of the following:
  - a.      All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid fluoropolymer coating with heat cure to follow each coat.
  - b.      All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
3.      Push-on Restrained Joints: Restrained joint pipe and fittings shall consist of one of the following restraint systems:
  - a.      Bolted retainer rings and welded retainer bars or boltless, push-on type which include ductile iron locking segments and rubber retainers. Bolts for restrained joints (if applicable) shall conform to ANSI B18.2. For thrust restraint of field cut piping, the manufacturer's standard assembly shall be used (if applicable).
  - b.      Restraint system integral to the gasket, with a minimum pressure rating of 350 psi. Gasket shall contain stainless steel or ductile iron locking segments that are embedded in the gasket. Gasket restraint system shall conform to the requirements of ANSI A21.11 (AWWA C111).
3.      Restraint Harness (DI): Ductile iron pipe bell restraint shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell:
  - a.      The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The restraint ring and its wedging components shall be made of minimum grade 65-45-12 ductile iron conforming to ASTM A536. The wedges shall be heat treated to a minimum hardness of 370 BHN. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges. The split ring shall be made of a minimum grade of 65-45-12 ductile iron conforming to ASTM A536. The restraint devices shall be

coated with a thermoset epoxy. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure with a minimum two to one safety factor of 350 psi for sizes 4"-16" and 250 psi for sizes 18" and larger. The product shall be manufactured by EBAA Iron, Inc., or approved equal.

2.03 PVC PIPE AND FITTINGS

- A. Polyvinyl Chloride (PVC) Pipe shall conform to ANSI/AWWA C900. Size and pressure class shall be selected based on design conditions.
- B. All fittings and specials shall be ductile iron, conforming to the requirements specified.
- C. Push-on Joints - Use rubber-gasket joints for pipe and fittings installed underground meeting ASTM F477.
- D. Restrained Joints
  - 1. Mechanical joint restraint shall be used at all bends, tees, and changes in direction.
  - 2. Mechanical Restrained Joints: Mechanical joint restraint consisting of follower gland which when actuated imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Restraint shall be designed specifically for use with C900 PVC pipe. ASTM A 536-80 ductile iron follower gland of dimensions such that it can be used with AWWA C153 mechanical joints. Restraining devices shall be of ductile iron, heat treated to a minimum hardness of 370 BHN. Twist-off nuts shall be used to insure proper actuating of the restraint device. Restraint device shall have a 250 psi minimum working pressure with 2:1 minimum safety factor. Mechanical joint shall be specifically made for the given pipe material.
  - 3. Restraint Harness (PVC): Restraint for PVC pipe bell (AWWA C900) shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. The restraint devices shall be coated with a thermoset epoxy coating. A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring. The combination shall have a minimum working pressure rated to the full pressure of the pipe. The restraint shall be manufactured by EBAA Iron, Inc., or approved equal.

2.04 HDPE (HIGH DENSITY POLYETHYLENE) PIPE AND FITTINGS (3" Diameter and larger)

- A. All HDPE pipe shall conform to all applicable provisions and requirements of the latest revision of AWWA C906 and be NSF Standard 61 certified. All HDPE pipe shall be Ductile Iron Pipe Size (DIPS). Pipe size and DR rating shall be selected based on design conditions.
- B. Polyethylene compounds utilized in the manufacturing of the pipe shall have a grade of PE 34 with a minimum cell classification of PE 345444C for PE 3408 materials in accordance with ASTM D3350.
- C. Polyethylene fittings shall be manufactured using the compounds previously specified

and be pressure rated to match the system piping to which they are joined. Fittings shall be manufactured by the same manufacturer of the pipe.

- D. The minimum working pressure rating of the pipe and fittings shall be in excess of 1.5 times the projected typical operating pressure. Coordinate with the Authority to determine typical operating conditions for the existing system.
- E. HDPE pipe and fittings shall be joined by use of the following methods:
  - 1. HDPE pipe shall be joined through the use of butt fusion. Fusion of pipe shall be conducted in strict accordance with the manufacturer's instructions and recommendations and ASTM D2657. The Contractor shall provide qualified personnel trained in the manufacturer's fusion procedures and shall provide proof of such qualification to the Engineer.
  - 2. HDPE Fittings and specials shall be joined using the electrofusion process. Electrofusion shall be in strict accordance with the manufacturer's instructions and recommendations.
  - 3. No pipe or fitting shall be joined by fusion or electrofusion unless the Contractor has proven that the personnel making the joints have been adequately trained and are qualified in the techniques involved.
  - 4. A copy of each manufacturer's joining system and techniques shall be provided to the Authority for review prior to any pipe or fitting being joined.
- F. All pipe and fittings shall have product traceability. Pipe and fittings shall be heat indent printed with the manufacturer's name, the nominal pipe size, the dimension ratio, the pipe grade, manufacturing standard reference, and the manufacturer's production code, from which the date and place of manufacture can be determined.
- G. HDPE piping shall be provided with color stripe coding in accordance with the striping codes developed by the Utility Location & Coordination Council of the American Public Works Association.
  - 1. Color stripe coding shall consist of a minimum 6 stripe pattern.
  - 2. Stripe color shall be Purple.
- H. Quality Control / Workmanship.
  - 1. HDPE pipe and fittings shall comply with AWWA C906, latest edition. All pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, dents, or other defects. The piping and fittings shall be uniform in color, opacity, density, and other physical properties as commercially practical.

#### 2.05 POLYETHYLENE TUBING AND FITTINGS (<3-INCH DIAMETER)

- A. Polyethylene tubing shall be designed for transporting potable water and shall have three evenly spaced blue strips along the length of the tubing. The tubing shall conform to ANSI/AWWA C-901, be manufactured of PE 3408 material, have a dimension designation of DR-9, and shall be rated for a minimum working pressure of 200 psi.

- B. Insert type fittings shall conform to ANSI/AWWA C800 and be constructed of stainless steel.

## 2.06 COPPER PIPE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K, water tube, annealed temper.
- B. All copper tubing shall conform to AWWA C800 for thickness design.
- C. Copper Pressure Fittings: Fittings shall be compression or flared connections and shall conform to ASME B16.22.
- D. Bronze Flanges: ASME B16.24, Class 150, with compression end. Furnish Class 300 flanges if required to match piping.
- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and compression or threaded ends.

## 2.07 COUPLINGS

- A. Restrained Joint Coupling (Extended Range Coupling)
  - 1. Coupling shall provide restrained joints for connecting plain pipe ends. Coupling body shall be ductile iron, meeting or exceeding the requirements of ASTM A 536, Grade 65-45-12. The restraint mechanism shall consist of a plurality of ductile iron grippers, meeting or exceeding ASTM A536, Grade 65-45-12. Grippers shall be actuated by properly torqued rotating end rings. Grippers shall distribute the load evenly around the pipe circumference. Where used in the design of the coupling, draw hook fasteners shall be 304L stainless steel. Bolts and nuts shall be e-coated, 304 stainless steel provided with anti-galling protection. Coupling shall be coated with an epoxy. Work pressure: up to 350 psi. Coupling shall accommodate up to 4 degrees of deflection per end.
- B. Restrained Coupling
  - 1. Joint Restraint shall be incorporated into the design of the sleeve or coupling used to connect two plain pipe ends. The restraint mechanism shall consist of a plurality of individually actuated gripping surfaces to maximize restraint capability. Torque limiting twist off nuts shall be used to insure proper actuating of the restraint devices. The restraint devices shall be coated with a thermoset epoxy. Ductile Iron components shall be of a minimum of 65-45-12 ductile iron meeting the requirements of ASTM A536 of the latest revision and shall be tested in accordance with the stated standard. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.
- C. Flanged Coupling Adapters
  - 1. Restrained flange adapters may be used in lieu of threaded, or welded, flanged spool pieces. Flanged adapters shall be made of ductile iron conforming to

ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.

2. Restraint for the flange adapter shall consist of a plurality of actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws or rotating end rings shall be used to insure proper initial set of gripping wedges. Grippers shall distribute the load evenly around the pipe circumference. Where used in the design of the coupling, draw hook fasteners shall be 304L stainless steel.
3. Pressure and service shall be the same as connected piping.
4. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
5. Flanged adapters shall be provided with manufacturer's standard finished coat.
6. Bolts and nuts shall be stainless steel.
7. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1

## 2.08 RECLAIMED WATERLINE DETECTION AND MARKING

### A. Underground Warning Tape

1. Underground Warning Tape shall be installed 18-24 inches below final grade and directly above all buried piping. Tape shall be capable of being detected with inductive methods.
2. Detectable warning tap shall consist of a nominal 4.5 mil (0.0045") overall thickness, with a solid aluminum foil core. The imprinted warning message shall be encased to prevent ink rub-off and shall be impervious to acids, alkalis and other destructive soil elements.
3. Minimum width of 3"
4. Color shall be Purple
5. Tape shall be clearly and permanently labeled "CAUTION: BURIED RECLAIMED WATERLINE BELOW".

### B. Reclaimed Waterline Marker

1. Reclaimed Waterline markers shall be provided at 500 ft intervals and at all points of access to the reclaimed waterline (valves, flush mounted tracer wire posts, etc.).
2. Markers shall be highly visible 100% recyclable triangular fiberglass composite posts with 360 degree visibility. Posts shall be capable of withstanding repeated vehicle impacts up to 55 mph and snap back to the original position. Markers shall be UV stable and fade resistant.

3. Marker shall be 66 inches in total length and extend a minimum of 48 inches above finished grade after installation.
4. Markers shall be purple, and be clearly and permanently labeled “WARNING RECLAIMED WATER PIPELINE”
5. Marker shall be installed directly above all buried piping. Install markers in accordance with the manufacturers’ instructions.

C. Test/Tracer Wire and Stations

1. Test/Tracer Wire and Stations shall be installed on all forcemains.
2. AWG No. 12 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 1, Class C.
3. Terminate test/tracer wire in a flush mounted or above ground (pedestal) test station at 500 ft intervals. The Authority will identify the required station based on waterline location. Where the flush mount station is required, install a Marker Post at each station. Station shall come standard with integral internal tracer wire access points. Tube material shall be of high grade ABS, or equivalent rigid plastic that meets or exceeds ASTM D-1788, Type 1 requirements. Lid material shall be of cast iron or ductile iron. Tensile strength or ductility of such material shall be equal or superior to hi-tensile cast iron ASTM A-126-B requirements. Lid-locking bolt material shall be made of aluminum material equal or superior to ASTM B-253. Lid-locking mechanism material shall be made of plastic to meet or exceed ASTM A-126-B requirements.
4. Test Stations shall be marked for reclaimed water and contain a purple insignia or be entirely purple.

D. Utility Marking Sign

1. Provide a utility marking sign in accordance with applicable detail at all locations where the public could potentially come into contact with reclaimed water (i.e. all points where water can exit the pipeline, fire hydrants, yard hydrants, storage tanks, pump stations, discharge locations, point of use locations etc.).
2. Utility Marking Sign shall be UV, chemical, abrasion and moisture resistant. It shall be constructed of rugged, enamel-coated aluminum and suitable for outdoor use at service temperatures from – 40 F to 180 F.
3. Sign post shall be as detailed.

### PART 3 – EXECUTION

#### 3.01 EXAMINATION

- A. Carefully examine each section of pipe and each pipe fitting before laying on conformance with the inspection requirements of the appropriate referenced standard. No

piece shall be installed which is known to be cracked, damaged, or otherwise defective.

- B. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense.

### 3.02 PREPARATION

- A. Clean piping interior and mating surfaces of bell, spigot and gasket before laying. Maintain clean until completed work is accepted.
- B. Perform trenching for water mains and place pipe bedding as specified in Division 33.
- C. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.

### 3.03 LAYING PIPE

- A. General Requirements:
  - 1. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used.
  - 2. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade. Lay bell and spigot pipe with bell end up grade unless shown otherwise on the drawings or directed by the Engineer.
  - 3. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
  - 4. Center spigot end in bell or socket end of previously laid pipe, shove tight and secure.
  - 5. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
  - 6. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.
  - 7. Walking or working on completed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
  - 8. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
  - 9. Take up and replace with new, such in-place pipe sections found to be defective. Replace at Contractor's expense.
  - 10. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be

securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

11. Take necessary precautions to prevent newly laid pipe from floating as a result of water accumulation in the trench; or the collapse of the pipe line from any cause. Restore or replace pipe as necessary at Contractor's expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
12. Bed pipe using materials specified in Division 33.
13. Cut pipe using only equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Grind smooth cut ends and rough edges. Bevel slightly, cut end for push-on connections.
14. Where cutting of pipe is necessary, minimum laying length shall be five (5) feet.

B. Joints:

1. Make pipe and fitting joints according to pipe manufacturer's specifications and to specifications previously specified for pipe.
2. Make joints watertight. Immediately repair detected leaks and defects. Methods of repair subject to Authority's approval.

C. Alignment and Grade:

1. Lay and maintain all pipe at the required lines and grades as shown on the Drawings. Place fittings and valves at the required locations with joints centered, spigots forced home, and all valve stems plumb. Do not deviate from the required line and grade, except with the approval of the Engineer.
2. Deflect pipe joints where indicated on the drawings. Deflections shall not exceed pipe manufacturer's recommended maximum allowable deflection.
3. Do not change grade or alignment without Engineer's approval.

D. Pipe Anchorage and Support

1. Buried Lines Under Pressure: Contractor to provide restraints at all bends, tees and changes in direction. Contractor to develop and submit for review a Restrained Pipe Length Schedule.

3.04 SERVICE LINE AND FITTINGS

- A. Install water service lines where required. Unless otherwise approved, all water lines shall be installed at a minimum depth of 4 feet of cover over the top of the pipe.
- B. Clean and inspect each pipe and part of the fitting before installing and assemble to provide a flexible joint. Use joints or lubricants recommended by the manufacturers.
- C. Operate each valve before and after installation.
- D. When the work is not in progress and at the end of each work day, securely plug the



ends of pipe and fittings to prevent any dirt or foreign substances from entering the lines.

- E. Test and disinfect lines as specified in Division 33.
- F. Provide concrete thrust blocking or restrained joints at all bends, tees and changes in direction.

3.06 FIELD QUALITY CONTROL AND TESTING

- A. As specified in Division 33.

3.07 DISINFECTION

- A. As specified in Division 33.

**END OF SECTION**

**DIVISION 33 – UTILITIES**  
**SECTION 33 12 00 – RECLAIMED WATER UTILITY DISTRIBUTION EQUIPMENT**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Gate Vales and accessories
  - 2. Valve Boxes
  - 3. Manual Valve Operators
  - 4. Service Connection Components
  - 5. Fire Hydrants
  - 6. Backflow Prevention Valves
  - 7. Pressure Reducing Valves
  - 8. Air Release Valve
  - 9. Yard Hydrant
  - 10. Meters

1.02 REFERENCES

- A. American Society for Testing and Materials:
  - 1. ASTM A36, Standard Specification for Structural Steel.
  - 2. ASTM A48, Standard Specification for Gray Iron Casting.
  - 3. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 4. ASTM A536, Standard Specification for Ductile Iron Castings.
  - 5. ASTM A307, Carbon Steel Externally and Internally Threaded Fasteners.
  - 6. ASTM D2657, Standard Practice for Heat Joining of Polyolefin Pipe and Fittings.
  - 7. ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
  - 8. ASTM D3035, Standard Specification for Polyethylene plastic Pipe Based on Controlled Outside Diameter.
  - 9. ASTM D3261, Butt Fusion Polyethylene Plastic Fittings for Polyethylene Plastic

Pipe and Tubing.

10. ASTM D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Material.
11. ASTM F714, Standard Specification of Polyethylene Plastic Pipe Based on Outside Diameter
12. ASTM F1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

B. American Nation Standard Institute:

1. ANSI A21.4, Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. ANSI A21.10, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
3. ANSI A21.11, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
4. ANSI A21.50, Thickness Design of Ductile Iron Pipe
5. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

C. American Water Works Association:

1. AWWA C104, Cement Mortar Lining for Ductile-Iron.
2. AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 in., Through 48 in., for Water and Other Liquids.
4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
5. AWWA C150, Thickness Design of Ductile Iron Pipe
6. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
7. AWWA C153, Ductile Iron Compact Fittings for Water Service.
8. AWWA C502, Dry-Barrel Fire Hydrants
9. AWWA C509, Resilient-Seated Gate Valves for Water and Sewerage Systems.
10. AWWA C600, Installation of Ductile Iron Water Mains and their Appurtenances
11. AWWA C605, Underground Installation of PVC Pressure Pipe and Fittings for Water
12. AWWA C800, Underground Service Line Valves and Fittings
13. AWWA C900, PVC Pipe and Fabricated Fittings, 4 inch through 12 inch, for

Water Transmission and Distribution

- 14. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch, for Water Service
- 15. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch for Water Distribution and Transmission
- D. American Welding Society:
  - 1. AWS D1.1, Structural Welding Code.
- E. National Electrical Manufacturers Association:
  - 1. NEMA Standard Specifications.
- F. NSF International:
  - 1. NSF-61 Listings.
- G. Plastic Pipe Institute
  - 1. PPI TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
  - 2. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings.

1.03 SYSTEM DESCRIPTION

- A. The Contractor shall furnish and install to the required line and grade, all equipment and appurtenances, required for a complete installation to support intended functionality of each component individually and systematically.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect or incorporate equipment into the overall project where connecting to piping or assemblies.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required to procure, install and test all equipment required for the project.
- D. Water meters shall be adequately sized to yield accuracy between 98.5-101.5% over the normal operating range. Adjacent piping design shall be in accordance with the manufacturer's recommendations to optimize performance. Consult with the Authority regarding the style of meter (i.e. turbine-type or electromagnetic).
- E. Pressure reducing valves shall be sized appropriately based on flow and pressure reduction to prevent long-term damage due to cavitation.
- F. The Authority will, at a minimum, provide access to the existing facilities for determination of design information. At all times, existing facilities will be operated by the Authority's personnel.

- G. Hydrants shall be located as directed by the Authority based on current and projected building and population densities.
- H. A backflow prevention device shall be installed at all potential cross-connections to prevent the backflow of polluted water into the reclaimed water system. Consult with the Authority to determine if the application requires a double check valve assembly or a reduced pressure zone assembly. Reduced pressure zone assemblies shall be installed at each potential health hazard location.

#### 1.04 SUBMITTALS

- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut sheets or other data as required to provide a complete description equipment specified.
- B. Certificates:
  - 1. The Contractor shall furnish to the Engineer, a Material Certification stating that the equipment provided under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- C. Operation and Maintenance Data: Furnish operation and maintenance manuals for all equipment.

#### 1.05 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Use only one manufacturer and model for each component unless conditions prevent model consistency throughout the project.
  - 2. Use equipment designed to withstand imposed trench loadings and conditions at the various locations.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle equipment and related products in accordance with specifications and manufacturer's recommendations.
- B. Equipment and related materials shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Do not drop or skid equipment against other products or items.
- C. Handle equipment and related materials at all times with care to avoid damage. Keep interior of equipment and operating mechanisms free from dirt and foreign matter. All equipment and appurtenances being incorporated into the work shall be carefully lowered or raised into place with suitable equipment in a manner that will prevent damage. Do not drop or dump equipment or accessories.
- D. Thoroughly equipment and all related materials for defects prior to being unloaded and again prior to installation. Repair or replace any defective, damaged, or unsound material, as determined by the Authority, at no cost to the Authority.

- F. Store all valves with rubber seats out of sunlight with discs or plugs opened slightly off seat (3 to 5 degrees).
- G. Exercise each manual valve operator through at least two (2) full open and close cycles at least once every two (2) months.

1.07 SITE CONDITIONS

- A. Environmental Requirements:
  - 1. Keep trenches dewatered until initial bedding has been placed, pipe joints have been made, and initial bedding and concrete cradle and encasement, if any, have cured.
  - 2. Under no circumstances lay pipe in water or on bedding containing frost.
  - 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

**PART 2 – PRODUCTS**

2.01 RESILIENT WEDGE GATE VALVES

- A. All gate valves 3" and larger shall conform to AWWA C509 or AWWA C515 (latest revisions), and be NSF Standard 61 certified, with a working pressure rating of 250 psi. All valves shall be ductile iron body, non-rising bronze stem, and resilient seated wedge type.
- B. The wedge shall be cast iron, completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge with a rubber tearing bond to meet ASTM D429.
- C. All internal parts shall be accessible without removing the body from the line.
- D. Nut operators shall have standard 2-inch square AWWA operating nuts. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- E. Gate valves shall be supplied with either mechanical joint or restrained joint connections as applicable.
- F. Each buried valve shall also be supplied with a valve box and lid as specified in this Section.
- G. Gate valves shall be provided with extension stems, stem guides, and other miscellaneous items required for a complete installation, shall be provided in accordance with the requirements and recommendations of the valve manufacturer. One tee handle valve operating wrench shall be provided, length of which shall insure that all valves are accessible.
- H. All internal and external surfaces of the valve body and bonnet shall have a fusion-bonded epoxy coating, complying with ANSI/AWWA C550, applied prior to assembly.

- I. Valves installed at a depth greater than 5'-0" (as measured from the top of the operating nut to finished grade) shall be provided with a stem extension installed to a height of 3 feet below finished grade.

## 2.02 VALVE BOXES

- A. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The trench base on which the valve boxes rests shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. Valve boxes shall be hot bituminous coated, inside and out, with a coal tar or asphaltic compound.
- B. All valve boxes shall be 2-piece cast iron, screw type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: RECLAIMED WATER).
- C. All valve box covers shall be painted purple and shall be provided with a bronze tag or suitable marking that shall be permanently attached to the underside of the cover and shall identify the valve type, size, number of turns, and direction to open.

## 2.03 MANUAL VALVE OPERATORS

- A. All valve operators shall be manual except where noted otherwise. All interior valves shall be hand wheel or lever operated if the centerline of the valve is 6 feet or less above the floor or platform from which it is to be operated and chain operated if the distance is greater than 6 feet.
- B. Nut operators shall have standard 2-inch square AWWA operating nuts and shall be provided where specified or as required by the Authority. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked. Valve operators shall be designed so that the force required to operate the hand wheel, lever, or chain does not exceed 80 pounds applied at the extremity of hand wheel or chain wheel operator. Nut operators shall be designed to produce the required operating torque with a maximum input of 150 ft.-lb. Hand wheels on valves 4 inches and larger shall not be less than 12 inches in diameter.
- C. Manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification.
- D. Quarter turn operators shall be equipped with adjustable AWWA input limit stops and shall require a minimum of 15 turns for 90° or full stem valve travel and shall be equipped with a valve position indicator.
- E. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- F. Manual operators on buried service valves shall be specially constructed for buried service. Buried service operators shall be permanently lubricated and watertight under an external water pressure of 10 psi. Unless otherwise shown or specified, buried service operators shall be furnished with Standard AWWA nut operator and valve box. Where required, a standard 2-inch AWWA nut operator and valve box shall be provided within 6-

inches of grade with a steel extension stem-equal to or greater than the diameter of the manual activator shaft.

## 2.04 SERVICE CONNECTION COMPONENTS

### A. Corporation Stop

1. Corporation stop to have tapered threaded inlet and threaded coupling on outlet for copper service pipe or copper tubing size O.D. Type K pipe connections.
2. Corporation stop to meet or exceed all requirements of AWWA Standard C800-89.
3. 300 psig working pressure, ball or ground key type, bronze body, double-stem o-rings, AWWA threaded inlet connections, compression style or Insta-tite outlet connections suitable for pipe or tubing used.

### B. Curb Stop

1. Curb stop to meet or exceed all requirements of AWWA Standard C800-89.
2. 300 psig working pressure, ball or curb type valve, bronze body and tee head, double-stem o-rings, compression style inlet and outlet connections suitable for pipe or tubing used.

### C. Curb Box

1. Cast iron construction, adjustable, two (2) piece screw type, 2 1/2 inch shaft with flush fit cover and bolt down lid marked "RECLAIMED WATER".
2. Length of box and base shall be as required for the actual field conditions encountered.
3. Interior and exterior of boxes shall be hot bituminous coated.

### D. Service Saddles

1. Ductile Iron Pipe: Epoxy coated ductile iron saddles with stainless steel straps shall be used for ductile iron pipe. Ductile iron body shall conform with ASTM A536. All straps, nuts and washers shall be Type 304 stainless steel. The body shall be coated with a fusion bonded epoxy coating. A Buna-N rubber gasket shall be integral with the unit.
2. PVC Pipe: Brass saddles shall be used for PVC pipe. Saddle shall be suitable for use on the given pipe material. Saddle body shall be made of 85-5-5 brass alloy as per ASTM B-62 and AWWA C800. Strap shall be made of 85-5-5 brass alloy as per ASTM B-62 or Type 304 stainless steel. All nuts and washers shall be made of Type 304 stainless steel. A Buna-N rubber gasket shall be integral with the unit.
3. Saddle shall carry a pressure rating greater than the water main.
4. Saddles to be used for 3/4" through 2" connections.



E. Meter Pit (Service Lines 2" Diameter and Less)

1. Meter pits shall be PVC.
2. Pit shall have a minimum interior diameter of 20 inches. Pit shall be supplied with an angle ball valve on the inlet, and an angle dual check valve on the outlet. Copper piping supplied inside the meter pit shall be in accordance with these specifications. Interior piping shall be located a minimum of 2-inches from the inside pit wall. All brass components shall conform to AWWA C800.
3. Meter and pressure reducing valve shall be firmly held in place inside the meter pit with a PVC support.
4. Double lid meter box cover shall be provided with each meter pit. Frame, barrel and lid shall be cast iron per ASTM A48, Class 25.
5. The meter pit shall incorporate a copper tandem setter to allow for the installation of a pressure reducing valve and water meter in the pit.

F. Meter Pit (Service Lines Larger than 2" Diameter)

1. Meter pits shall be concrete vaults in accordance with Section 03 40 00.

2.05 FIRE HYDRANT

- A. Fire hydrants shall meet or exceed the requirements of AWWA C502 (latest revision). Rated working pressure shall be 250 psig, test pressure shall be 500 psig and hydrant
- B. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure.
- C. Hydrant shall open counterclockwise.
- D. The nozzle section, upper and lower standpipes and hydrant base shall be ductile iron. The nozzle caps, pumper caps and weather shields shall be cast or ductile iron.
- E. The hydrant's upper and lower stem, as well as its break coupling and internal pins and clips shall be manufactured of stainless steel. External bolting shall also be manufactured of stainless steel.
- F. The hydrant shall have two hose nozzles and one pumper nozzle. Hose nozzles to be 2-1/2". Pumper nozzle to be 4-1/2" (friction loss to not exceed 3.5 psi at 1,000 gpm). Nozzles shall have national standard threads matching existing hydrants on reclaimed water system. Each nozzle shall be bronze and secured using a 1/4 turn locking mechanism with a threaded retainer ring.
- G. The hydrant shall have a bronze seat that is to be threaded into bronze mating threads. The seat diameter shall be 5 1/4"
- H. All working parts of the hydrant shall be removable without excavation.
- I. Hydrant shall have an internal travel stop nut located in the top housing.
- J. Fire hydrants shall be provided with a breakaway traffic flange and allow 360-degree

rotation.

- K. There shall be a sealed lubrication chamber with triple O-rings to seal operating threads from the waterway and accommodate an anti-friction thrust washer.
- L. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod. Hydrant drains shall close completely after no more than three turns of the operating nut. There shall be a minimum of three internal ports and four drain port outlets to the exterior of the hydrant Drain shut off to be by direct compression closure.
- M. External surface above grade shall be factory coated with an epoxy primer and a two-part polyurethane top coating. The standpipe shall be bitumen coated internally and externally with a bury line present below the break flange to indicate proper installation depth. Bury depth shall be clearly stenciled on the standpipe section.
- N. Hydrant assemblies shall be supplied with either restrained mechanical joint or restrained joint connections as applicable. All joints through hydrant assembly shall be restrained.
- O. All fire hydrants shall be painted reclaimed water purple.

## 2.06 BACKFLOW PREVENTION VALVE

- A. Double Check Valve (1/2" through 3")
  - 1. The valve shall meet the requirements of AWWA C510 and have a lead free cast copper silicon alloy body. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable.
  - 2. The assembly shall include two resilient seated isolation valves; four top mounted, resilient seated test cocks.
  - 3. Assembly to incorporate an upstream strainer.
  - 4. Maximum Pressure: 175 psi
- B. Double Check Valve (2-1/2" through 10")
  - 1. The valve shall meet the requirements of AWWA C510-92. Valve shall feature modular check assemblies with center stem guiding. Each check module shall have a captured spring and be accessible through bolted cover plate.
  - 2. Valve shall be a complete assembly included tight-closing resilient seated shutoff valves, test cocks, and a strainer.
  - 3. Valve bodies shall be epoxy coated cast iron (lead free)
  - 4. Seats shall be stainless steel.
  - 5. Maximum Pressure: 175 psi
- C. Reduced Pressure Zone Assemblies (1/2" through 3")
  - 1. The valve shall meet the requirements of AWWA C511 and have a lead free cast copper silicon alloy body. The assembly shall consist of an internal pressure

differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. The check module and relief valve seats and seat discs shall be replaceable. There shall be no threads or screws in the waterway exposed to line fluids.

2. The assembly shall include two resilient seated isolation valves; four top mounted, resilient seated test cocks.
3. Assembly to incorporate an upstream strainer.
4. Maximum Pressure: 175 psi

D. Reduced Pressure Zone Assemblies (2-1/2" through 10")

1. The valve shall meet the requirements of AWWA C511-92. Valve shall feature modular check assemblies with center stem guiding. Each check module shall have a captured spring and be accessible through bolted cover plate. The assembly shall contain an internal pressure differential relief valve located in a zone between two positively seating check modules. There shall be no threads or screws in the waterway exposed to line fluids.
2. Valve shall be a complete assembly included tight-closing resilient seated shutoff valves, test cocks, and a strainer.
3. Valve bodies shall be epoxy coated cast iron (lead free).
4. Test cocks shall be lead free copper silicon alloy.
5. Seats shall be stainless steel.
6. Maximum Pressure: 175 psi

2.07 PRESSURE REDUCING VALVE

- A. Pressure Reducing Valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure.
1. Provide PRV's in accordance with project design requirements.
    - a. Flow Range: As required for application
    - b. Pilot Adjustment Ranges: As required for application
    - c. Pressure Rating: 250 psi
    - d. End Connections: Flanged (ANSI 150 lb)
- B. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body, with seat installed; the cover, with bearings installed; and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.
- C. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to

permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

- D. The diaphragm assembly shall contain a non-magnetic 303 stainless steel stem with sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.
- E. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.
- F. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.
- G. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment, provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one year warranty.
- H. The valve manufacturer shall be able to supply a complete line of equipment from 1 1/4" through 24" sizes and a complete selection of complementary equipment. The valve manufacturer shall also provide a computerized cavitation chart which show flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.
- I. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves 3" as standard equipment.

- J. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.
- K. A full range of spring settings shall be available in ranges of 0 to 450 psi.
- L. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

2.08 AIR RELEASE VALVE

- A. Bodies and covers shall be cast iron (ASTM A126, Class B, or ASTM A48, Class 35) or ductile iron (ASTM A536, Grade 65-45-12). Cover bolts and nuts shall be stainless steel.
- B. Valve Connections: Flanged-end dimensions and drilling for cast-iron bodies and covers shall conform with ASME B16.1, Class 125 or Class 250. Flanged-end dimensions and drilling for ductile-iron bodies and covers shall conform with ASME B16.42, Class 150 or Class 300. Flanges shall be flat-faced unless otherwise specified by AW. Threaded-end connections shall conform with the requirements for tapered pipe threads for general use, per ASME B1.20.1.
- C. Floats: Float balls and guides shall be stainless steel. For valves with inlet sizes less than 4 inches, the float shall be capable of withstanding a collapse pressure of 1,000 psig. For valves with inlet sizes 4 inches and larger, the float shall be capable of withstanding collapse pressures of 750 psig.
- D. Venting: Air release valves and the air release mechanism of combination valves shall be designed to open positively and vent air to the atmosphere at system pressures up to the maximum working pressure. Orifices shall be sized accordingly.

2.09 YARD HYDRANT

- A. Non-freeze yard hydrant shall be suitable for exterior installation and shall include a drainage hole at the bottom of the unit to ensure drainage of water from the hydrant assembly when not in use.
- B. Hydrant shall be suitable for use with potable water.
- C. Hydrant shall have the following characteristics:
  - 1. Inlet: 3/4" brass valve body, FPT.
  - 2. Casing: 1" galvanized steel pipe.
  - 3. Operating Rod: 1/4" stainless steel rod.
  - 4. Head/Lever: Epoxy coated heavy duty cast iron head with a cam-type operating control lever for full or variable flow and a one piece plunger. Lever shall be lockable.
  - 5. Outlet: 3/4" brass male hose connection
- D. Acceptable Manufacturers: Josam Co., 71450 Series, Watts HY-800, or equal.

2.10 RECLAIMED WATER METER

- A. Reclaimed Water Meter (5/8" through 1")
  - 1. Meter shall consist of a solid state, battery operated electromagnetic flow measurement system with hermetically sealed, glass covered, electronic register with a programmable 9-digit display. Meter shall conform to AWWA C-700 and

C-710 and be NSF/ANSI Standard 61, Annex F and G compliant.

2. The register shall be an electronic device encapsulated in glass with 9 programmable digits utilizing a liquid crystal display (LCD). The display shall contain indicators for flow direction, empty pipe, battery life and unit of measurement. The register shall be hermetically sealed with a heat tempered glass cover and be tampering resistant. The register shall not be removable from the measuring sensor. It shall utilize magnetic coupling technology to connect to a touch read, radio read or fixed base meter reading system in either a an inside or pit set installation.
3. The measuring element shall be made of a non-corrosive, lead-free glass fiber reinforced, composite alloy. A battery powered magnetic flow sensor utilizing silver/silver chloride electrodes shall be used to measure the velocity of the water. The measuring element shall have not moving parts.
4. The register and measuring element shall be an integrated unit housed within a thermal plastic external casing. This integrated unit shall not be removable from the external housing. The housing shall contain the water flow direction and size.
5. Meter systems shall operate up to a working pressure of 200 psi, without leakage or damage to the components. The accuracy shall not be affected by variation of pressure up to the maximum working pressure.

**B. Reclaimed Water Meter (1-1/2" and Larger): Turbine Type**

1. Meter shall be a turbine-type cold water meter suitable for measurement of low flow usage for typical billing purposes.
2. Meter package shall meet or exceed all requirements of ANSI/AWWA C701 for Class II turbine meter assemblies. Each meter shall be performance tested to ensure compliance.
3. Meter package shall meet or exceed all requirements of NSF/ANSI 61, Annex F and G.
4. The main case shall be epoxy coated ductile iron. Epoxy coating shall be fusion-bonded and adhere to NSF for non-lead.
5. The meter assembly shall be capable of continuous operation up to the rated maximum flows without long-term accuracy impacts and without causing undue component wear. The meter assembly shall provide a 25% flow capacity in excess of the maximum flows listed for intermittent flow demands.
6. The measuring chamber shall consist of a measuring element, removable housing, and an all-electronic register. The measuring element shall be mounted on a horizontal, stationary stainless steel shaft with sleeve bearings and be essentially weightless in water. The measuring element shall come integrate with the advanced Floating Ball Technology design.
7. The meter shall be equipped with a direct magnetic drive system, occurring between the motion of the measuring element blade position and the electronic register.
8. The meter's register shall be all-electronic without mechanical gearing and

include the following features:

- a. AMR resolution units fully programmable
- b. Pulse output frequency fully programmable
- c. Integral data logging
- d. Integral resettable accuracy testing feature
- e. Large, easy-to-read LCD display
- f. 10-year battery life guarantee

- 9. Meter assembly shall operate properly without leakage, damage, or malfunction up to 200 psi.
- 10. A meter strainer shall be integral and cast as part of the meter's maincase. The strainer screen shall have a minimum net open area of at least two (2) times the pipe opening and be a V-shaped configuration. The strainer body shall be of the same material and contain the same coating as the maincase. All fasteners shall be stainless steel.
- 11. A straightening vane assembly shall be positioned directly upstream of the measuring element and be an integral component of the measuring chamber.

C. Reclaimed Water Meter (1-1/2" and Larger): Electromagnetic Type

- 1. Electromagnetic type meters shall meet or exceed the requirements of AWWA C701, Class 11 and conform to NSF/ANSI Standard 61, Annex F and G. Each meter shall be performance tested to ensure accuracy compliance.
- 2. The meter shall have no restrictions as to sustained flow rates within its continuous operating range. The measuring tube shall allow for flows up to the meters rated maximum capacity without undue wear and accuracy degradation.
- 3. The metering tube shall consist of a polyurethane coated steel housing and a nonmagnetic alloy tube with an obstruction-less cross section and a homogenous magnetic field. The liner of the measuring tube shall be made of polyamide and shall be resistant to corrosion, aging and abrasion.
- 4. Provide an electronic register either attached to the meter or remotely mounted as directed by the Authority for the specific project application. The large character LCD shall display AMR, tantalization and a resettable test totalizer. Features shall include AMR resolution units that are fully programmable, pulse output units that are fully programmable, integral resettable accuracy testing, and flow direction. Register shall be cable of more than 10 years of operation before battery replacement.

D. Radio Read Unit

- 1. Each meter shall be equipped with a radio transmitter. Transmitter shall function to transmit an encoded serial number, water consumption, leak detection information and status data via radio frequency to the Authority's radio reading equipment.
- 2. The transmitter shall be unaffected by prolonged submergence under water or operation in a cyclical high humidity (100% relative humidity in temperature ranges of 32 °F to 105 °F) condensing atmosphere.

3. Transmitters shall be factory sealed and waterproof as supplied by the manufacturer.
4. Transmitters shall have a typical minimum reading range of up to 1,200 feet.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Carefully examine each piece of equipment with the inspection requirements of the appropriate referenced standard. No piece of equipment shall be installed which is known to be cracked, damaged, or otherwise defective.
- B. If any defective pieces are discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his expense.

#### **3.02 PREPARATION**

- A. Clean equipment and mating surfaces before installation. Maintain clean until completed work is accepted.

#### **3.03 SERVICE LINE AND FITTINGS**

- A. Install reclaimed water service lines in accordance with detail. Unless otherwise approved, all water lines shall be installed at a minimum depth of 4 feet of cover over the top of the pipe.
- B. Clean and inspect each pipe and part of the fitting before installing and assemble to provide a flexible joint. Use joints or lubricants recommended by the manufacturers.
- C. Operate each valve before and after installation.
- D. When the work is not in progress and at the end of each work day, securely plug the ends of pipe and fittings to prevent any dirt or foreign substances from entering the lines.
- E. Test and disinfect lines as specified in Division 33.
- F. Provide concrete thrust blocking or restrained joints at all bends, tees and changes in direction.

#### **3.05 VALVES**

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under these Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe.
- B. All valves shall be tested at the operating pressures at which the particular line will be used.



- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.
- E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Backfill material shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

#### 3.06 FIELD QUALITY CONTROL AND TESTING

- A. As specified in Division 33.

#### 3.07 DISINFECTION

- A. As specified in Division 33.

#### 3.08 GRADE ADJUSTMENT

- A. Contractor shall adjust all valve covers, valve boxes and other piping accessories to meet the grade specified in the Contract Drawings.

**END OF SECTION**

**DIVISION 33 - UTILITIES**  
**SECTION 33 13 00 - DISINFECTION OF RECLAIMED WATER UTILITY DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. This Section Includes:
  - 1. Provisions for Disinfection of Reclaimed Water Utility Distribution Piping
- B. Related Work:
  - 1. Section 33 11 00 – Reclaimed Water Utility Distribution Piping
  - 2. Section 33 08 10 – Testing of Reclaimed Water Utility Distribution

**1.02 REFERENCES**

- 1. American Water Works Association
  - a. AWWA B300, Standard for Hypochlorites.
  - b. AWWA B301, Standard for Liquid Chlorine.
  - c. AWWA C651, Disinfecting Water Mains.
  - d. AWWA Manual M12, Simplified Procedure for Water Examination.

**1.03 SUBMITTALS**

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Product Data: Submit procedures, proposed chemicals, number of samples, and treatment levels.
- C. Test Reports: Bacteriological test results
- D. Certificate: Certify that reclaimed water distribution system meets or exceeds specified requirements.

**1.04 QUALITY ASSURANCE**

- A. Bacteriological Tests:
  - 1. See AWWA Standard C651, Sections 7 and 8.
    - a. Number of Samples Required: Two samples or as directed by the Owner.

**1.04 DELIVERY, STORAGE AND HANDLING**

- A. Transport, handle and store disinfection products specified in a manner recommended by the respective manufacturer to prevent contamination and deterioration of products.
- B. When handling disinfection products, due caution is advised. Comply with safety precautions identified in Material Safety Data Sheets.

1.05 JOB CONDITIONS

A. Environmental Requirements:

1. Testing and disinfection of water mains is not to be performed if the air temperature is expected to fall below 35° F or as directed by the Authority.
2. Keep interior of pipe clean. Close open end of pipe with a watertight plug anytime pipe laying is not in progress.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Hypochlorites: AWWA Standard B300.
- B. Liquid Chlorine: AWWA Standard B301.

**PART 3 - EXECUTION**

3.01 DISINFECTION

- A. General: Before being placed in service, all reclaimed water pipe installed shall be disinfected by chlorination. Disinfection shall be accomplished after the pipe has been flushed and passed hydrostatic testing.
- B. Form of Chlorine for Disinfection: Either of the following methods may be followed upon approval of the Authority.
  1. Liquid chlorine: Prepare a 1% hypochlorite solution from a stock hypochlorite solution. Ten gallons of a 1% hypochlorite solution can be prepared by mixing 0.8 gallons of a 12.5% hypochlorite solution with 9.2 gallons of water.
  2. Calcium Hypochlorite Solution: Prepare a chlorine-water solution of 1 percent (1%) available chlorine using granular calcium hypochlorite, and this solution shall be injected or pumped into the pipeline. A chlorine-water solution of 1 percent available chlorine may be prepared by mixing approximately one (1) pound of calcium hypochlorite with eight (8) gallons of water.
- C. Preparation:
  1. Preliminary Flushing: Prior to disinfection, flush the section of pipeline being disinfected as thoroughly as possible with the water pressure and outlets available.
  2. Flush after the pressure and leakage tests have been completed.
- D. Disinfection:
  1. Apply the hypochlorite solution to the water main with a chemical feed pump. For small applications, the solution may be prepared in a barrel, and then pumped into the main with a hand pump, such as a hydraulic test pump. Apply at a dosage rate such that the chlorine concentration in the water in the pipe is a minimum of 25-mg/l free chlorine. The following table gives the amount of calcium hypochlorite and the quantity of one percent (1%) hypochlorite solution required to produce a 25 mg/l

DIVISION 33 – UTILITIES

SECTION 33 13 00 – DISINFECTION OF RECLAIMED WATER UTILITY DISTRIBUTION

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chlorine concentrate in 100 feet of pipe.

CALCIUM HYPOCHLORITE AND CHLORINE SOLUTION REQUIRED TO PRODUCE 25 MG/L CONCENTRATION IN 100 FEET OF PIPE						
Pipe Size Inches	Volume in Cu. Ft.	100-ft. Lbs.	Section Gals.	Amount of Calcium Hypochlorite		1% Chlorine Solution Gallons
				Ounces	Pounds	
6	19.65	1,227	147	3/4	0.046	0.36
8	34.90	2,178	261	1-3/8	0.083	0.65
10	54.28	3,388	406	2-1/8	0.131	1.02
12	78.48	4,899	587	3-0	0.185	1.44
16	139.98	8,738	1,047	5-3/8	0.334	2.60
20	218.06	13,611	1,631	7-3/4	0.486	4.08
24	314.16	19,603	2,350	11-5/32	0.698	5.88
36	706.86	44,108	5,287	25-1/8	1.570	13.23

FEET OF PIPE IN WHICH 1 OUNCE OF CALCIUM HYPOCHLORITE WILL PRODUCE 25 MG/L AVAILABLE CHLORINE							
$\frac{6"}{144}$	$\frac{8"}{79}$	$\frac{10"}{51}$	$\frac{12"}{36}$	$\frac{16"}{20}$	$\frac{20"}{13}$	$\frac{24"}{9}$	$\frac{36"}{4}$

2. Apply the chlorinating agent at the high end of the pipeline section being chlorinated.
3. Pump the chlorine solution slowly into the new pipeline. Chlorine application shall not cease until the entire main is filled with chlorine solution. Measure the chlorine residual at several points along the section of main being disinfected to assure that the proper dosage and distribution of the chlorine solution is obtained.
4. If applicable, exercise great care in manipulating valves so that the strong chlorine solution in the line being treated will not flow back into the adjoining water distribution system.
5. Retain the chlorinated water in the main for at least 24 hours. All valves and hydrants in the section shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10-mg/l free chlorine.

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6. The chlorine solution shall be thoroughly flushed out prior to placing the new sections of pipe in service. The replacement water throughout the pipeline shall be proven comparable to the quality of water in the existing distribution system.
  7. At no time will valves on the water distribution system be operated without the presence of a duly qualified representative of the Authority.
  8. Discharge the chlorine solution from the water main through available outlets or provide temporary ports for. Inspect the area of the discharge point thoroughly before discharging the chlorine bearing water, since it is extremely toxic and, if allowed to flow into streams, can readily destroy aquatic life.
  9. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life. If the possibility of damage of aquatic life is such that special precautions are required, dechlorinate the disinfecting solution before it goes to waste. The chlorine solution may be neutralized by applying sodium thiosulfate in the ratio of two-(2) parts thiosulfate to one (1) part chlorine at the point of discharge.
- E. After final flushing and before each treated water main is placed in service, collect a sample or samples from the end of the line. Test the sample or samples for bacteriological quality in accordance with Standard Methods to show the absence of coliform organisms. Take samples of water that has stood in the main for at least 16 hours after final flushing has been completed. Collect and analyze at least one sample per 1,000 linear feet of new line.
- F. If the initial disinfection fails to produce satisfactory bacteriological samples, the main shall be re-flushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be re-chlorinated as specified hereinbefore.

**END OF SECTION**

**DIVISION 33 – UTILITIES**  
**SECTION 33 31 00 – SANITARY UTILITY SEWERAGE PIPING AND ACCESSORIES**

**PART 1 – GENERAL**

1.01 SECTION INCLUDES

- A. Force main sanitary sewer pipe, fittings, and related appurtenances.
- B. Gravity sanitary sewer pipe, fittings, and related appurtenances.

1.02 RELATED SECTIONS

- A. Section 31 23 33 – Trenching and Backfilling for Utilities.

1.03 REFERENCES

- A. American Society for Testing and Materials:
  - 1. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 2. ASTM A312/A312M – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - 3. ASTM A536 – Standard Specification for Ductile Iron Castings.
  - 4. ASTM A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
  - 5. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 6. ASTM C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 7. ASTM C828 – Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
  - 8. ASTM C 1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems
  - 9. ASTM D714 – Standard Test Method for Evaluating Degree of Blistering of Paints.
  - 10. ASTM D1784 – Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
  - 11. ASTM D2321 – Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
  - 12. ASTM D2412 – Standard Test Method for Determination of External Loading

Characteristics of a Plastic Pipe by Parallel- Plate Loading.

13. ASTM D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
14. ASTM D2683-10 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
15. ASTM D3034 – Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
16. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
17. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
18. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
19. ASTM D3261-10a – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
20. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
21. ASTM D 5926 – Standard Specification for Poly Vinyl Chloride (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems.
22. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
24. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
25. ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
26. ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.
27. ASTM F2206 – Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock.
28. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
29. ASTM G95 – Standard Test Method for Cathodic Disbondment Test of Pipeline

Coatings (Attached Cell Method).

B. American Nation Standard Institute:

1. ANSI/ASME B16.50 – Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings.
2. ANSI B18.2 – Square & Hexagon Bolts & Nuts.

C. American Water Works Association:

1. ANSI/AWWA C104/A21.4 – Cement Mortar Lining for Ductile-Iron.
2. ANSI/AWWA C105/A21.5-10 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. ANSI/AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
4. ANSI/AWWA C111/A21.11 – Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
5. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C116 – Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron.
7. ANSI/AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast.
8. AWWA C153 – Ductile-Iron Compact Fittings for Water Service.
9. AWWA C213 – Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
10. AWWA C517 – Standard for Resilient-Seated Cast-Iron Eccentric Plug Valves.
11. ANSI/AWWA C905-10 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in.

1.04 SYSTEM DESCRIPTION

- A. All pipe shall be installed with 4'-0" of cover.
- B. Termination of main sewer shall be in a manhole.
- C. Provide minimum of 10'-0" separation between mainlines and structures.
- D. Mainlines shall not be installed in areas with fill greater than 5 ft.
- E. Where a sewer line crosses over or under another pipe, provide a minimum separation of



eighteen (18) inches for pressurized lines and twelve (12) inches for gravity conveyance lines.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping, fittings and other appurtenances specified herein.
- C. For force main sanitary sewers, submit design calculations sealed by a licensed Professional Engineer in the State of Pennsylvania for concrete thrust blocks. Where mechanical joint restraints are to be used, submit restraint lengths with supporting calculations.
- D. Certificates:
  - 1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
  - 2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.06 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Use only one type and class of pipe in any continuous line of sewer between structures, unless otherwise approved in writing by the Authority.
  - 2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.
  - 3. Use pipe and fittings designed to withstand project specific internal operating pressures and potential surge rises.
- B. Source Quality Control:
  - 1. Perform hydrostatic and leakage shop tests on all pipe and fittings in accordance with applicable AWWA Standards.
  - 2. Shop Tests: Each pipe manufacturer must have facilities to perform listed tests. The Authority and/or its Engineer reserves the right to require the manufacturer to perform such additional number of tests as deemed necessary to establish the quality of the material offered for use.
  - 3. Laboratory Tests: The Authority and/or its Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for

collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory. Costs for these laboratory tests shall not be the responsibility of the Authority.

4. Quality Management System shall be ISO 9001:2000 registered.

C. Field Quality Control:

1. Provide qualified workman trained and experienced in the skills required for the work identified herein.
2. Use all means necessary to protect all materials of this section before, during, and after installation and to protect all objects designated to remain. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Authority and at no additional cost to the Authority.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle piping and related products in accordance with Specifications, manufacturer's recommendations, and as supplemented herein.
- B. Pipe and related materials to be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances drop or skid such material against other products already on ground.
- C. Handle pipe and related materials at all times with care to avoid damage. Keep the pipe interior free from dirt and foreign matter. All pipe and appurtenances shall be carefully lowered or raised into place, with suitable equipment in a manner that will prevent damage to material. Do not drop or dump pipe or accessories under any circumstances.
- D. Thoroughly inspect pipe, pipe linings, fittings, valves, and all related materials for defects prior to being unloaded and again prior to being installed. Repair or replace any defective, damaged, or unsound material, as determined by the Authority and/or its Engineer, at no cost to the Authority.
- E. All lumps, blisters, and excess coating shall be removed from ends of each pipe. Joints shall be wire brushed and wiped clean and shall be dry and free from oil and grease before pipe is installed.

1.08 PROJECT/SITE CONDITIONS

- A. Safety:
  1. The Contractor shall be responsible at all times for carrying out all pipe laying operations in a safe and prudent manner to protect all workman and the public. Encountered field conditions shall determine any necessary sheeting and bracing. All applicable OSHA requirements apply.
- B. Access and Inspection:
  1. All work included in this section is subject to Inspection by the Authority or its

representative. Full access to the project shall be granted.

C. Maintenance and Protection of Traffic:

1. Contractor shall be responsible for the maintenance and protection of traffic in accordance with the requirements of the Pennsylvania Department of Transportation (PennDOT) and any applicable Highway Occupancy Permit(s). Refer to Section 01 41 00.

D. Environmental Requirements:

1. Keep trenches dewatered until initial bedding has been placed, pipe joints have been made, and initial bedding and concrete cradle and encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.
3. Do not lay pipe when weather conditions are unsuitable, as determined by the Authority and/or its Engineer, for pipe laying work.
4. The Authority reserves the right to suspend the work during inclement weather, if, in the opinion of the Authority, the safety of its field personnel is endangered or if the quality of the work itself is threatened.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Paragraph 3.08.
- C. If the work affects existing piping and appurtenances, the Contractor shall excavate test pits as required of all connections and crossings which may impact the new work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements as required to complete the work.

### **2.02 FORCE MAIN PIPE, FITTINGS AND APPURTENANCES**

A. Force Main: PVC or Ductile Iron Pipe

1. Force Main Pipe – PVC

- a. PVC sewer force main pipe shall conform to AWWA C900 Pressure Class 165 psi (DR 25), 235 psi (DR 18), 305 psi (DR 14); for sizes 4"-12" in diameter (C905 for sizes 14"-24"). Size and pressure class shall be selected based on design conditions.
  - b. PVC sewer force main pipe shall be manufactured from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 as defined by ASTM D1784.
  - c. All PVC sewer force main pipe shall be suitable for use as a pressure conduit. Provisions shall be made at each joint for expansions and contraction at each joint with an elastomeric gasket. Pipe shall be bell and spigot.
  - d. The bell shall consist of an integral thickened wall section with a factor installed, solid cross section elastomeric seal and shall be designed to be at least as hydrostatically strong as the pipe barrel and meet the requirements of AWWA C900. The wall thickness in the bell section shall conform to the requirements of Section 6.2 of ASTM D3139
  - e. Pipe shall be manufactured to cast iron outside diameters (CIOD).
  - f. The seal shall meet the requirements of ASTM F477.
  - g. Standard laying lengths shall be no longer than 20 feet for all sizes.
  - h. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory.
  - i. PVC sewer force main pipe to be manufactured in green and marked "Forced Sewer".
  - j. Thermoplastic pipe is not acceptable for use in areas where temperature variation is possible.
2. Force Main Pipe – Ductile Iron Pipe:
- a. Ductile iron pipe, for sanitary sewer force main, shall be centrifugally cast with push-in compression joints conforming to AWWA C111, not less than 12 feet nor more than 20 feet in length. Mechanical joints are acceptable. Ductile iron sewer pipe shall be Pressure Class 350 for sizes 4"-12". Pressure Class for pipe sizes 14" and greater shall be as required to meet design conditions. Ductile iron pipe shall meet the requirements of ANSI A21.51 and ANSI 21.50.
  - b. Fittings and specials for ductile iron pipe shall be made of cast iron in accordance with ANSI A21.10 and rated for 350-psi working pressure.
  - c. Lining: Ceramic epoxy lining material shall be an amine cured novalac epoxy containing at least 20% by volume ceramic quartz pigment (Protecto 401™ or equal).

- d. Coating: For buried pipe, factory coated with bituminous material, minimum 1 mil dry thickness. Bituminous material and finished coat shall conform to seal coat requirements of ANSI A21.4 and AWWA C151.
- e. All exposed (non-buried) force main ductile iron piping and fittings, including that inside wet wells and vaults, shall have flanged joints and be primed and top coated with a minimum two coats of a hi-build polyamide epoxy. Surface preparation and application shall be in accordance with the manufacturer's requirements (Tnemec Series 66 or equal). Color shall be gray.

3. Force Main Fittings – Ductile Iron Fittings:

- a. All fittings, regardless of pipe materials, shall be made of ductile iron in accordance with ASTM D536, Grade 65-45-12 and ASTM F1336. Working pressure shall be equal to or greater than the working pressure of the pipe. Wall thickness shall meet the requirements of AWWA C153. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR) in accordance with ASTM F477.
- b. Mechanical joints: Shall conform to AWWA C111. Bolts shall be high-strength, low-alloy steel per AWWA C111. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR).
- c. Flanged Joints: Shall conform to AWWA C110 and C115, Class 125. Gaskets shall be vulcanized natural or vulcanized synthetic rubber that is free of porous areas, foreign material, and visible defects. Gasket materials shall conform to AWWA C111. Factory cut gaskets shall be used. Bolts shall be black steel machine bolts with heavy hexagon heads conforming to ANSI B18.2.1. Nuts shall conform to ANSI B18.2.2. The bolts shall be tightened uniformly to distribute the bolt stress evenly and bring the pipe into alignment.
- d. Lining: Ceramic epoxy lining material shall be an amine cured novalac epoxy containing at least 20% by volume ceramic quartz pigment (Protecto 401™ or equal).
- e. Fittings Coating: For buried pipe, factory coated with bituminous material, minimum 1 mil dry thickness. Bituminous material and finished coat shall conform to seal coat requirements of ANSI A21.4 and AWWA C151.
- f. All exposed (non-buried) fittings, including those inside wet wells and vaults, shall have flanged joints and be primed and top coated with a minimum two coats of a hi-build polyamide epoxy. Surface preparation and application shall be in accordance with the manufacturer's requirements (Tnemec Series 66 or equal). Color shall be gray.

B. Force Main Thrust Restraint:

- 1. Contractor has the option of any of the means specified below. Restraint shall be provided at open cut force main (non-fused) fittings, bends, tees, changes in

direction, etc.

- a. Concrete Thrust Blocks and Tie Rods: Concrete shall be as specified in PennDOT Publication 408, Section 704 for Class A Concrete - 3,000 psi compressive strength (at 28 days). Tie rods shall be constructed of suitable metal. Metal harness of tie rods shall be galvanized or otherwise rust proofed and shall be painted with bituminous coating after installation. Contractor shall submit design calculations to support
- b. Mechanical Joint Restraint: Restraint device for nominal pipe sizes 3" through 48" shall consist of multiple gripping wedges incorporated into a follow gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The device shall have a minimum working pressure of 350 psi for sizes 3"-16" and 250 psi for sizes 18"-48", including a minimum safety factor of 2:1. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material conforming to ASTM A536. Ductile iron gripping wedges shall be heat treated within a range of 370 and 470 BHN.
- c. Restraint Harness (PVC): Restraint for PVC pipe bell (AWWA C900) shall consist of the following: The restraint shall be manufactured of ductile iron conforming to ASTM A536. The restraint devices shall be coated with a thermoset epoxy coating. A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring. The combination shall have a minimum working pressure rated to the full pressure of the pipe. The restraint shall be manufactured by EBAA Iron, Inc., or approved equal.
- d. Restraint Harness (DI): Ductile iron pipe bell restraint shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The restraint ring and its wedging components shall be made of minimum grade 65-45-12 ductile iron conforming to ASTM A536. The wedges shall be heat treated to a minimum hardness of 370 BHN. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges. The split ring shall be made of a minimum grade of 65-45-12 ductile iron conforming to ASTM A536. The restraint devices shall be coated with a thermoset epoxy. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure with a minimum two to one safety factor of 350 psi for sizes 4"-16" and 250 psi for sizes 18" and larger. The product shall be manufactured by EBAA Iron, Inc., or approved equal.

C. Swing Check Valves (3" and larger)

1. Check valves larger than 3-inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi.

2. Valve closure shall be controlled by an external weighted lever arm, the action of which is cushioned by a hydraulic oil or pneumatic cylinder. Counterweights and cushion cylinders shall be designed so that adjustments can be made in the field to minimize surge and to prevent backflow and hammering noises during actual service conditions. The pneumatic cushion system shall be completely self-contained.
3. Valve bodies, cover discs, levers, and disc arms shall be constructed of heavy cast iron or cast steel fully conforming to the latest revision of ASTM A-126 Class B or Class WCB, respectively. Valve ends shall be Standard American 125 pound flat-faced flanged, in accordance with ANSI B16.1. Each valve disc shall be suspended from a noncorrosive shaft which shall pass through a stuffing box and be connected on the outside of the valve to the cushion and counterweight mechanism.
4. Valve seating shall be rubber-to-metal designed for drop-tight shutoff. The body seat ring shall be made of bronze or stainless steel and the disc seat ring of 80 Durometer rubber. Body and disc seats shall be renewable.
5. With the exception of the valve body and seat, all parts in contact with water shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop painted with two coats of epoxy for corrosion resistance. Exterior of valves shall be manufacturer's standard finish.

D. Plug Valves:

1. Plug valves shall be non-lubricated eccentric type with flanged ends. Eccentric plug valves shall be not less than 100% port in all sizes and meet AWWA C517. Flanges to be faced and drilled ANSI 125 pound standard. Mechanical Joint valves shall fully comply with ANSI/AWWA C111/A21.11.
2. Eccentric plug valves to be provided with grease fittings in body.
3. Valve bodies of ASTM A126 Class B cast iron. Bodies in 4 inch and larger valves furnished with 1/8 inch welded overlay seat of not less than 99 percent pure nickel. Seat area to be raised, with raised surface completely covered with weld to insure that plug face contacts only nickel. Screwed-in seats not acceptable.
4. Plugs shall be of ASTM A536 ductile iron. Plug to have cylindrical seating surface eccentrically offset from center of plug shaft. Interference between plug face and body seat, with plug in closed position, to be externally adjustable in field with valve in line under pressure. Plug resilient faced with soft rubber.
5. Valves to have sleeve type metal bearings of sintered, oil impregnated permanently lubricated type 316 Grade CF-8M or Type 317L stainless steel in ½ inch to 36 inch sizes. Non-metallic bearings not acceptable.
6. Valve shaft seals shall be of the U cup type in accordance with AWWA C-517, externally adjustable and repackable without removing bonnet from the valve.
7. Valve shall be designed and manufactured to shut off bubble tight at 175 psi for

valves through 12" and 150 psi for valves 14" and larger. Each valve shall be given a hydrostatic and seat test.

8. Interior of valves to be fluidized bed epoxy coated. Exterior of valves shall be manufacturer's standard finish.
9. Plug valves to be manual hand-wheel actuated. Valves to open left unless otherwise required.

E. Restraint Couplings

1. Joint Restraint to prevent axial separation shall be incorporated into the design of the sleeve or coupling used to connect two plain pipe ends. The restraint mechanism shall consist of a plurality of individually actuated gripping surfaces to maximize restraint capability. Torque limiting twist off nuts shall be used to insure proper actuating of the restraint devices. The restraint devices shall be coated with a thermoset epoxy. Ductile Iron components shall be of a minimum of 65-45-12 ductile iron meeting the requirements of ASTM A536 of the latest revision and shall be tested in accordance with the stated standard. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000. The restrained joining system shall be manufactured by EBAA Iron, or approved equal.

F. Flanged Coupling Adapters

1. Restrained flange adapters shall be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
2. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
3. Pressure and service shall be the same as connected piping.
4. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
5. Flanged adapters shall be provided with manufacturer's standard finished coat.
6. Bolts and nuts shall be stainless steel.
7. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.

G. Combination Valves (2" through 6")

1. Combination air valves shall be heavy-duty "Universal" style single body units incorporating the functions of an air and vacuum valve with an air release valve in a single housing.



2. Combination air valves shall release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled, and then by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Combination air valves shall also be designed to permit large volumes of air to enter the pipe-line during pipeline drainage. Valves shall be sized and located in accordance with manufacturer's recommendations.
3. The valve body and cover flange shall be cast or fabricated 316 stainless steel and shall incorporate a "sanitary clamp" to attach the flange to the body at the outlet. Valves that use traditional bolting to attach the cover flange to the body are not acceptable. The flange clamp must be located at the outlet of the body for ease of cleaning and maintenance.
4. All non-sealing internal metal components shall be 316 stainless steel.
5. The valve shall incorporate an Air Release orifice of 3/16" for use at 200 psig. This orifice shall be located in the outlet of the valve and shall be drilled in a 316 stainless steel orifice plate that seals against a Buna-N rubber seat.
6. Unit may have a maximum height of 14 inches and a maximum weight of 28 lbs.

## 2.03 GRAVITY SEWER PIPE AND FITTINGS

### A. PVC SDR-35 Pipe and Fittings:

1. Polyvinyl chloride (PVC) pipe, used for gravity sewer construction, shall meet or exceed the requirements of ASTM D3034 for sizes 6"-15" and ASTM F679 for sizes 18"-48". The pipe shall be colored green for in-ground identification as sewer pipe. All pipe shall be manufactured from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 or 12364 as defined by ASTM D1784. The PVC sewer pipe shall have a minimum standard dimension ratio (SDR) of 35 and the minimum pipe stiffness, as tested in accordance with ASTM D2412, shall be 46 psi when measured at 5 percent deflection at 738 F. Pipe shall be manufactured with integral wall bell and spigot joints in standard lengths of 14 and/or 20 feet.
2. All pipe shall be suitable for use as a gravity sewer conduit. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket which meets the requirements of ASTM F477. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly. The joint design shall meet requirements of ASTM D3212 under both pressure and 22 in. Hg vacuum. All polyvinyl chloride (PVC) pipe and fittings except lateral riser cleanout stacks shall utilize elastomeric O-ring gasketed joints assembled in accordance with the manufacturer's recommendations. Provide elastomeric gaskets that have been tested as suitable for continuous contact with domestic sewage.
3. All lateral riser components shall utilize solvent welded joints and be assembled

with the manufacturer's recommendations. Solvent Weld Sewer Fittings SDR 35 (3" -12" ) 3 through 12 injection molded solvent weld SDR 35 sewer fittings shall be manufactured in accordance with ASTM D3034. They shall be molded from virgin PVC compound having a minimum cell classification of 12454-B in accordance with, and certified by the National Sanitation Foundation (NSF), to meet ASTM D 1784. Solvent weld SDR 35 sewer fittings shall be certified by the National Sanitation Foundation (NSF) to meet ASTM D 3034.4.

4. Polyvinyl chloride wye branches, repair couplings, tees, pipe stoppers, and other fittings shall be manufactured in accordance with the same specifications and shall have the same thickness, depth of socket, and annular space as the pipe. PVC sewer fittings shall conform to ASTM D3034 specifications with a minimum wall thickness of SDR 35. PVC material shall have a cell classification of 12454 or 12364 as defined in ASTM D1784.

B. Ductile Iron (DI):

1. Ductile Iron gravity sewer pipe shall be centrifugally cast with push-on joints conforming to ASTM A746. Pipe and fittings shall have push-on joints with gaskets all conforming to AWWA C111/A21.11. Pipe and fittings shall have cement-mortar lining conforming to AWWA 104/A21.4, standard thickness.

2.04 LATERAL SEWER PIPE

- A. Lateral sewer pipes (4" or 6") that extend from the property line to the structure, in a gravity application, shall be constructed with Schedule 40 solid wall PVC pipe. All PVC Schedule 40 pipe shall be manufactured from a Type I, Grade I PVC compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665, consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory.

2.05 LOW PRESSURE SEWER PIPE PIPE AND FITTINGS

A. High Density Polyethylene - HDPE (3" and smaller):

1. Polyethylene pipe shall be made from a HDPE material having a material designation code of PE 3408/3608. The material shall meet the requirements of ASTM D3350 and shall have a minimum cell classification of PE345464C for PE 3408/3608.
2. HDPE pipe shall be rated for use at a pressure class of 160 psi. The outside diameter of the pipe shall be based upon the IPS sizing system.
3. IPS HDPE Butt and Socket Fusion Fittings:
  - a. Fittings shall be made of HDPE material with a minimum material designation code of PE 3408/3608 and with a minimum Cell Classification as noted in paragraph 2.02.A.4.a above. Butt Fusion

Fittings shall meet the requirements of ASTM D3261. Socket fittings shall meet ASTM D2683. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the Contract Drawings.

- b. Markings for molded fittings shall comply with the requirements of ASTM D3261. Fabricated fittings shall be marked in accordance with ASTM F2206.
- 4. Electrofusion Fittings: Fittings shall be made of HDPE material with a material designation code of PE 3408/3608 and with a minimum Cell Classification as noted in 2.02.A.4.a above. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F1055.
- 5. IPS Polypropylene (PP) compression fittings:
  - a. Compression fittings shall be suitable for connecting HDPE pipe, rated for a minimum working pressure of 160 psi, and manufactured in accordance with the latest revisions of ASTM D3035 and ASTM F714.

B. PVC – SDR 21

- 1. PVC pipe with integral bell and spigot joints for low pressure sewer application shall be minimum SDR 21 iron pipe size (IPS) meeting or exceeding the requirements of ASTM D1784 cell class 12454. Gaskets shall conform to ASTM F477.
- 2. The bell shall consist of an integral wall section with a factory installed, solid cross section elastomeric gasket conforming to the requirements of ASTM F477. The bell section shall be designed to be at least as hydrostatically strong as the pipe barrel and meet the requirements of ASTM D2241. The joint design shall meet the requirements of ASTM D3139, under both pressure and 22 in. Hg vacuum.
- 3. PVC-SDR 21 shall have a pressure rating of 200 psi and a minimum burst pressure of 630 psi at 73°F.
- 4. All fittings for IPS pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM D1784. Fittings shall conform to requirements of DR 21. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73°F., tested in accordance with ASTM D1599. Bell shall be gasketed joint conforming to ASTM D3139 with gaskets conforming to ASTM F477.

C. Low Pressure Thrust Restraint:

- 1. Contractor has the option of any of the means specified. Restraint shall be provided for all open cut (non-fused) fittings, bends, tees, changes in direction,

etc.

- a. Concrete Thrust Blocks and Tie Rods: Concrete shall be as specified in PennDOT Publication 408, Section 704 for Class A Concrete - 3,000 psi compressive strength (at 28 days). Tie rods shall be constructed of suitable metal. Metal harness of tie rods shall be galvanized or otherwise rust proofed and shall be painted with bituminous coating after installation.

## 2.06 PIPELINE DETECTION AND MARKING

### A. Pipeline Detection Tape for Gravity (including laterals), and Forcemain Pipe

1. Underground Warning Tape shall be installed 18-24 inches below final grade and directly above all buried piping. Tape shall be capable of being detected with inductive methods.
2. Detectable warning tap shall consist of a nominal 4.5 mil (0.0045") overall thickness, with a solid aluminum foil core. The imprinted warning message shall be encased to prevent ink rub-off and shall be impervious to acids, alkalis and other destructive soil elements.
3. Minimum width of 3"
4. Color shall be Green
5. Tape shall be clearly and permanently labeled "CAUTION: BURIED SEWER PIPELINE BELOW".

### B. Sewer Markers for Forcemain Pipe

1. Reclaimed Waterline markers shall be provided at 500 ft intervals and at all points of access to the reclaimed waterline (valves, flush mounted tracer wire posts, etc.).
2. Markers shall be highly visible 100% recyclable triangular fiberglass composite posts with 360 degree visibility. Posts shall be capable of withstanding repeated vehicle impacts up to 55 mph and snap back to the original position. Markers shall be UV stable and fade resistant.
3. Marker shall be 66 inches in total length and extend a minimum of 48 inches above finished grade after installation.
4. Markers shall be green, and be clearly and permanently labeled "WARNING FORCE MAIN SEWER PIPELINE"
5. Marker shall be installed directly above all buried piping. Install markers in accordance with the manufacturers' instructions.

### C. Test/Tracer Wire and Stations

1. Test/Tracer Wire and Stations shall be installed on all non-conductive forcemains.

2. AWG No. 12 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 1, Class C.
3. Terminate test/tracer wire in a flush mounted or above ground (pedestal) test station at 500 ft intervals. The Authority will identify the required station based on force main location. Where the flush mount station is required, install a Marker Post at each station. Station shall come standard with integral internal tracer wire access points. Tube material shall be of high grade ABS, or equivalent rigid plastic that meets or exceeds ASTM D-1788, Type 1 requirements. Lid material shall be of cast iron or ductile iron. Tensile strength or ductility of such material shall be equal or superior to hi-tensile cast iron ASTM A-126-B requirements. Lid-locking bolt material shall be made of aluminum material equal or superior to ASTM B-253. Lid-locking mechanism material shall be made of plastic to meet or exceed ASTM A-126-B requirements.
4. Test Stations shall be marked for sanitary sewer and contain a green insignia or be entirely green.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Carefully examine each section of pipe and each pipe fitting before laying on conformance with the inspection requirements of the appropriate referenced standard.
- B. Remove rejected pipe from the Project.

#### **3.02 PREPARATION**

- A. Clean piping interior and mating surfaces of bell, spigot and gasket before laying. Maintain clean until completed work is accepted.
- B. Perform trenching for sewer pipe and place pipe bedding as specified in Section 31 23 33 "Trenching and Backfilling for Utilities."
- C. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.

#### **3.03 LAYING PIPE**

- A. General Requirements for Open Cut Pipe Installation:
  1. Lay pipe with a minimum of 4'-0" cover.
  2. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade unless otherwise directed by the Authority. Lay all pressure piping with the bell end toward pump discharge.

3. The Contractor shall use care in setting lasers or the other means that he plans to utilize for construction of the sewers. If not constructed at the required grade, the Authority shall have the option of directing the Contractor to relay the pipe to the required grade at no cost to the Authority.
4. Exercise care to insure that each length abuts against the next in such a manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipeline.
5. Center spigot end in bell or socket end of previously laid pipe, shove tight and secure.
6. No wedging or blocking permitted in laying pipe unless by written order of Engineer.
7. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.
8. Walking or working on completed pipe line, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.
9. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
10. Take up and replace with new, such in-place pipe sections found to be defective. Replace at Contractor's expense.
11. Take necessary precautions to prevent newly laid pipe from floating as a result of water accumulation in the trench; or the collapse of the pipe line from any cause. Restore or replace pipe as necessary at Contractor's expense.
12. Bed pipe using materials specified in Section 31 23 33.
13. At the close of each day's work, and at such other times when pipe is not being laid, protect open end of pipe with a close fitting stopper.
14. Cut pipe using only equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Grind smooth cut ends and rough edges. Bevel slightly, cut end for push-on connections.
15. Where cutting of pipe is necessary, minimum laying length shall be five (5) feet.

B. Specific Requirements:

1. Install plastic pipe and fittings, and assemble joints according to ASTM D2321 for Class 1 bedding material.

2. Ductile Iron Pipe and Fittings – Install per AWWA 600. Pipe cutting, where necessary to field cut pipe use an approved pipe cutter, milling cutter or abrasive wheel. Pipe sections must have a minimum laying length of five (5) feet.
3. Refer to Section 31 23 33 – Trenching and Backfilling for Utilities, for backfilling requirements.
4. Pipeline detectable tape shall be installed continuously along all gravity and forcemain sewer lines. The tape shall be installed directly above each pipeline and two (2) feet from the ground surface. Tracer wire shall be installed continuously along all force main sewer lines.

C. Joints:

1. Make pipe and fittings joints according to pipe manufacturer's specifications and to specifications previously specified for pipe.
2. Make joints watertight. Immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.

D. Alignment and Grade:

1. Lay and maintain all pipe at the required lines and grades as shown on the Contract Drawings. Place fittings and valves at the required locations with joints centered, spigots forced home, and all valve stems plumb. Do not deviate from the required line and grade, except with the approval of the Engineer.
2. Deflect pipe joints where indicated on the drawings. Deflections shall not exceed pipe manufacturer's recommended maximum allowable deflection.
3. Do not change grade or alignment without Engineer's approval.

E. Drop Connections:

1. Make drop connections only as required, where drop in invert is two feet or more or as required by the Authority. Construct drop connection in accordance with the Authority's detail.

3.06 LATERALS

A Service Connection Fittings:

1. Make connections to sewer using fittings of same material and joint configuration as the sewer at the planned point of branch connection.
2. Use commercially manufactured wye fittings and one-eighth bends.
3. Set wye branches at proper vertical angles as required to bring service

connections to the proper depth.

4. Fitting locations shall be determined in the field by the Authority.

**B. Deep Cut Laterals**

1. Where elevations of main sewers and service connections are such that lateral trenching is required to be in excess of seven (7) feet, a riser connection off of the main shall be made.
2. Riser assemblies consist of a wye fitting inserted in the main sewer with an elbow for plumb. Place a six (6) inch diameter riser pipe of a length terminating at a height allowing for shallow lateral trenching. Place an elbow on the riser pipe and extend the lateral to two (2) feet inside the property line and cap.
3. Where appropriate, place a wye on top of the riser pipe and extend to the surface and properly cap for use as a clean-out. Comply with cleanout requirements
4. Bed sewer main and riser pipe to height of elbow or wye with bedding, minimum of 6" thick.

**C. Cleanouts**

1. Cleanouts shall consist of a wye, 45 degree elbow, and riser pipe placed along a sewer lateral or at the end of a main for maintenance and observation.
2. Cleanouts placed in sewer laterals shall be at minimum intervals of fifty feet for 4" diameter pipe and one hundred feet for 6" diameter pipe.
3. Riser pipes shall extend to meet finished grade, capped with an adaptor for a threaded flush plug.
4. Protect cleanout and plug as required by the Applicable detail. Refer to standard details.
5. Cleanout riser shall be of the same size and material as the lateral pipe.

**D. Building/House Connection**

1. Shall comply with all requirements of these specifications, including material, trenching, backfill, and compaction.
2. The house sewer shall be installed in a trench separate from the water service line with a minimum separation of ten (10) feet.
3. Where passing through the building wall or under a footer, the service lateral shall be cased in a steel conduit one pipe diameter larger than the lateral. The annular space between the later and the casing shall be sealed with a modular seal.



**3.06 BORING AND JACKING**

- A. Refer to Section 33 05 23 – Utility Pipe Boring and Jacking, for trenchless installation of pipe.

**3.07 THRUST RESTRAINTS**

- A. Temporary Thrust Restraint: Provide temporary thrust restraint at temporary caps or plugs. Submit details of temporary restraint to the Engineer for review.
- B. Permanent Thrust Restraint: Provide as specified.

**3.08 FIELD QUALITY CONTROL**

- A. General Requirements: Conduct tests specified herein so that each pipe line installed in the Project is tested to the Authority's satisfaction.
  - 1. Provide tools, materials (including water), apparatus and instruments necessary for pipe line testing.
  - 2. Conduct tests in the presence of and to the satisfaction of the Engineer.
- B. Alignment: After the gravity mains have been laid and backfilled, a light will be flashed between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer.
  - 1. Horizontal Alignment: Each section (manhole to manhole) of sewer shall show no less than a three-quarter (3/4) light circle throughout its length and any and all defects shall be corrected by the Contractor, to the satisfaction of the Engineer, before the work shall proceed and before acceptance of and/or payment shall be made.
  - 2. Vertical Alignment: No vertical displacement or misalignment will be accepted. The Contractor, to the satisfaction of the Engineer, shall correct all defects before the work shall proceed and before acceptance of and/or payment shall be made.
- C. Initial Section Test:

To demonstrate acceptability of installed pipe materials and workmanship, construct and air test one sewer section from manhole to manhole using the pipe provided in the Contract. Pre-testing such section prior to actual Initial Section Test not permitted.

  - 1. Conduct Initial Section Test in same manner as Line Acceptance Test specified in a following paragraph.
  - 2. Conduct said Initial Section Test for each size and type pipe material used in the Project prior to continued installation of same pipe.
  - 3. Provide pipe manufacturer's representation during laying, backfilling and testing

of Initial Sections Tests.

4. Failure of an Initial Section Test will be sufficient cause for the Engineer to reject manufacturer and supplier of pipe regardless of cause of failure.
5. Sewer sections successfully tested as Initial Section Test will be retested under Line Acceptance Test.
6. Include costs for above stated tests in unit or lump sum price or prices bid for the Work as no separate payment will be allowed for Initial Section Test.

D. Line Acceptance Test for Gravity Lines: (Leakage tests)

1. After a section of sewer is constructed between adjacent manholes, backfilled and successfully cleaned, perform a low pressure air Line Acceptance Test in accordance with ASTM C828 and the following:
  - a. Seal and brace sewer piping at upstream and downstream manholes and at all laterals. Test plug seal before actual use by testing plugs outside the trench in one length of pipe pressurized to maximum anticipated testing pressure. Plugs shall hold without bracing and show no movement. After plug is placed in pipe and sealed, brace or protect as insurance against blow out. Protect workers from potential of plug blow out.
  - b. Introduce low pressure air slowly into sealed sewer section until the internal air pressure is four psig greater than the average ground water pressure acting on the pipe, but in no case higher than 10 psig.
  - c. To determine the internal air pressure for the test, add 3.5 psig to the height in feet of the ground water above the invert of the pipe divided by 2.3. However, the test pressure should not exceed 10 psig.  
For example, if ground water height is 6.9':  $3.5 + (6.9/2.3) = 6.5$  psig
  - d. Allow no less than 3 minutes for air temperature and pressure to stabilize. Add air only to maintain required test pressure.
  - e. After the stabilization period, adjust the test pressure to the required test pressure, and disconnect the air supply. Then measure the time that is required to achieve a 1.0 psig pressure drop.
  - f. The line passes if the time required for a 1-psig pressure drop exceeds the value listed in Table 1 included at the end of this Section. Interpolate values for intermediate distances from those shown. If the time for 1 psig pressure loss is less than that reported in the table, then the line fails and shall be repaired prior to re-test.
  - g. For conditions not reflected in the Table, utilize the following equation:

$$T=0.085 * (D^3K) /Q$$

Where: T=shortest time, in seconds, allowed for the air pressure to drop 1.0 psig.  
K=0.000419D\*L, but not less than 1.0  
Q=0.0015 cubic feet/minute/square feet of internal surface  
D=nominal pipe diameter in inches  
L=Length of pipe being tested in feet

2. After laterals are installed, re-test line in accordance with the above procedure if

line is initially tested before the installation of laterals.

3. Where lines are live and carry flow, perform Joint Acceptance Test by testing one joint at a time as described in paragraph E, below.

E. Joint Acceptance Test for Gravity Lines (Leakage Tests)

1. Joint Testing Equipment Control Test: A two-part control test shall be performed to insure the accuracy, integrity, and performance capabilities of the testing equipment; testing as follows:
  - a. Demonstration Test: Prior to starting the air testing work, perform a demonstration test in the presence of the Engineer using a test cylinder, furnished by the Contractor, constructed so that a leak can be simulated. The demonstration test shall use the procedures specified in this Section.
    - 1) The purpose of the demonstration test is to establish that the air testing system is capable of meeting the specified test criteria.
    - 2) If this test cannot be performed successfully, the Contractor shall repair or otherwise modify his equipment and repeat the test until the results are satisfactory to the Engineer.
    - 3) The Engineer may require that this test be repeated at any time during the joint testing work when, in the Engineer's opinion, the testing results are suspect.
  - b. Readiness Test: Prior to commencing joint testing in each section of sewer main piping, perform a readiness test in the presence of the Engineer. Position the air testing packer on a section of sound sewer pipe between pipe joints and perform a test as specified in Paragraph 3.03 of this Section.
    - 1) The purpose of the test is to check that the piping is properly cleaned for air testing and the air testing equipment system is operating in accordance with the requirements of the Specifications.
    - 2) If this test cannot be performed successfully, the Contractor shall remove the air testing packer from the sewer section and repair or otherwise modify his equipment and repeat the test until the results are satisfactory to the Engineer.
2. Air Testing Equipment: Provide a complete air testing system specifically designed and constructed for internal air pressure tightness integrity testing of sewer piping joints. The equipment shall be constructed in such a way as to provide means for introducing air, under pressure, into the void area created by the expanded ends of the joint-testing packer and a means for continuously measuring the actual static pressure of the air within the void area only. The system shall include, but not be limited to, the following items and features:
  - a. Closed Circuit Television System per requirements of Section 33 01 31.
  - b. Packer: Open end, cylindrical casing of a size less than the pipe diameter, remote controlled for forward and backward movement within the sewer mains.
    - 1) Air-inflatable sleeves (or diaphragms) mounted at each end of the casing exterior with the ends of sleeves fastened to the casing. Devices that have sleeves which may require extreme

- pressures to “seat” against the inside periphery of the sewer main pipe are not permitted.
- 2) Regulate expansion of air-inflatable sleeves by precise pressure gauges and controls. Under no conditions will hydraulically or mechanically expanded devices be allowed.
- 3) Pass conduits leading from the surface through one end of the packer casing adapted to supply air, under pressure, to the space at the center of the casing.
- c. Compressed Air System: compressed air system shall include compressed air source, piping, valves and pressure gauges to control the rate of air flow to the packer sleeves and test section.
  - 1) To prevent loading the test section with the full pressure of the compressor, the test equipment shall be provided with an approved pressure regulating device.
- d. Test Monitoring Equipment: Provide test monitoring equipment to transmit the value of the void air pressure to a remote test pressure monitoring gauge or readout.
  - 1) Test pressure monitoring gauge or readout shall be located to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by the Engineer.
- 3. Use internal televising to observe each joint and fault and to accurately position air testing equipment in sewer piping. Televising conducted in conjunction with air testing will be considered a part of the work of air testing.
- 4. The air testing packer end elements shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the packer end elements and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the air within the void without leakage past the expanded ends.
- 5. Contractor shall then introduce pressurized air into the isolated void created by testing device. Pressure shall be applied until it is determined that the pressure cannot be built in the void or until the test pressure of  $\frac{1}{2}$  psi per foot of depth plus four (4) psi to a maximum of 10 psi is reached as recorded by the void pressure monitor. When either of these conditions is reached, Contractor shall shut off the air supply.
- 6. If the required pressure cannot be developed, joint shall have failed the test. If the required test pressure in the void was increased to  $\frac{1}{2}$  psi per foot of depth plus four (4) psi, rate of decay of this pressure shall not exceed one (1) psi in 30 seconds. The joint being tested will also have failed if the pressure drops more than one (1) psi in 30 seconds. The line shall then be repaired prior to the retest.
- 7. Test Records:
  - a. During joint acceptance testing, records shall be kept which include identification of the sewer section tested, test pressure used, location (footage) of each joint tested, a statement indicating test results (passed or failed) for each joint tested, test pressure achieved and maintained for

each joint passing air test, weekly equipment pressure test results, sewer section barrel test results, and air temperature at time of testing joints.

F. Hydrostatic Testing for Pressure Lines (Force Main and Low Pressure Sewers):

1. Leakage Test Requirements

- a. After the pipe has been installed as specified, all newly laid pipe, or any valved section thereof, shall be subjected to a pressure of 150 pounds per square inch, or 50% in excess of the normal working pressure. Engineer will provide working pressures.
- b. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
- c. All piping inside chambers, valve pits, etc. shall show no leakage.
- d. Leakage in PVC and DIP pipelines shall be acceptable when the leakage is less than the number of gallons per hour as determined by the formula,

$$L = \frac{ND \times P^{1/2}}{7400}$$

in which "L" equals the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipelines tested; "D" is the nominal diameter of the pipe, in inches, and "P" is the average test pressure during the leakage test, in pounds per square inch gauge. (the allowable leakage according to the formula is equivalent to 11.6 gallons per 24 hours per mile of pipe per inch nominal diameter, for pipe in 18' lengths evaluated on a pressure basis of 150 psi.).

- e. Duration of Test: The duration of the test under pressure shall be two hours.
- f. Procedure: Each valved section shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to Engineer. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by Contractor and approved by Engineer. Contractor will make all taps into the pipe, and furnish all necessary assistance for conducting the tests.
- g. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blowoffs are not available at high places, Contractor shall make the necessary taps at points of highest elevation before the test is made and insert the plugs after the test has been completed, at no additional cost to Owner.
- h. Should any test of pipe laid disclose leakage greater than that specified above, Contractor shall, at his own expense, locate, repair and replace the defective joints, pipe or fittings until the leakage is within the specified allowance.

G. Time for Making Test:

1. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
2. Engineer shall be present during the operating of valves required to fill mains for pressure and leakage test.
3. Contractor shall advise Engineer of any pressure test and leakage test at least 48 hours in advance. No testing will be authorized unless ambient air temperature is 35<sup>o</sup>F or higher.
4. The pressure and leakage tests shall be witnessed by Engineer.
5. Contractor shall furnish laboratory calibrated test gauges and measuring devices for the leakage test.
6. The section under test shall be brought back to test pressure at one-half hour intervals during the testing. Engineer will record both the makeup water amount and pressure at each one-half hour re-pressurization.

H. Alignment Test for Pressure Lines:

1. Prior to backfilling of pressure lines, the joint alignment shall be inspected to assure the maximum deflection present in each joint does not exceed the manufacturer's recommendations.
2. Pressure lines that are a portion of a pump discharge system shall be inspected to assure the line is installed at a constant or increasing grade so as to eliminate the possibility for air accumulation at an intermediate high point.
3. Contractor shall correct any and all defects at no additional cost to Authority and to the satisfaction of Engineer prior to backfilling. This shall be completed before the work shall proceed and before acceptance of and/or payment shall be made.

I. Acceptance: Observation of successful testing of manholes, gravity sewers, force mains, or low pressure piping by the Authority does not constitute acceptance of the system or any portion thereof. Only upon final televisual inspection by the Authority, and upon written acceptance for same, will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the manholes, sewers or force main will commence.

1. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.

TABLE 1

**MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP  
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**

1  Pipe Diameter (in.)	2  Minimum Time (min: sec)	3  Length for Minimum Time (ft)	4  Time for Longer Length (sec)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

**END OF SECTION**

**DIVISION 33 – UTILITIES  
SECTION 33 32 16 – PACKAGED SEWAGE GRINDER PUMP UNITS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. The Authority recognizes that there are many types of grinder pumps and manufacturers of packaged grinder pump units. The Authority is also aware that operation and maintenance costs of grinder pumping stations can be substantial. Therefore, the Developer shall do or cause the following element to be done:
  - 1. Whenever possible, a pressure sewer system with grinder pumping stations shall not be used.
  - 2. Prior to the design of a pressure sewer system, the Developer shall discuss the proposed system in detail with the Authority.
  - 3. Any pressure sewer system and grinder pumping station shall be of a type satisfactory to the Authority and shall meet all applicable requirements of the Pennsylvania Department of Environmental Protection (PA DEP).
  - 4. The Authority's intent is to standardize components used in pressure sewer systems and grinder pumping station applications to facilitate inventory control, equipment familiarization, and safety.
- B. Section Includes
  - 1. Wetwell/Drywell Grinder Pump Station(s) to be owned and maintained by the Authority.
- C. Grinder Pump Stations to be owned and maintained by the private property owner are encouraged to be as specified or equal.

**1.02 REFERENCES**

- A. National Electric Code - N.E.C.
- B. National Electric Safety Code.

**1.03 SYSTEM DESCRIPTION**

- A. Operating Conditions
  - 1. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valves be allowed to create a false apparent head.

**1.04 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00.



- B. Submit shop drawings/product data and pump curves from manufacturer's descriptive literature and specifications for all materials used in this Section.
- C. Specific submittals will be included with each project as may be required for testing, warranties, project manuals, etc. Provide manufacturer's Operation and Maintenance data and manuals.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site in accordance with Manufacturers recommendations.
- B. The grinder pump unit shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump unit shall be listed by Underwriters Laboratories, Inc. to be safe and appropriate for the intended use.

#### 1.06 QUALITY ASSURANCE AND MANUFACTURER

- A. Grinder pump stations, complete with all appurtenances, shall form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The Manufacturer shall provide, upon request, a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.
- B. The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. All manufacturers proposing equipment for this project shall have at least 10 years of experience in the design and manufacture of units of identical size(s) and performance to the specified units. All manufacturers proposing equipment for this project must also have not less than 500 successful installations of low pressure sewer systems utilizing grinder pumps of like type to the grinder pumps specified herein. An installation is defined as a minimum of 25 pumps discharging into a common force main which forms a low pressure sewer system.
- C. The Manufacturer of the grinder pump station shall be Environment One Corporation, Model DH071, or approved equal.

#### 1.04 WARRANTY

- A. The grinder pump Manufacturer shall provide a warranty on the complete station and accessories including, but not limited to, control panels, valves, pump components, and wetwell, for a period of twenty-four (24) months after notice of the Authority's acceptance, but no greater than 27 months after receipt of shipment. The Authority will not accept any equipment found to be defective and Manufacturer will be required to replace any defective equipment with new material. Any manufacturing defects found during the warranty period will be reported to the Manufacturer by the Authority and will be corrected by the Manufacturer at no cost to the Authority.

- B. **WARRANTY PERFORMANCE CERTIFICATION:** As a bid certification requirement, each bidder shall provide with their bid schedule a Warranty Performance Certification statement executed by the most senior executive officer of the grinder pump Manufacturer, which certifies a minimum of a 24-month warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, and certify that the Manufacturer will bear all costs to correct any original equipment deficiency for the effective period of the warranty. All preventive maintenance type requirements shall be included in this form as exclusions. These requirements include, but are not limited to, unjamming of grinder mechanism, periodic motor maintenance, and periodic cleaning of liquid level controls.

## **PART 2 - PRODUCTS**

### **2.01 PUMPS**

- A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

### **2.02 GRINDER**

- A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.
- B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.
  3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.
  4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

#### 2.03 MOTOR

- A. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds.
- B. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability.
- C. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

#### 2.04 MECHANICAL SEAL

- A. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

#### 2.05 WET WELL AND INTEGRAL ACCESSWAY

- A. Wet well shall be a custom molded high density polyethylene as supplied by Grinder Pump manufacturer. Along with the wet well, an integral access way shall be high density polyethylene of a grade selected for environmental stress cracking resistance.
- B. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250" thick (minimum). All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function

normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

- C. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. The tank capacity and dimensions shall be as follows:
  - A. Minimum Station Capacity: 70 gallons
  - B. Exterior Diameter of Wet Well: 29.5 inches
  - C. Overall Height: 91.8 inches (referenced from exterior bottom of wetwell to top of unit)
  - D. Pump Off Level: 14 inches (referenced from interior bottom of wet well)
  - E. Pump On Level: 18 inches (referenced from interior bottom of wet well)
  - F. Alarm Level: 26 inches (referenced from interior bottom of wet well)
  - G. Inlet Centerline: 36 inches (referenced from interior bottom of wet well)
  - H. Inlet Invert Depth: 55 inches (referenced from finished grade elevation)
  - I. Discharge Centerline: 42 inches (referenced from bottom of wet well)
  - J. Discharge Centerline Depth: 46 inches (referenced from finished grade elevation)
- D. The Drywell accessway shall be an integral extension of the wet well assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The accessway design and construction shall enable field adjustment of the station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- E. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.
- F. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4" Female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
- G. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 50 feet of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required.

- H. The access way on pump basins shall include a 2" PVC goose neck vent to prevent sewage gases from accumulating in the wetwell.

#### 2.06 CHECK VALVE

- A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

#### 2.07 ANTI-SIPHON VALVE

- A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices due to their tendency to clog from the solids in the slurry being pumped. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

#### 2.08 CORE UNIT

- A. The grinder pump station shall have a cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level controls, electrical quick disconnect and wiring. The core unit shall be installed in the basin by the manufacturer. Field assembly of the pump and controls into the basin is not acceptable because of potential workmanship issues and increased installation time. In some cases, stations taller than 96" may be shipped on their side without the cores assembled in the basin for freight purposes but this is the only exception. The core unit shall seal to the tank deck with a stainless steel latch assembly. The latch assembly must be actuated utilizing a single quick release mechanism requiring no more than a half turn of a wrench. The watertight integrity of each core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

#### 2.09 CONTROLS

- A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating the motor starting controls in a plastic enclosure is not acceptable. The wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. The level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. The level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. The level sensing housing

must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

- B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.
- C. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

#### 2.10 ALARM/DISCONNECT PANEL

- A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 12.5" W x 16" H x 7.5" D.
- B. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp, single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
- C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:
  - 1. When liquid level in the sewage wet-well rises above the alarm level, the contacts on the alarm pressure switch activate, audible and visual alarms are activated, and the redundant pump starting system is energized.

- 2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
- 3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the “off” setting of the alarm pressure switch.
- D. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
- E. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

#### 2.11 SERVICEABILITY

- A. The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

#### 2.12 SAFETY

- A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc. to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

#### 2.13 SPARE PARTS

- A. Contractor shall supply the following spare parts as part of the work:
  - 1. One (1) pump core unit, complete with operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit and grinder.
  - 2. One (1) complete Alarm/Disconnect Panel.

### PART 3 - EXECUTION

#### 3.01 FACTORY TEST

- A. Each grinder pump shall be submerged and operated for 1.5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve. Additional validation tests include: integral level control performance, continuity to ground and acoustic tests of the rotating components.

### 3.02 INSTALLATION

- A. Each grinder pump unit shall be installed in accordance with the Manufacturer's instructions. Installation shall include all internal and external piping, concrete anchoring (as required), connection of electrical components and incidentals.

### 3.03 COMMISSIONING AND ACCEPTANCE TESTING

- A. The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the installation, placement and wiring of each station, perform field tests as specified herein, and instruct the Authority's personnel in the operation and maintenance of the equipment before the stations are accepted by the Authority.
- B. **Commissioning Period:** Manufacturer's technicians shall inspect the installation of each grinder pump unit to render an opinion as to if the grinder pump unit was installed in accordance with the Manufacturer's instructions. Technician shall provide written confirmation to the Authority for each grinder pump unit that states that the grinder pump unit appears to have been installed correctly and is ready for operation. If the grinder pump unit is not found by the Technician to be ready for operation, the Technician shall provide a written detailed description of issues that need to be resolved. Commissioning Period shall be considered complete after the Technician has provided their written opinion on the acceptability of the installation of each grinder pump unit. Manufacturer's technician(s) shall provide a minimum of one (1) hour in the field per grinder pump unit in order to complete commissioning activities.
- C. **Acceptance Testing:** Manufacturer's technicians shall perform the required tests on each grinder pump station. Manufacturer's technician(s) shall provide a minimum of one (1) hour in the field per grinder pump station in order to complete acceptance testing activities. Acceptance Testing activities shall be performed on a separate site visit than the commissioning activities.
  - 1. All equipment and materials necessary to perform testing shall be the responsibility of the INSTALLING CONTRACTOR. This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.
  - 2. Upon completion of the installation and commissioning activities, the authorized factory technician(s) will perform the following test on each station:
    - a. Make certain the discharge shut-off valve in the station is fully open.



- b. Turn ON the alarm power circuit and verify the alarm is functioning properly.
  - c. Turn ON the pump power circuit. Initiate the pump operation to verify automatic “on/off” controls are operative. The pump should immediately turn ON.
  - d. Consult the Manufacturer’s Service Manual for detailed start-up procedures.
3. Upon successful completion of the acceptance testing, the Manufacturer shall submit to the Authority a start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

#### 3.04 OPERATION MANUALS

- A. Manufacturer shall provide a separate Operation and Maintenance Manual to the Authority for each unit provided.

**END OF SECTION**

**DIVISION 33 – UTILITIES**  
**SECTION 33 39 13 – SANITARY UTILITY SEWERAGE MANHOLES, FRAMES AND COVERS**

**PART 1 – GENERAL**

1.01 SUMMARY

- A. Section Includes
  - 1. Sanitary Sewer Manholes
  - 2. Sanitary Sewer Manhole Frames and Covers
  - 3. Cleanout Frames and Covers
  - 4. Sanitary Sewer Manhole Accessories
  - 5. Connections to Existing Infrastructure
  - 6. Manhole Cover Adjustment

1.02 REFERENCES

- A. American Society for Testing and Materials.
  - 1. ASTM A48, Gray Iron Castings.
  - 2. ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes.
  - 3. ASTM A307, Carbon Steel Externally Threaded Standard Fasteners.
  - 4. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 5. ASTM C270, Mortar for Unit Masonry.
  - 6. ASTM C361, Reinforced Concrete Low-Head Pressure Pipe.
  - 7. ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - 8. ASTM C478, Precast Reinforced Concrete Manhole Sections.
  - 9. ASTM C923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
  - 10. ASTM D2146, Polypropylene Plastic Molding and Extrusion Materials.
  - 11. ASTM D2240, Rubber Property-Durometer Hardness, Test Method.

- B. American Association of State Highway and Transportation Officials (AASHTO) Standards as referenced throughout these Specifications.
- C. American Water Works Association:
  - 1. AWWA C 302, AWWA Standard for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed.
- D. Federal Specifications:
  - 1. Federal Specification SS-S-210A, Sealing Compound, Preformed Plastic, for. Expansion Joints and Pipe Joints (Type 1 Rope Form).
- E. PennDOT Publication 408, latest edition.
- F. PennDOT Publication 72 – Standards for Roadway Construction (RC's), latest edition, as referenced throughout these Specifications.

1.03 SYSTEM DESCRIPTION

- A. Concrete Compressive Strength (ASTM C39): 5,000 psi minimum at 28 days.
- B. Water Resistant: No water intrusion through wall, base or top sections.
- C. Concrete shall be designed to be resistant to sulfate.
- D. Manhole inside diameter shall be based on the quantity, size and configuration of inlet and outlet sewers. Minimum inside diameter shall be forty-eight (48) inches.
- E. Top section opening shall be thirty (30) inches and contain four (4) anchoring devices, equally spaced to receive  $\frac{3}{4}$  inch frame anchor bolts. Coordinate with frame pattern.
- F. Design standard precast concrete units to withstand design load conditions in accordance with applicable industry standards. Design must consider stressed induced during handling, shipping, and installation to avoid cracking or other handling damage.
- G. Exterior of all manholes to receive two coats of a high build coal tar epoxy.
- H. Force Main Discharge Manholes: Manholes directly receiving pumped flow shall be lined with an HDPE liner.
- I. Watertight manhole frames and covers shall be required where cover submergence is possible or where directed by the Authority.
- J. All manholes and frames and covers shall be designed to withstand H-20 AASHTO loading.
- K. Manholes greater than 20' deep shall be 5'-0" (or greater) in diameter and contain intermediate platforms. Maximum distance between platforms shall be 15' vertically (minimum distance shall be 10' vertically).

1.04 SUBMITTALS

- A. Comply with Section 01 33 00.

- B. Product Data:
  - 1. Manufacturer's data
  - 2. Manufacturer's standard storage, handling, and installation instructions
- C. Shop Drawings:
  - 1. Plans, elevations, sections, and details of base, wall and top components.
  - 2. Project manhole list including all applicable data not limited to base elevation, in and out pipe size, in and out invert elevations, manhole wall and top section data, height of grade adjustment required/proposed, top of casting elevation.
  - 2. Where manholes do not strictly conform to applicable details, provide manhole specific detailed drawings,
  - 3. Joint details illustrating sealant.
  - 4. Pipe penetration details illustrating size, location and type of seal.
  - 5. Manhole frame anchorage bolt pattern layout.
- D. Calculations: Submit calculations for manholes required to be larger than 48 inches inside diameter. Calculations shall be sealed by a Professional Engineer registered with the Pennsylvania State Registration Board and shall include.
  - 1. Buoyancy calculations assuming ground water elevation is equal to the top of concrete elevation provided on the Contract Drawings.
  - 2. Structural calculations.
- E. Quality Assurance/Control Submittals
  - 1. Design date
  - 2. Test Reports
    - a. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
    - b. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete.
    - c. Concrete Testing
      - i. Slump: A slump test shall be performed at least once per day per mix design used. Slump tests shall be performed in accordance with ASTM C 1611 for self-consolidating concrete.

- ii. Temperature: The temperature of fresh concrete shall be measured each time a slump, air content, or compressive strength tests are made. Temperature shall be measured in accordance with ASTM C 1064.
- ii. Compressive Strength: At least four compressive strength specimens shall be made each day for each mix design unless otherwise specified. In accordance with ASTM C 31, C 39, C 192.

3. Qualification Statements

- a. Upon request, the precast concrete producer shall supply copies of in-plant QA/QC inspection reports.

1.05 QUALITY ASSURANCE

- A. Initial Sanitary Sewer Manholes: Construct first sanitary sewer manholes in the Project to demonstrate the following, and serve as the minimum acceptable conditions of construction throughout the Project. No additional compensation allowed for initial manhole requirement.
  - 1. Demonstrate manhole base construction methods.
  - 2. Demonstrate manhole component sealing in the case of precast reinforced concrete manholes.
  - 3. Demonstrate manhole step alignment.
  - 4. Demonstrate pipe opening sealing.
  - 5. Demonstrate method of adjustment of manhole frame and cover to grade and manhole frame and cover attachment.
- B. Shop Inspection:
  - 1. All materials furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.
- C. Field Inspection:
  - 1. All materials furnished shall be tested for defects in material and/or workmanship in the manner specified and in the presence of and as approved by the Authority.
- D. Source Quality Control:
  - 1. Precast concrete unit manufacturer shall be listed in PennDOT Bulletin 15.
  - 2. Precast concrete supplier plant shall be registered and certified under either the Prestressed Concrete Institute (PCI) or the National Precast Concrete Association (NPCA) plant certification program.
  - 3. Maintain uniform quality of products and component compatibility by using the products of one manufacturer in the case of precast reinforced concrete structures.

4. Obtain certificate of construction compliance with ASTM C478 from the precast reinforced concrete structure manufacturer.
5. Obtain sworn certification from manufacturer that sanitary sewer manholes were constructed using Type II Portland cement. No payment for sanitary sewer manholes will be approved until such certificate has been submitted.
6. Obtain certificate of material compliance with ASTM A48, Class 30 tensile strength from the manhole frame and cover manufacturer. Furnish certification that tensile test bars were from same pour as castings.
7. Obtain certification from manufacturer that manhole frame and cover meets or exceeds AASHTO HS-20 highway loading requirements.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport and handle precast reinforced concrete structure components and other Products specified herein in a manner recommended by the respective manufacturer to prevent damage. Through-wall lifting holes and cast-in lifting cables are not permitted in manhole component construction.
- B. Store precast reinforced concrete structure components in accordance with manufacturer's recommendations to prevent joint damage and contamination. Exercise care in storage of other specified Products as recommended by the respective manufacturer.

1.06 PROJECT/SITE CONDITIONS

- A. Access and Inspection:
  1. All work in this section is subject to inspection by the Authority or its representative. Inspectors shall be granted full access to the project site.
- B. Environmental Requirements:
  1. In no instance set or construct manhole on subgrade containing frost.
  2. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70° F or artificially warm compound in a manner satisfactory to the Engineer.

**PART 2 – PRODUCTS**

2.01 PRECAST REINFORCED CONCRETE SANITARY SEWER MANHOLE COMPONENTS

- A. Materials and Construction:
  1. Concrete: Composition conforming to ASTM C478, with minimum compressive strength as specified.

- a. Provide Type II sulfate resistant Portland cement in sanitary sewer precast manhole and force main valve vault components.
  2. Reinforcing bars in accordance with ASTM A615 Grade 60.
  3. Casting and Curing: Wet cast and steam curing process in accordance with Section 3.6.11 and 3.7.2 of AWWA C302.
  4. Joints between manhole components/sections shall be precast tongue and groove design to incorporate a mastic seal.
- B. Precast Riser Sections:
1. Riser sections shall be manufactured in conformance with the requirements of ASTM C-478. Riser sections shall have a minimum wall thickness in accordance with applicable details and design requirements.
- C. Precast Concrete Bases:
1. All manhole bases shall be pre-cast unless otherwise agreed to in writing by the Authority. Contractor shall submit a written request for deviation from this requirement with justification for why a pre-cast base cannot be used.
  2. Precast bases shall be constructed in accordance with ASTM C-478.
  3. Precast bases shall have factor installed pipe openings with integrally cast pipe seals.
- D. Precast Top Sections:
1. Top sections shall be manufactured in conformance with the requirements of ASTM C-478.
  2. Hold Down Bolt Inserts: Factory cast in top section no less than two 3/4-inch threaded inserts or slotted inserts to accommodate manhole frame hold down bolts. Threaded inserts of 3-inches depth. Both insert types designed for an ultimate load in tension of 12,500 pounds. Inserts factory plugged for shipping. Coordinate insert location with manhole component manufacturer to assure proper location in top sections.
  3. Flat Slab Tops: Flat slab tops shall have a minimum thickness of six (6) inches and shall be reinforced with steel in accordance with the design requirements.
  4. Eccentric Cone Tops: Manufactured to same minimum wall thickness and with same area of circumferential steel reinforcement as riser sections.
- E. Invert Channels:
1. Invert channels can be precast or field poured. If field poured, refer to Part 3.

2. Precast invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the outside of the adjacent sewer section. Changes in direction of the sewer and entering branches shall have a true curve of as large a radius as constructible based on the manhole inside diameter. Slope channel in accordance with applicable details. Allow for 6 inches of pipe insertion into the manhole. Field apply hydraulic cement around pipe in accordance with applicable detail.

F. Manufacturers:

1. Refer to Appendix A – List of Acceptable Manufacturers

2.02 MANHOLE FRAME AND COVER

A. Standard Manhole Frame and Cover:

1. Castings for manhole frames and covers shall be gray iron conforming to ASTM A48, Class No. 30, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
  - a. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Entire frame and cover shall be sandblasted clean and then coated with one coat of asphaltum paint.
  - b. Cast the letters "SANITARY" integrally in the center of cover in raised letters.
  - c. Covers shall contain two non-penetrating pick holes.  
Frame Hold-down Bolts:  $\frac{3}{4}$ " diameter Type 316 stainless steel bolts and washers.

B. Watertight Manhole Frame and Cover

1. Castings for manhole frames and covers shall be gray iron conforming to ASTM A48, designed for AASHTO Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
  - a. Finish: Bearing surfaces machined to prevent rocking and rattling under traffic. Entire frame and cover shall be sandblasted clean and then coated with one coat of asphaltum paint.
  - b. Cast the letters "SANITARY SEWER" integrally in the center of cover in raised letters.
  - c. Covers shall contain two non-penetrating pick holes.  
Frame Hold-down Bolts:  $\frac{3}{4}$ " diameter Type 316 stainless steel bolts and washers.
  - d. Cover Gasket: One piece gasket factory installed in a machined rectangular or dovetail groove in the cover bearing surface.
    - 1) Gasket material of neoprene composition having good abrasion resistance, low compression set, Type D 40 durometer hardness



determine in accordance with ASTM D 2240 and suite for use in sanitary and storm sewer manholes.

- e. Castings shall be drilled and tapped with stainless steel hold-down bolts.

C. Manufacturers (consult with the Authority for updated model information):

- 1. Refer to Appendix A

## 2.03 CLEANOUT FRAME AND COVER

A. Sanitary Sewer Cleanout Frame and Cover

- 1. Castings for cleanout frames and covers shall be gray iron conforming to ASTM A48 Class 35 designed for load requirements specified in AASHTO M-306 and Highway Loading Class H-20. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects.
- 2. Sized appropriate to accommodate size of cleanout riser pipe.
- 3. Cover shall be marked "SEWER"

B. Manufacturers:

- 1. Vestal Manufacturing Enterprises, Inc.: Model No. LH-10
- 2. Bingham & Taylor: Lamphole
- 3. Or Equal with Authority Approval

## 2.04 ACCESSORIES

A. Reinforced Plastic Manhole Steps

- 1. Composed of a 0.5 inch Grade 60, ASTM A615 deformed steel reinforcing bar completely encapsulated a polypropylene copolymer compound conforming to ASTM D4101.
- 2. Manhole step dimensions shall meet requirements of OSHA standard 1910.27 for fixed ladders.
- 3. Factory installed in manhole components, pre-aligned vertically, spaced on equal centers, and located as indicated on applicable details.

B. Grade Rings:

- 1. Precast Concrete: Leveling and adjusting units of 2-inch, 3-inch or 4-inch thickness conforming to ASTM C-478. Grade rings shall have a minimum opening of thirty (30) inches and shall have precast bolt holes matching frame pattern. Design must provide for full bearing of manhole frame.

C. Pipe to Manhole Connector

1. Custom preformed during manufacturing in each base and riser section, as required, accommodating type and size of pipe specified.
2. Resilient Gasket Type Connector:
  - a. Manufacturers:
    - 1) A Lok Products Corporation; A-LOK X-Cel Connectors.
    - 2) Press-Seal Gasket Corporation; Econoseal
    - 3) Hamilton Kent; Tylox Dual Seal II Series.
    - 3) Or equal.
  - b. Cast integrally with manhole component conforming to requirements of ASTM C-923.
  - c. Connector shall provide a flexible, watertight seal between the pipe and concrete structure (13 psig water-tight sealing in straight alignment and 10 psig water-tight sealing at 7° axial deflection).

C. Preformed Plastic Sealing Compound

1. Sealing compound shall be a butyl rubber base flexible gasket-type sealant meeting or exceeding the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198-B, and ASTM C-990-91). Material shall be in rope form, supplied with a two-piece cover to preclude adhesion until use. Cross sectional of rope shall be sized to provide squeeze-out of material around entire interior and exterior circumference when joint is completed. Compound shall not require primer to be effective.
2. Manufacturers:
  - a. Henry: RUBR-NEK LTM
  - b. ConSeal: CS-102/202.
  - c. Hamilton Kent Manufacturing Company: KENT-SEAL NO. 2.
  - d. Or equal.

D. Bituminous Coating

1. High build coal tar epoxy for protection of concrete in two-coat applications. Color to be black.
2. Manufacturers:
  - a. Carboline: Bitumastic 300
  - b. Koppers: Super Service Black
  - c. Royston: Roskote 201

E. Rapid Setting Concrete Repair Material

1. Rapid setting concrete shall be a cement-based concrete and masonry repair mortar. The 28-day compressive strength shall be 5,700 in accordance with ASTM C 109. Initial set time shall be 8 to 10 minutes with a final set time within 20 minutes. Shrinkage at 50% relative humidity shall not exceed – 0.069% at 28 days. Expansion at 100% relative humidity shall not exceed 0.142%.
  2. Manufacturers:
    - a. The Euclid Chemical Company; Speed Crete Red Line
- F. Hydraulic Cement
1. Portland-cement based quick-setting, non-shrinking mortar with a compressive strength of 4,000 psi after 24 hours. Hydraulic cement shall be completely waterproof and suitable for immersion service. Dry time shall be 3 to 5 minutes.
  2. Manufacturers:
    - a. Thoro: Waterplug

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Inspect precast reinforced concrete structure components in accordance with requirements of ASTM C-478 and PennDOT Publication 408 and PennDOT Publication 72 regarding repairable defects and defects subject to rejection by the Authority.
- B. All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Authority. All defective materials furnished by the Contractor shall be promptly removed from the site.

#### **3.02 PREPARATION**

- A. Keep pipe and precast structure interiors cleared of debris as construction progresses.
- B. Earthwork: Perform earthwork as specified in Section 31 23 33.

#### **3.03 MANHOLE INSTALLATION**

- A. Precast Concrete Bases: Install manhole and chamber bases on an 8-inch deep compacted layer of AASHTO No. 57 aggregate.
- B. Length of Pipe Connections into Manholes:
  1. Where possible utilize a full stick length of pipe when connection to manholes. In no case install a joint within five (5) feet of the manhole outside wall.
- C. Concrete Channel Fill: Field pour concrete channel fill for each manhole base.

1. Form inverts directly in concrete channel fill.
  2. Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
  3. Make changes in size and grade gradually.
  4. Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
  5. Make slopes gradual outside the invert channels.
  6. Use 3,000 psi 28-day compressive strength as specified for Class A Concrete in PennDOT Publication 408, Section 704, unless indicated otherwise on Drawings. Type II Portland cement shall be used for concrete in sanitary sewer structures.
- D. Manhole Wall Erection: Provide precast reinforced concrete straight riser, tapered riser and top sections necessary to construct complete manholes. Fit the different manhole components together to permit watertight jointing and true vertical alignment of manhole steps.
1. Install sealing compound in accordance with manufacturer's recommendations, and join sections also in accordance with written instructions of manhole component manufacturer.
    - a. If sealing compound is installed in advance of section joining, leave exposed half of two-piece protective wrapper in place until just prior to section joining.
    - b. Use preformed sealing compound as the sole element utilized in sealing section joints from internal and external hydrostatic pressure.
    - c. To improve workability of Preformed Plastic Sealing Compound during cold weather, store such at temperature above 70°F or artificially warm compound in a manner satisfactory to the Authority.
    - d. During warm weather stiffen Preformed Plastic Sealing Compound by placing under cold water or by other means as recommended by the compound manufacturer.
    - e. Following manhole section installation, trowel sealing compound surface smooth and flush with interior face of manhole.
    - f. Make pipe connections into manhole walls as specified for pipes connecting into manhole bases.
    - g. Remove all interior excessive plastic sealing compound after all manhole sections have been set.
- E. Lifting Recess Sealing: Seal with hydraulic cement.
- F. Frame and Cover Installation: Where required, make final adjustment of frame to elevation using precast grade rings (maximum adjustment of 12 inches). Frame and Covers installed within paved areas shall be set at 1/8" below final pavement elevation. Frame and Covers installed in all other areas shall be set within 1/8" of final grade elevations, with exception of manholes with rim elevations identified above final grade elevations.

1. Set precast grade rings:
    - a. Waterproof Mortar. Mortar thickness not to exceed 3/4-inch maximum and 3/8-inch minimum. Wet, but do not saturate precast grade rings immediately before laying.
  2. Preset grade rings to proper plane and elevation using wedges or blocks of cementitious material not exceeding one square inch wide on all sides. No more than four wedges or blocks per grade ring permitted. Incorporate wedges or blocks in fresh mortar only in a manner to completely encase each. Crown fresh mortar to produce squeeze-out between grade rings. Tool exposed joints with appropriately shaped tool and compact mortar edge into joints. Clean off excess mortar prior to initial mortar set.
  3. When using brick or concrete masonry units for adjustment, set units in full mortar bed, with staggered joints. Strike all joints inside and out.
  4. Bolt manhole frames in place on manhole top section, or on leveling units if required, after installing 1/2-inch thick preformed plastic sealing compound on bearing surface of manhole frame. Remove excess sealing compound squeeze-out after manhole frame is bolted in place.
  5. Use bolts of sufficient length to properly pass through leveling units, if any, engage full depth of manhole top section inserts and allowing enough threaded end to pass through manhole frame to properly tighten nut and washer. Tighten manhole frame bolts after mortar has cured.
  6. Parge exterior surface of grade rings or masonry units with a minimum 1/2 inch of waterproof mortar or rapid setting concrete. Apply waterproof mortar or rapid setting concrete over frame as shown on applicable details. Paint exterior with bituminous coating.
- G. Drop Manholes:
1. A drop connection is required to be installed when the sewer entering a manhole is at an elevation of two (2) feet or more above the invert out of the manhole.
  2. Construct drop manholes in accordance with applicable details. Pre-cast manhole sections shall have openings with integrally cast pipe seals to fit design elevations for new installations.
  3. Support drop assembly with a concrete cradle as detail. Entire configuration of piping shall be bedded in AASHTO NO. 8 clean stone.

### 3.04 CONNECTION TO EXISTING INFRASTRUCTURE

#### A. Connections to Existing Manholes

1. Cut required opening by core boring; prevent cracking and spalling. Make openings of sufficient size to accommodate pipe and annular seal.
  2. Install a modular seal (Link-Seal by GPT) and apply hydraulic cement to the interior and exterior of seal.
  3. Form a new flow channel in the existing manhole base.
  4. During all aspects of work, prevent ground water, surface water, and/or debris from entering the existing infrastructure. Maintain all existing flow during construction.
- B. Connection to Existing Manhole that Cannot be Cored
1. Make openings of sufficient size to accommodate pipe and annular seal.
  2. Install a modular seal (Link-Seal by GPT) and apply hydraulic cement to the interior and exterior of seal.
  3. Form a new flow channel in the existing manhole base.
  4. During all aspects of work, prevent ground water, surface water, and/or debris from entering the existing infrastructure. Maintain all existing flow during construction.
- C. Connections to Existing Sewers:
1. New sewers shall be constructed at a uniform grade to meet the existing sewer at a slightly higher invert elevation than the invert of the existing sewer at the point of proposed connection.
  2. For proposed sewers of a diameter equal to the existing sewer, a new manhole shall be constructed in-line, with the new sewer invert 0.2 ft higher than the upstream invert.
  3. Replace broken or damaged pipe with new pipe. New pipe material shall comply with the Authority's specifications. Use solid sleeve couplings.
  4. Connect new pipe to new manhole bases or new in-line structures as specified.
  5. Replace existing sewer pipe with new pipe to a joint outside the manhole at least five (5) from the manhole outside wall.
  6. Maintain flow in existing sewer both during construction operations and until field poured concrete is cured.

### 3.04 MANHOLE FRAME AND COVER ADJUSTMENT

- A. Raising of Existing Manhole Frame and Cover
1. An adjustment to within 12 inches of the manhole top section shall be performed in accordance with Section 3.03, Paragraph F.

2. Adjustments in excess of 12 inches from the existing manhole top section shall be made by removing the top section of each manhole and inserting precast sections to meet required elevation. Each increment of one (1) foot shall contain a manhole step set in alignment with the existing steps. Manhole steps shall comply with the Authority's specifications.
3. When elevation changes require removal of an existing manhole section(s), the Authority shall be consulted in advance of the work to determine the best method to accomplish the work. All work will be inspected by the Authority.
4. If the distance from the top of cone to the first step is more than 12 inches, then an additional step shall be installed.

B. Lowering of Existing Manhole Frame and Cover

1. Adjust frame and cover in accordance with Section 3.03, Paragraph F. Remove all existing grade adjustment components down to the top of the manhole and replace with new materials.

3.05 FUTURE PIPE OPENINGS IN MANHOLES

- A. When a future pipe connection(s) have been planned for a manhole, pipe opening shall be plugged to prevent exfiltration/infiltration.
1. Install a short piece of pvc with a watertight plug.

3.06 FIELD QUALITY CONTROL

- A. General: Each manhole shall be tested as specified.
1. Conduct tests in the presence of and to the complete satisfaction of the Authority.
  2. Should a manhole not satisfactorily pass testing, discontinue manhole construction on the Project until the failed manhole does test satisfactorily.
  3. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing as specified.
  4. Prior to testing manholes, thoroughly clean the manhole and seal all openings to satisfaction of the Authority. Seal openings using properly sized plugs.
  5. Perform manhole testing with frames installed. The joints between the manhole, any grade rings, and the manhole frame shall be included in the test.
  6. The tests of the manholes for acceptance shall be conducted after the backfilling has been completed.
- B. Sanitary sewer manholes must pass a vacuum test in accordance with the requirements identified in this Section. If the sanitary sewer manhole is constructed on an existing sewer

where sewage flow must be maintained, the test will be visual.

- C. The Authority shall conduct visual inspection of force main chambers.
- D. Vacuum Testing of Sanitary Sewer Manholes
  - 1. Vacuum Testing Equipment:
    - a. Use vacuum apparatus equipped with necessary piping, control valves and gauges to control air removal rate from manhole and to monitor vacuum.
    - b. Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
    - c. Vacuum testing equipment and associated testing apparatus subject to Engineer's approval.
    - d. Provide seal plate with vacuum piping connections for inserting in manhole frame.
  - 2. Vacuum Test Procedure:
    - a. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
    - b. Draw a vacuum of ten inches of mercury and close the valves.
    - c. A passing test is documented when the vacuum does not drop below nine inches of mercury for the following manhole sizes and times.
      - 1) Four foot diameter: 60 seconds.
      - 2) Five foot diameter: 75 seconds.
      - 3) Six foot diameter: 90 seconds.
- E. Repair and Retest: Manhole test failures shall require the determination of the leakage source(s) and subsequent correction.
  - 1. Repair or replace defective materials and workmanship, as is the case, and conduct additional tests and any subsequent repairs and retesting as required until manholes meet test requirements.
  - 2. Materials and methods used to make manhole repairs must be approved by the Authority.
  - 3. Make repairs, replacements and retests at no expense to the Authority.
  - 4. Contractor shall be responsible for all costs for additional inspection of tests.

### 3.07 BACKFILLING

- A. Backfill and Compact in accordance with the requirements of Section 31 23 33.

**END OF SECTION**



**DIVISION 40 - PROCESS INTEGRATION  
SECTION 40 61 13 – PROCESS CONTROL SYSTEM GENERAL PROVISIONS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. The scope of work under this Section includes but is not limited to:
  - 1. All investigation work required to establish the use and configuration of the as-found hardware and software of each control signal affected under this contract.
  - 2. Document all changes to the plant's control system, including the updating of the plant's existing control system documentation to reflect changes made during construction and discrepancies found during the investigation work.
  - 3. Furnish, install, connect, configure and test PLC hardware, and software products and related items.
  - 4. Coordinate with the Authority for communication requirements.
  - 5. Furnish and install all equipment enclosures, power supplies, interconnecting cables, and support software and equipment required for a complete and functional system.
  - 6. Furnish and install all conduit, conductors, terminal boxes, and appurtenant equipment shown on the Contract Drawings, hereinafter specified, and/or required for a complete and fully functional installation to the satisfaction of the Engineer.
  - 7. Configure all equipment to operate satisfactorily and demonstrate that the system is properly operating.
  - 8. Provide training on the OIT hardware and software supplied and implemented under this contract.
  - 9. Provide additional services from the System Integrator, as requested, for additional training, configuration and programming services, troubleshooting, and related activities.
- B. This section outlines procedures and requirements that will assure a timely installation with minimal disruption to the operation of the facility. Any requirements listed in this section are in addition to requirements listed in other sections.

**1.02 DISCONNECTION AND IDENTIFICATION**

- A. All power, control and instrumentation wiring associated with equipment, panels, devices, etc. to be removed and replaced shall be identified, marked and then disconnected in order to make the equipment safe. Refer to any applicable demolition drawings for more details.
- B. Notify the Authority prior to disconnection of any existing equipment.

1.03 SEQUENCE OF CONSTRUCTION

A. General

1. The contractor shall begin the submittal process within two weeks after notice to proceed by submitting the name of the proposed System Integrator along with all information required to determine the adequacy of the proposed System Integrator.
2. Within one month after approval of the System Integrator, all hardware and software product submittals shall be delivered to the Authority.
3. Within two months after approval of the System Integrator, detailed installation submittals shall be delivered to the Engineer.
4. All work shall be coordinated with plant maintenance personnel and approved by plant operations personnel prior to beginning any work.
5. Written consent from the Authority must be obtained not less than one week prior to carrying out any portion of the work which requires interruption of service.
6. Plant operations shall be notified no less than 24 hours prior to beginning any work that requires disruption of plant operation.
7. Complete any work that can be performed without interference to the existing operation of the plant control system, such as conduit and cable installations, prior to disconnecting any existing control equipment.
8. Provide and implement a workaround to address any Plant control or monitoring process that is affected by temporary or permanent work being performed under this contract. Submit this plan to the Authority for review.
9. Train operators in the functional operation of the new equipment.
10. Demonstrate that the new and existing equipment is properly configured and operating by displaying process data at the local workstation and at other workstations on the existing SCADA system and verifying the accuracy of the displayed data.

1.04 SPECIAL NOTICES TO CONTRACTOR

- A. Unavoidable interruption of service must be confined to the daytime. The Authority will not be responsible for overtime, should this become necessary to insure continued service.
- B. In connection with all of the foregoing, Contractor must have on the construction site, all materials, equipment, construction facilities, adequate supervision and a sufficient number of qualified workmen to insure carrying out all of the above work in the shortest possible time.

1.05 INSUFFICIENT INSTRUCTION

- A. The Contractor shall furnish and install all materials and equipment which are reasonably inferable to be part of the complete installation.
- B. If, in the opinion of the Contractor, any work shown on details or called for under these Specifications is insufficiently specified or specified in such a manner as to

make it impossible for him to produce first-class work which will meet the approval of the Authority, he shall notify the Authority before proceeding with the work and, if he fails to refer such instances to the Authority, no excuse for poor workmanship will be entertained.

**1.06 FIELD ENGINEERING**

- A. Where dimensions are shown or indicated, the information given is approximate only, and is not warranted by the Authority to be either complete or correct. The Contractor shall verify actual existing conditions and dimensions in the field before ordering materials or starting construction.
- B. The Authority's details indicate the general location and arrangement of conduit, wiring devices, equipment, and other products. The Contractor shall adjust the indicated locations (subject to approval in the field) as necessary to:
  - 1. Comply with all applicable code requirements.
  - 2. Permit access for construction, inspection, testing, operation, and maintenance.
  - 3. Avoid conflict with pipes, mechanical equipment, structural openings (e.g., doors), and other obstructions, as built, whether or not as shown on the Contract Drawings.
  - 4. Produce a neat, workmanlike arrangement.
- C. The Contractor shall determine the proper connection points for all power, control, and signal wiring, regardless of whether the connection points are in equipment furnished under this Contract, in equipment furnished by others, or in existing equipment.
- D. The Authority will make available to the Contractor any reference drawings it may have. However, the Authority does not guarantee the correctness, completeness, or availability of reference drawings. Should the Contractor choose to rely upon the reference drawings, he does so at his own risk.
- E. The Contractor shall coordinate the making and sealing of all holes through structures to accommodate electrical conduits and supports for electrical equipment, and shall submit working drawings thereof for the Authority's approval.
- F. The Contractor shall ensure that proper service is provided to all mechanical equipment requiring electricity for power or control.

**PART 2 - PRODUCTS** Not Used

**PART 3 - EXECUTION** Not Used

**END OF SECTION**

**DIVISION 40 - ELECTRICAL  
SECTION 40 61 96 – PROCESS CONTROL DESCRIPTIONS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. General Requirements and Process Control Description for Duplex Submersible Pump Stations.
  - 2. Refer to Related Sections for specific component requirements.
- B. The Authority's Duplex Submersible Pump Station control panels shall be similar in design and construction to provide operations with an easy to maintain and service product. The panels shall meet the following requirements and shall include the features described.
- C. Related Sections:
  - 1. Division 26
  - 2. Division 40
  - 3. Division 43

**1.02 SYSTEM DESCRIPTION**

- A. General:
  - 1. Wastewater Pump Station control panels shall be constructed within a stainless steel NEMA 4X enclosure which shall include a dead front. Each panel shall include a lamp with door actuated switch, convenience receptacle, thermostatically controlled heater and fan. The face of panel shall include the following devices and instruments:
    - a. Main Circuit Breaker Operator
    - b. Individual Circuit Breaker Operator For Each Pump
    - c. Control Power Circuit Breaker
    - d. OIT
    - e. VFD Key Pad
    - f. HAND OFF AUTOMATIC (HOA) Selector Switch For Each Pump
    - g. Run Time Meter For Each Pump
    - h. Amperage Meter for Each Pump
    - i. Pump Run Lamp
    - j. Pump Motor Fail Lamp
    - k. Pump Motor High Temp Lamp
    - l. Pump Motor Seal Fail Lamp
    - m. Back Up Level Engaged Lamp
    - n. Normal / Back Up Level Control Selector Switch

B. Control Hardware

1. Except for back-up level control, all logic shall be executed by an Allen Bradley (AB) Programmable logic controller (PLC). The PLC shall be a CompactLogix 1769 PLC to match other Authority panels.
2. Each panel shall also include an operator interface terminal (OIT). The OIT shall be an AB Panelview 1000 color graphic terminal with color touch screen. The Panelview OIT shall have a 10 inch display. The OIT display shall be mounted on the face of the inner door panel. The OIT and PLC shall communicate via Ethernet.
3. An Ethernet switch with at least 5 ports shall be included in the panel.

C. Communication

1. The Authority has standardized on two methods of communication for wastewater pump station control panels. The Authority will identify which communication mode will be used based on expected reliability. The Authority uses either cellular modems or General Electric / Microwave Data Systems Ethernet spread spectrum radio to facilitate communication between system sites.
2. A record of the contiguously assigned registers which shall be available to transmit to the Authority SCADA system shall be prepared and shall be submitted to the Authority for review and approval.

D. Pump Motor Controllers

1. Variable Frequency Drives (VFD) (Allen Bradley PowerFlex 400) shall be provided to control each pump. The VFD shall be rated for the incoming power (240 VAC or 480 VAC).
2. Where incoming power is limited to 240 V, single phase, the drive shall convert single phase to three phase and be oversized per the manufacturer's recommendations to support phase conversion.

E. Pump Control

1. The wastewater pump station control panel shall accomplish wet well level control by:
  - a. Cycling pumps on and off if constant speed pumps are used
  - b. Cycling pumps on and off and adjusting the speed of the pump(s) if variable speed pump control is being implemented
2. Each control panel shall incorporate primary level control based on a submersible level transducer. Back up level control shall be accomplished by use of five (5) float switches (Low Alarm, Pump Shut Down, Lead Pump On, Lag Pump On, High Water Alarm), which shall actuate completely independent from the PLC, OIT and submersible level transducer. Back up level control shall be executed by relays. Both primary and back up level control shall be intrinsically safe. The primary level control shall be the normal mode of pump control. If the high level float of the back-up system actuates, the back-up level control system

shall take over the control of the pumps. The back-up level control system shall remain in control until an operator selects primary level control to again assume control of the station.

3. Pump motor controllers shall be included in the pump control panel. The pump control panel logic shall include monitoring of pump fail as well as monitoring of the MiniCAS module supplied with each pump. The MiniCAS module monitors seal and pump motor temperature. The pump shall be inhibited from running if a high temperature is sensed. An alarm shall be generated if a pump seal is sensed but the pump will be allowed to run.
4. Back-up level control shall include five float level switches which shall have the following level assignments:
  - a. High Level
  - b. Lag Pump Start
  - c. Lead Pump Start
  - d. Pumps off
  - e. Low Level
5. If the high level switch is actuated, the back-up level system shall take over level control from the primary level control system.

F. Other Panel Features and Functions

1. The Pump Station control panel shall be the marshalling location for all pump monitoring and control. The following alarm contacts shall be available on a customer terminal strip located within the pump control panel:
  - a. Generator Run
  - b. Generator Fail
  - c. Fuel Tank Low
  - d. Fuel Tank Rupture
  - e. Commercial / Utility Power Fail
2. The control panel shall accept the incoming power available at the site. The panel shall include a main circuit breaker properly sized for the pump loads and associated circuits. The main circuit breaker shall include an operator that can be locked out. The Authority personnel shall be able to lock out pumps without opening the deadfront door. The control panel shall include a control power transformer to reduce incoming power to 120 vac. The 120 vac power shall be used to power panel devices. The control panel shall include an uninterruptible power supply (UPS) to power control power devices with the exception of convenience receptacle, fan, heater, and lamp. The UPS shall be sized to operate all panel devices for a minimum of 12 minutes.
3. The panel shall include a secondary surge suppresser (TVSS) for incoming power.
4. Provide 24 vdc power supply as necessary for PLC, OIT and for I/O.

5. Fuse or otherwise protect circuits within the panel. All 24 volt power supplies shall be fused on the line and load side.
6. Discrete (control) outputs shall be isolated from the PLC output by use of a relay. Each point discrete output point shall include a isolating relay. All discrete inputs shall be fused. It is acceptable to fuse up to four (discrete) inputs on the same fuse.
7. Pilot lamps shall be 30 MM LED type lamps. Selector switches and pushbuttons shall be 30 MM devices.

G. Spares

1. Install and wire spare I/O points for each type of I/O included in the panel (Analog inputs, discrete inputs and control outputs). Installed spares shall be wired and labeled. Provide 10 percent spare I/O minimum 1 point. Provide spare terminal blocks, installed in the panel and available for use by the customer.
2. Provide one spare of each type relay for every ten relays installed in the panel.
3. Provide one spare of each face of panel mounted operator of each type for selector switches and pushbuttons. Provide two spare (total) of each type of contact block used. Provide one spare pilot lamp and one lense of each color used in the panel.

H. Marking and Labeling

1. All wires shall be labeled. Terminal numbers shall be applied to all terminals. All panel devices shall be identified with a label. All face of panel devices shall be labeled with two color lamicoid lables.

I. Documentation

1. Provide complete as built documentation for each panel. Provide documentation in electronic (.PDF file) and paper format.
2. Provide all application software configured for the PLC and OIT. The application software shall be provided in paper format and in electronic format. In addition, after start-up and testing, the final software configuration shall be provided to the Authority in an electronic form that shall be loadable into a replacement PLC or OIT in the event the currently configured unit fails.

1.03 SUBMITTALS

A. Submit in accordance with requirements of Section 01 33 00.

B. Product Data:

1. Record of the contiguously assigned register which shall be available to transmit to the Authority SCADA System.

- C. Shop Drawings:
  - 1. Submit panel layout
  - 2. Submit panel wiring diagrams
  - 3. Submit panel component list
- D. Documentation:
  - 1. Submit all application software (paper and electronic format).
  - 2. Final software configuration in electronic format.

**PART 2 - PRODUCTS – Not Used**

**PART 3 - EXECUTION – Not Used**

**END OF SECTION**



**DIVISION 40 - PROCESS CONTROL  
SECTION 40 63 00 – CONTROL SYSTEM EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Programming Software
  - 2. Programmable Logic Controller
  - 3. Ethernet Lan Equipment and Materials
  - 4. Equipment Enclosures
  - 5. Miscellaneous Equipment
- B. Related Sections
  - 1. Section 40 61 96 – Process Control Descriptions

**1.02 SYSTEM DESCRIPTION**

- A. Design, Supply and Install all hardware and software products required to provide a complete and fully functional control system.
- B. Design the control panels and field wiring interfaces required to implement the control equipment.
  - 1. All control panels shall be designed and manufactured in accordance with UL 508A, Standard for Industrial Control Panels, and NFPA 79, Electrical Standard for Industrial Machinery.
  - 2. All components shall be UL recognized.
- C. Furnish, Install and Test:
  - 1. Control panels, programmable controllers, enclosures and appurtenant equipment.
  - 2. Software products, interface cables and related products.
  - 3. Software required to interface the new control equipment to the existing SCADA network.
  - 4. Relays, resistors, signal splitters or other devices required to condition input and output field signals for the control equipment.
- D. Connect and test all input and output field wiring to and from the control equipment.
- E. Provide all manufacturer's services required for installation, startup, calibration, inspection, and training.

- F. Provide all coordination required for system integrator's services.

1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 01 33 00.
- B. Submit catalog cuts, shop drawings, and O&M manuals for all equipment.
1. All control equipment hardware, software and control panel shop drawings shall be reviewed and approved by the System Integrator prior to submission to the Authority.
- C. Submit the following information involving proposed hardware for the control system:
1. A detailed written description of the control system outlining the purpose and capabilities of each component.
  2. Catalog information, shop drawings, and descriptive literature for each component of the control system.
  3. Shop drawings and catalog cuts for all panels and enclosures.
- D. Submit complete detailed shop drawings, working drawings and descriptive literature for control panel equipment, cabinets, and components. As a minimum the shop drawings and working drawings shall include the following:
1. Bill of Materials
  2. Power load calculations verifying capacity of power supplies and UPS units to carry the panel load.
    - a. Provide a minimum of 20% spare capacity on DC power supplies.
    - b. Provide 10 minutes of no power operation on UPS units.
  3. Heat rise calculation of each enclosure.
  4. Front panel, back panel and panel schematic wiring diagrams.
    - a. Submit detailed drawings showing proposed arrangement of equipment within each enclosure, proposed locations of all equipment and enclosures, and proposed arrangement of all conduits and conductors that will enter each enclosure.
    - b. Provide a minimum of 20%, but no less than two (2), installed spare I/O for each type of I/O present in the panel. All I/O are to be factory wired out to field terminal strips in the panel. These spare I/O are to be in addition to the material to be supplied under the Spare Parts section of this specification.
    - c. Provide a minimum of 20%, but no less than two (2), spare (open) module slots on the controller I/O back plane.
  5. Interconnection wiring diagrams showing all component and panel terminal board identification numbers and external wire numbers, including existing equipment and equipment furnished by others.

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SECTION 40 63 00 – CONTROL SYSTEM EQUIPMENT

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1.04 QUALITY ASSURANCE

A. Qualifications:

1. The contractor shall retain the services of a qualified system integrator to assist in the selection of equipment, preparation of submittals, installation, configuration and startup of all control equipment.

1.05 AUTHORITY'S INSTRUCTIONS

A. Communication:

1. The Authority will identify the communication mode to be used based on highest expected reliability.

**PART 2 - PRODUCTS**

2.01 PROGRAMMING SOFTWARE

- A. All Programming shall be performed using the latest version and edition of the programming software being used by the Authority. Consult with the Authority for information.
- B. The Contractor's System Integrator shall be responsible for maintaining his own version of the programming software for his own purposes, and shall not be permitted to use or work with the Authority's software for the execution of the work required.
  1. Refer to Section 40 68 00 – Control System Integration, for system programming requirements.
  2. Refer to Section 40 61 96 – Process Control Descriptions for a general description of system functionality.

2.02 PROGRAMMABLE LOGIC CONTROLLER

- A. In order to minimize training requirements, provide a uniform look and feel, and provide better support and administration, the Authority has standardized on a single Control System software package and PLC manufacturer. Therefore, no substitutes will be accepted for the specified products.
- B. The Programmable Logic Controllers (PLC) shall be Allen-Bradley CompactLogix 1769 Controller.
  1. Operator Interface Terminal (OIT) shall be Allen Bradley PanelView Plus 1000 Color with Ethernet port and a 10 inch display.

2.03 ETHERNET LAN EQUIPMENT AND MATERIALS

- A. For premises wiring cable refer to Division 26.
- B. Unmanaged Ethernet Switches
  1. Heavy Duty, hardened, sealed steel enclosure, DIN rail mounted, copper switch.

2. Features:
  - a. Support VLAN tagging and spanning tree pass through.
  - b. Include Link-Loss-Learn (LLL) feature for fast network recovery.
  - c. Auto MDI/MDI-X ports
  - d. Nonblocking switching architecture with a 2K MAC address table
3. Ports:
  - a. (5) RJ-45 10/100Mbps copper ports.
4. LED Indicators:
  - a. Power
5. Standards: IEEE 802.3, IEEE 802.3u, IEEE 802.1p/q
6. CE Approved
7. Temperature Rating:
  - a. Storage: -40 to +185° F
  - b. Long-term operating: -13 to +140° F
8. Humidity: 5–95%, noncondensing
9. Size: 3.6"H x 3"W x 1.7"D
10. Weight:
  - a. Switches: 0.8 lb.
  - b. Power Supplies: 0.4 lb.
11. Black Box Heavy Duty Hardened Edge Switch with hardened power supply, or approved equal.

C. Cat-5 Patch Cables

1. Shielded twisted pair (ScTP) cables shall be high performance 4-pair cables with protective foil shielding specifically designed for Ethernet applications, verified to EIA/TIA Category 5e, with snagless boot and factory installed RJ-45 connectors.
  - a. Cat-5 Patch Cables shall be Black Box CAT5 Shielded Twisted-Pair (STP) Patch Cables, or approved equal.

2.04 EQUIPMENT ENCLOSURES

A. Enclosures

1. Enclosures shall be UL 508A listed, wall or floor mounted, NEMA 4X, 12 gauge stainless steel, hinged with quick-release latches.
2. Dimensions shall be adequate to enclose all required equipment.

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3. Doors shall be lockable using a padlock.
4. External hardware shall be manufactured of Type 316 stainless steel.
5. Hoffman Bulletin A80-series or approved equal.

2.05 MISCELLANEOUS EQUIPMENT

A. Control Power Transformers:

1. The control panel shall be provided with a single voltage feed. Provide a control power transformer(s) as required for each voltage in the control panel
2. Primary voltage shall be the primary voltage of the system. Secondary voltage shall be as required for the equipment being powered.
3. Transformer VA rating shall be as required for the system being provided.
4. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.
5. Transformer shall be UL listed, Square D or equal

B. Uninterruptible Power Supply (UPS)

1. DIN-Rail Mounted UPS, 500VA, Input 120V/Output 120V, SOLA Model SDU500, or approved equal.

C. DC Power Supply

1. Din Rail mounted power supply housed in rugged narrow metal case with large, rugged, accessible, multiple connection screw terminations.
  - a. Power supply shall be enclosed and completely finger safe. Open power supplies shall not be acceptable.
2. Auto Select 115/230 VAC, 50/60 Hz single phase Input
3. Powers high inrush loads without shutdown or foldback, meet SEMI F47 Sag Immunity
4. Power Factor Correction (per EN61000-3-2)
5. Adjustable Voltage
6. Industrial grade design
7. – 10 C to 60 C operation without derating.
8. Indefinite short circuit, overvoltage and overtemperature protection.
9. High MTBF and reliability
10. Highly efficient greater than 90% switching technology

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11. Power supply shall be UL listed (UL 508) and have 5 year warranty.
  12. SOLA Hevi-Duty, model: SDN, in size and voltage as required for application, or approved equal.
- D. Signal Isolators
1. Signal conditioner with AC powered re-transmitter
  2. Single or Dual channel DC input, as required for the application.
  3. Signal Isolation: 2000VAC isolation between Input, Output and Power.
  4. Action Instruments Q403 DC input multi-channel isolator or approved equal
- E. Interposing Relays
1. Miniature plugin relay, 10A resistive rating, double throw C-Form contact output, UL Listed
  2. Coil Voltage and contact count as required for the application.
  3. SqD Class 8501 - Type R Miniature Plug-in Relays with DIN Rail mounting Socket, or approved equal
- F. Power-On Relay
1. Miniature plugin relay, 10A resistive rating, double pole, double throw C-Form contact output, UL Listed
  2. Coil Voltage equal to panel incoming power.
    - a. Coil to be wired to panel incoming power.
    - b. Contact output to be wired to receiving device as indicated in other section of these specifications or as shown on the drawings.
  3. SqD Class 8501 - Type R Miniature Plug-in Relays with DIN Rail mounting Socket, or approved equal
- G. Motor Controllers
1. Variable Frequency Drives (VFD's)
    - a. All VFD's required for a system shall be in accordance with the applicable requirements of Section 26 29 23 - Variable Frequency Motor Controllers.
- H. Wiring
1. All wiring shall be in accordance with the applicable requirements of Division 26 05 19 – Electrical Power Conductors and Cables.

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I. Terminal Blocks

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts.
2. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.
3. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed.
4. Terminal blocks shall be fused type where indicated on the drawings.
5. Analog signals shall be terminated on modular narrow form factor terminal blocks intended for the protection of a floating double conductor (4-20 mA analog) signal.
  - a. Two-stage surge protection for one operated floating double conductor.
  - b. Disconnect knife on both signal paths.
  - c. Separate ground connection.
  - d. Screw terminal connections.
  - e. Nominal voltage: 24 V DC
  - f. Phoenix Contact TERMITRAB TT-2-PE-M-24DC or approved equal.

J. Power Disconnects

1. Panel disconnects
  - a. Provide NEC compliant panel disconnects. Disconnect and shall be interlocked to the control panel door handle.
2. Motor disconnects
  - a. Provide NEC compliant lockable motor disconnecting means for each controlled motor.

K. Nameplates And Name Tags

1. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.
2. Nameplate shall be engraved, rigid, laminated plastic type with adhesive back. Unless otherwise noted, color shall be black with white letters and letter height shall be 3/16 inch.

2.06 SPARE PARTS

- A. Terminal Blocks: Provide 20% spare blocks of each type used, installed
- B. Fuses: Provide 10% spares for all types used (no less than one each).
- C. Patch Cables: Provide 10% spares for all types used (no less than one each).
- D. 1 (One) spare 5 Port Copper Ethernet switch

- E. PLC Equipment:
  - 1. 1 (one) spare Power Supplies
  - 2. 1 (one) spare CPU

### **PART 3 - EXECUTION**

#### **3.01 SCHEDULING OF WORK**

- A. The Plant will be kept in full scale operation during the performance of the work specified in this section. All modifications to existing panels, all equipment/device/panel replacement work and all rehabilitation work shall be scheduled by the contractor and submitted to the Engineer for approval.
- B. The Contractor, in addition to the requirements of Section 01 33 00, shall submit an expended initial schedule to the Authority for approval showing all the work specified in this section. The contractor shall adjust the schedule as per the comments of the Authority and resubmit the schedule for final approval.
- C. Written consent from the Authority must be obtained not less than one week prior to carrying out any portion of the work which requires interruption of service and control/instrumentation systems.
- D. Unavoidable interruptions must be confined to the daytime. The Authority will not responsible for overtime, should this become necessary to insure continued service.
- E. In connection with all of the foregoing, Contractor must have on the construction site, all materials, equipment, construction facilities, adequate supervision and a sufficient number of qualified workmen to insure carrying out of the above work in the shortest possible time.

#### **3.02 CONTROL SYSTEM COMMUNICATION COORDINATION**

- A. Establish communications between the existing Human Machine Interface (HMI) server and each programmable logic controller (PLC), and verify monitoring of I/O data points.
- B. Cutover PLC data points to the SCADA monitoring system.

#### **3.03 DISCONNECTION AND REMOVALS**

- A. All power, control and instrumentation wiring associated with equipment, panels, devices, etc. to be removed and replaced shall be identified, marked and then disconnected to facilitate their replacement and any related work.
- B. All materials no longer used shall be removed unless otherwise directed by the Engineer. Affected surfaces shall be repaired to confirm to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner.



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3.04 CONTROL PANELS

- A. Control panels shall be completely fabricated, instruments installed and wired in the manufacturer's factory and tested prior to delivery to the site. The control panels shall be factory assembled with all input and output devices.
  - 1. All wiring and equipment shall be completed and tested prior to shipment.
  - 2. All external connections shall be by way of numbered terminal blocks.
  - 3. Install spare terminal blocks on back panel.
- B. Panel instrumentation arrangement shall be as shown, with minor modifications as required by the particular equipment furnished. Modifications shall be subject to the approval of the Authority.
- C. All back panels shall be secured with all the appropriate zinc plated mounting hardware.
- D. All devices and wiring shall be properly labeled.
  - 1. Front panel devices shall be identified by laminated nameplates
  - 2. Panel mounted devices and wiring shall be identified by a permanent marking system.
- E. All circuit breakers, terminal strips, and related devices required to provide a complete, safe, and neat installation shall be provided.
- F. Wiring
  - 1. Wires shall be 600-volt class, PVC insulated stranded copper and shall be of the sizes required for the current to be carried, but not below 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.
  - 2. Wiring for signal circuits shall be twisted shielded pairs not smaller than No. 18 AWG, and be separated at least 6-inches from any power wiring.
  - 3. All wires shall be identified as per the requirements of Division 26 05 19.
  - 4. Provide wiring channels as required.
  - 5. All interconnecting wires between panel mounted equipment and external equipment shall be brought out to numbered external wiring terminals and terminated.
  - 6. All wires shall be numbered and identified.
- G. Terminal Blocks
  - 1. Wires shall be terminated at the terminal blocks with crimp type, pre-insulated, ring-tongue lugs.
  - 2. Lugs shall be of the appropriate size for the terminal blocks screws and for the number and size of the wires terminated.

3. Fused terminal Block shall be used for power distribution.

H. Nameplates And Name Tags

1. All components provided under this Section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire tag number and description of the component.

3.05 INSTALLATION

- A. All items shall be installed in accordance with the manufacturer's recommendations.
- B. The Contractor shall furnish and install all material and hardware required to supply a complete and functional installation.
- C. Notify Plant personnel prior to disconnect any existing signals.
- D. Deliver all salvaged equipment to the Authority.
- E. Prior to connecting any signals, each existing signal shall be tested to verify that the signal is within the expected range and suitable for connection to the new PLC.
- F. Completely configure and program each PLC as required to meet these Specifications (Refer to Section 40 61 96 and Section 40 68 00).

3.06 CONFIGURATION AND PROGRAMMING

- A. Configure each new programmable logic controller (PLC) for all inputs and outputs.
- B. Configure and program the new programmable logic controllers to allow monitoring and control from the control system.
- C. Configure the new PLC to communicate with the control system I/O servers via Ethernet connections.
- D. Coordinate and document PLC LAN Node numbering and IP addresses with Plant personnel before installation.
- E. Qualified representatives of the PLC manufacturer or a qualified systems integrator shall perform all configuration and programming.
- F. Completely configure and program each PLC as required to meet these Specifications (see Section 40 61 96 and Section 40 68 00).

3.07 TESTING

- A. Test the hardware and software using simulated inputs and outputs prior to installation.
  1. The Contractor shall retain the services of a system integrator to provide detailed test plans and procedures to demonstrate and document that all

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equipment has been properly installed and configured for a full functional system which meets all contract requirements.

2. See Section 40 68 00 for additional details.

B. Test the complete installed system by demonstrating that all signals are properly received and sent and that the control system operates as intended.

3.08 CLEANING AND TOUCH-UP PAINTING

A. The premises shall be kept free from accumulation of waste material and rubbish. Upon completion of work, the Contractor shall remove materials, scraps, and debris from the site. Scratches, scrapes, or ships in interior or exterior surfaces of devices shall be touched up with finishes matching as nearly as possible the type and color of the original finish.

B. All material, equipment, and workmanship shall be subject to inspection by the Engineer or his representatives. In the event the Engineer finds the materials or workmanship not in accordance with these Contract Documents, the work or materials shall be removed and replaced, or corrected, by and at the expense of the Contractor.

3.09 TRAINING

A. Provide all on-site and off-site training, minimum of eight (8) hours. Cover all aspects of the control panel, including instrumentation and motor controllers.

**END OF SECTION**

**DIVISION 40 - PROCESS CONTROL  
SECTION 40 68 00 – CONTROL SYSTEM INTEGRATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Review and approve all submitted control equipment and designs of other sections of the specifications prior to submission to the Authority.
- B. Supervise, inspect and test the installation of the control equipment and materials supplied under other sections.
- C. Provide all programming necessary to replace the functionality of the existing control system and to implement the new control functionality as specified.
  - 1. Programming shall include All Programmable Logic Controller (PLC) and Operator Interface Terminal (OIT) programming services necessary to provide a fully functional control system.
  - 2. Programming shall include the modification and integration of the new pump station into the Plant's existing HMI runtime application.
- D. Perform the Final Acceptance Testing of all control equipment and materials supplied under this Contract.
- E. Provide and coordinate the training of Authority personnel in the operation, configuration, and maintenance of the new control system.
- F. All items and created works performed under this contract shall become the property of the Authority and shall be turned over to the plant personnel at the completion of Testing.

**1.02 CONTRACTOR RESPONSIBILITIES**

- A. The Contractor shall retain the services of a qualified System Integrator to select equipment, provide any design details required to accommodate the selected equipment, completely configure and program the equipment, supervise and inspect the installation, test the systems, provide training, and prepare submittals and final documentation, all as herein specified.
- B. The Contractor shall furnish all labor, equipment and materials required to install a fully functional monitoring and control system including any and all items recommended by the System Integrator.
  - 1. The Contractor shall furnish all programming and configuration required for a complete and functional system to automatically control and monitor all of the equipment being supplied under this Project.
  - 2. The Contractor is responsible to notify the Engineer immediately upon recognition of an instruction or specification contained herein that would cause the supplied system to fail to meet the conditions set forth in these specifications.
- C. The Contractor shall coordinate the implementation and recommendations of the System Integrator with Contractors staff and the Contractor's subcontractors.

### 1.03 SYSTEM INTEGRATOR RESPONSIBILITIES

- A. The system integrator shall perform the following general activities:
1. Selection and Evaluation of Components:
    - a. The System Integrator shall evaluate and select the individual components of the control system. The evaluation shall be based on the specification requirements, industry standards, compatibility between components and the experience of the System Integrator.
      - 1) The System Integrator shall review and approve all control hardware, software and control system related components prior to submission to the engineer.
      - 2) The System Integrator shall assist in the preparation of submittals and documentation of other sections of this specification as needed for a complete and coordinated hardware design.
      - 3) The Engineer shall review all equipment following approval by the System Integrator.
  2. Interfacing of Equipment:
    - a. The System Integrator shall interface between all components within the control system including those components supplied by others and existing equipment.
    - b. The system Integrator shall evaluate the interface between components and supply and/or modify systems to ensure compatibility.
    - c. The System Integrator shall provide any design assistance required to accommodate the selected equipment, to completely configure and program the equipment, and to the interface the new equipment to new and existing field devices.
  3. Information Gathering:
    - a. The System Integrator shall investigate plant documentation and as-found conditions of the plant control system to establish the use and configuration of the hardware and software of each control signal affected under this contract. This investigation shall include the entire signal path from the initiating hard wired field device through to the control room operator interface terminal.
  4. Coordination:
    - a. The System Integrator shall inspect the existing equipment to determine the best method for interfacing the new control system with the existing equipment. All work required to interface to existing equipment and communications networks shall be provided by the System Integrator.

5.     Programming:
  - a.     The System Integrator shall provide all programming, control logic and software for the system controls and monitoring.
  - b.     The System Integrator shall interact with the Engineer to determine detailed operational conditions and shall incorporate those conditions into the system control logic.
  - c.     All configuration and programming performed under this contract shall be fully documented by the system Integrator and shall become the property of the Authority.
  - d.     Programming for the control algorithms shall be performed with the equipment vendor's latest configuration software using the IEC ladder diagram configuration.
  
6.     Installation:
  - a.     The System Integrator shall oversee the installation and field connection of the control system.
  - b.     The System Integrator shall make all the necessary modifications, additions and/or updates to hardware and software as required to accommodate the field conditions encountered.
  
7.     Field Tests:
  - a.     The System Integrator shall be present during the start-up of each programmable controller to respond to any discrepancies or questions which arise.
  - b.     The System Integrator shall be on-call during the operational testing of the systems.
  
8.     Documentation:
  - a.     The System Integrator shall provide detailed documentation for the design of the control system. As a minimum the following design documentation is required:
    - 1)     Cut sheets and descriptions of all components and hardware including ratings and limitations.
    - 2)     Wiring diagrams for all connections and controls.
    - 3)     Program logic on both hard copy printout and compact disk.
    - 4)     Flow charts describing the functioning of the control system.
    - 5)     As-built drawings for field wiring and connections.
    - 6)     Panel layouts.
    - 7)     Update existing plant control system documentation to show new connections to the PLCs.
  - b.     The System Integrator shall document the field tests in accordance with detailed test reports.
  - c.     The System Integrator shall coordinate the final documentation, including as-build drawings, O&M Manuals and Warranty information. All documentation shall be submitted to the Engineer for review and shall become part of the Operation and Maintenance Manuals.

- d. The System Integrator or contractor shall label all wires and equipment with a unique non repeating system. The labeling identification numbers shall be included on the As-Built, existing loop and interconnection drawings.
  - e. The System Integrator shall provide standard warranty services.
9. Training:
- a. The System Integrator shall provide or coordinate the training of control equipment provided for under this or other sections of the specification with Plant personnel.

#### 1.04 SYSTEM INTEGRATOR QUALIFICATIONS

- A. The system integrator shall be subject to approval by the Authority.
- B. The system integrator shall meet the following minimum requirements:
  - 1. Actively involved in the control integration for control systems for a period of at least five years.
  - 2. Actively involved in the design and installation of Ethernet local area networks.
  - 3. Maintain a permanent staff of engineers and technicians who assemble, program, test and field service distributed control systems.
  - 4. Experienced in the installation, configuration, and programming of PC based SCADA software using the specified software.
    - a. The system integrator shall have provided these services for not less than two major projects, using the specified SCADA software, within the last 5 years.
    - b. This experience shall be documented by submitting two references, complete with project descriptions, services provided, contact names and phone numbers, for projects which included not less than 5 personal computers on a standard local area network using the specified SCADA software to monitor and control plant processes through programmable logic controllers.
    - c. Each of these systems shall be for a system with not less than 200 points.
  - 5. Experienced in configuring and programming PLCs for industrial processes, such as a pumping station, including PID control.
    - a. The system integrator shall have provided these services for not less than two major projects within the last 5 years.
    - b. This experience shall be documented by submitting two references, complete with project descriptions, services provided, contact names and phone numbers, for projects which included multiple PLCs with not less than 100 points of I/O

#### 1.05 SUBMITTALS

- A. Submit in accordance with requirements of Section 01 33 00.
- B. Review and approve all submitted control equipment and designs of other sections of this specification prior to submission to the Authority.
- C. In addition to the requirements of Section 01 33 00 submit the following information necessary to determine the adequacy of the system integrator.
  - 1. A detailed experience list of at least five control systems assembled and programmed by the system integrator. Include project descriptions, contact names and phone numbers in the list.
    - a. List shall include at least one control system upgrade of similar size and scope to this project.
  - 2. A description of the system integrator's capabilities. Include a listing of personnel who shall work on this project, test equipment available, and facility size and layout.
  - 3. All other references, resumes, and other information required to document that the proposed system integrator meets all requirements of the contract specifications and is capable of providing all required services.
  - 4. Provide a copy of the letter or stamp used to review and approve the submitted control equipment and designs of other sections of this specification.
- D. IP Address Listing
  - 1. Submit a complete IP address listing of all existing and proposed Ethernet components.
- E. I/O Data Base
  - 1. Submit an I/O Database for all new and modified PLC data points. Database shall include:
    - a. Unique Signal ID (Record Key Value)
    - b. PLC Tag Name
    - c. OIT Tag Name
    - d. HMI Tag Name
    - e. I/O Description
    - f. Drawing Reference
    - g. Source Unit
    - h. Source Unit Address
    - i. Signal Type
    - j. Signal Level
    - k. Signal Format
    - l. Signal Power (Field or Panel)
    - m. Raw\_zero
    - n. Raw\_full
    - o. Eng\_zero
    - p. Eng\_full
    - q. Eng\_units
    - r. Zero State



- s. One State
- t. Alarm

F. Programming

1. Submit detailed description of all proposed control equipment programming prior to delivery to the site. The submittal shall include:
  - a. A tabular listing of all I/O points.
  - b. Written functional description, including:
    - 1) Listing of the input signals, including a reference to the monitored instruments and devices.
    - 2) Listing of the output signals, including a reference to the controlled devices
    - 3) Listing of status tags and calculated values interfacing with all other plant control systems, including existing controllers and control systems specified in other sections and divisions of this Contract.
    - 4) A description of the control functions generating the output signals and calculated values
  - c. Preliminary program listings
  - d. HMI workstation graphics
  - e. OIT panel graphics
  - f. Any programming manuals or other documents required to interpret the program listings.
2. A detailed written description of all proposed configuration and programming of the existing PLC and HMI system, including all I/O lists, nicknames, register locations, and related items.

G. Testing Plan

1. Detailed step-by-step test procedures to demonstrate all functions and features of each component of the control system.
  - a. These test procedures shall cover all control and communication equipment and materials specified under other sections of these specifications plus any additional items required to document that a complete and fully functional system has been installed.
2. Submit a detailed testing plan and procedure for each I/O data point and calculated value, including test forms.
3. Refer to TESTING subsection in Part 3 of this specification for additional requirements.
4. Test forms to document completion of field tests with written procedures, expected results, spaces for entry of actual results, spaces for comments, and spaces for sign off by the contractor, system integrator, and Plant representative.

H. O&M Manuals

1. Submit detailed final documentation including as-built (record) drawings, Operation & Maintenance manuals, software documentation, and other

items required to fully document the system as installed and commissioned.

- a. The O&M manual shall include a detailed functional description and alarm section with descriptive trouble-shooting procedures for each alarm.
  - b. Refer to Section 01 33 00 and Section 01 78 23.
2. Include final copies of all program listings with annotations, comments and cross reference tag list in both hard copy printout and on CDs in O&M Manuals.
- a. Load final copies of all programs on the HMI workstation, along with the configuration programs, and verify communication and interaction of all development software with remote equipment prior to submitting O&M manual.

#### 1.06 TRAINING

- A. Coordinate the training provided for under other sections of the specification with Owner personnel.
- B. All training must be coordinated with the activities of the plant personnel.
  1. The system integrator shall not schedule any training until it has been confirmed in writing that the proposed schedule is acceptable to the Authority.
  2. The system integrator shall submit the proposed schedule for each course not less than 4 weeks prior to the proposed training date.
  3. If the proposed dates for training are not convenient to Authority personnel, the system integrator shall adjust the schedule accordingly.
- C. Training shall be scheduled to the convenience of Authority personnel and shall be coordinated with the Authority.

#### PART 2 - **PRODUCTS** Not Used

#### PART 3 - **EXECUTION**

##### 3.01 CONFIGURATION AND PROGRAMMING

- A. Completely configure all programmable controllers, data communications equipment, and field devices supplied under other sections of this specifications.
  1. Provide all calculations and functions called for in other sections of these specifications or noted on the contract drawings.

2. Debug and trouble shoot all programming and software installation prior to the beginning of the testing phase.

B. Network Configuration

1. Provide all programming necessary to interface the new control and communication equipment with the existing SCADA communications system.
  - a. Work with the Authority's integrator to modify and test the existing network of Human Machine Interface (HMI) operator interface units (client workstations) and SCADA system servers on the plant-wide local area network to accept the new and modified signals from the new PLC and HMI hardware.
2. Work with the Authority's integrator to coordinate and organize the new control equipment communication addresses with the existing SCADA at the plant.
3. Completely configure the refresh rate and polling configuration of all nodes on the PLC and HMI LAN to optimize the transfer of data under worst case conditions.

C. I/O Coordination

1. Create, compile and install all databases required to monitor and control the plant processes from any and all Operator Workstations.
2. Create and configure a variable tag for each input point and each output point for each new PLC and other input devices.
3. Configure all calculated variables required to present the desired information.

D. Programmable Logic Controller (PLC) Programming

1. Programming for the control algorithms shall be performed with the Owner's current software using the IEC ladder diagram configuration.
  - a. All Programming shall be done in ladder logic format; function blocks, structured text, or other programming methods shall not be acceptable.
2. Configure the new PLC equipment to monitor and control the field devices described in the Function Description.
3. Map each hardwired discrete input I/O point to a series of consecutive registers in the PLC CPU.
4. Map each hardwired analog input I/O point to a series of consecutive registers in the PLC CPU.
  - a. Program a second set of analog values, stored in a series of consecutive registers, representing the engineering value of each of the input and output signals.

- b. Multiply the raw numerical value by the engineering scale, plus the zero offset
  - 5. Program the control logic required for the analog outputs and discrete outputs as indicated under Function Description.
  - 6. Program the control logic required to generate and maintain a calculated value to be passed to the HMI system.
    - a. Provide calculated values for all functions indicated in this and other sections of these specifications.
  - 7. Program the control logic required to allow operator override control of all PLC outputs passed from the HMI system.
    - a. Provide programming necessary for the HMI to monitor and control every data point that the PLC is monitoring and controlling.
- E. Human Machine Interface (HMI) programming
  - 1. Provide graphic programming for the existing HMI server for all work performed for the project. Programming shall provide all the functionality and control that an operator would have when standing in front of the local control panels and equipment.
    - a. General Requirements
      - 1) Display all monitored process values and device status in a tabular format.
      - 2) Display an alarm log screen in a tabular format with time and date stamp.
      - 3) Display an exaggerated alarm indication on unacknowledged alarm conditions.
      - 4) Display motor run times as both resettable and unresettable values. Motor run times shall be individually resettable from the operator interface terminal.
      - 5) Display a 24 hour trend screen of the monitored process values.
    - b. Display all monitored I/O points.
      - 1) Provide HMI operator forced override to all monitored I/O points
    - c. Display all controlled I/O points.
      - 1) Provide HMI operator manual override to all controlled (output) I/O points.
  - 2. Provide tag modifications and communication configuration of the existing Human Machine Interface (HMI) terminals.
    - a. Provide all programming and coordination necessary to create control equipment addresses tags, links to screen components and configuration in the existing HMI.
    - b. Investigate each of the I/O signal tags that are listed in the HMI tag list dump at the beginning of construction.
      - 1) Identify each tag that is not affected by the work under this Contract.

- 2) Identify each tag that needs to be redirected due to the work under this Contract.
- 3) Identify each tag that needs to be added due to the work under this Contract.
- 4) Identify each tag that needs to be removed from the database due to the work under this Contract.
- c. Create new tags for I/O not presently in HMI system.
  - 1) Create new graphic screens displaying a tabular list linking all I/O tags with a displayed indicator or control for each I/O tag not actively displayed in the HMI at the beginning of construction.
- d. Remove existing tags from the abandoned pump stations which are not going to be reused in the HMI system.
- e. Verify the function of each I/O tag by actuating the field device or graphic control and verifying that the corresponding graphic indicator or controlled field device responds appropriately.

### 3.02 FUNCTIONAL DESCRIPTIONS

- A. This section specifies programming work required for specific process applications in addition to the general programming descriptions above and described in Section 40 61 96.
  - 1. Manual Control: A Hand-Off-Auto selector switch shall be provided on the Pump Control Panel for each pump. When the Pump Control Panel selector switch is turned to Hand the associated pump will start immediately unless:
    - a. Over-temperature Alarm is active.
    - b. Seal-Failure Alarm is active.
  - 2. Auto Control: For Auto control operations to work the Hand-Off-Auto selector switch on the VFD must be in the Auto position. When the Pump Control Panel selector switch is in the Auto position the system will automatically start and stop all pumps available for operation as indicated below:
    - a. Normal Operation: The control system is to utilize the submersible pressure transducer for level indication and as the reference to start and stop the pumps.
      - 1) The start and stop settings for pump operation shall be user adjustable.
      - 2) The controls are to incorporate a dead-band or utilize de-bounce timers to start and stop the pumps to eliminate “chattering” the starters.
    - b. High Level Float: In the event that the High Level Float is triggered a back-up five float based level control system (Low level, Pumps Off, Lead Pump Start, Lag Pump Start, High Level) shall take over for control of the pumps as follows:
      - 1) Turn on both submersible pumps.
      - 2) High Level Float alarm will be sent through SCADA, requiring the operators to acknowledge the alarm.
      - 3) Run both submersible pumps until to the pump shutoff float turns the pumps off.

- 4) The back-up level control system shall remain in control until an operator selects primary level control.
  - c. Loss of Power: In the event of a power failure, the system will automatically re-start the pumps based on the wet well level.
  - d. The lead/lag pump designation shall be alternated to the next successive available pump each time the pumps stop.
    - 1) The operator shall be able to choose the lead, lag configuration (i.e. 1-2. 2-1. None).
    - 2) The operator shall also have the option to alternate the lead pump on a weekly basis.
  - e. Pump Failure: If a pump fails to start or is not in Auto, the next successive pump in the sequence (or the other available pump) shall be started immediately.
  - f. Pump speed for the submersible pump shall either be constant or vary based upon level within the Wetwell. Consult with the Authority for requirements. For speed variance, as the pumps start, the submersible pumps shall start at their minimum speed setting (defined by pump manufacturer to prevent cavitation of submersible pump). As wetwell level rises, submersible pump(s) speed shall increase to maximum speed at a user defined set point. As wetwell level decreases, the submersible pump speed shall decrease to the minimum pump speed (defined by pump manufacturer to prevent cavitation of submersible pump).
- 3. Hardwire Interlocks:
  - a. Pump shall be shutdown on Low Level float activation in auto control.
- 4. Local Monitoring and Alarms:
  - a. The following status and alarm conditions will be indicated on the Control Panel utilizing an Operator interface as specified in as well as other points listed in the I/O list contained in Part 4 - I/O List:
    - 1) Pump Run indication.
    - 2) Pump Stopped indication.
    - 3) Pump Runtime Meter.
    - 4) Pump Seal-Failure Alarm.
    - 5) Pump Overtemp Alarm.
    - 6) Pump Failure Alarm.
    - 7) Pump Motor High Temp.
    - 8) Pump Motor Seal Fail
    - 9) Low Level Float Alarm.
    - 10) High Level Float Alarm.
    - 11) VFD Fail Alarm
    - 12) Wetwell Level.
    - 13) Wetwell Level High (based on LIT).
    - 14) Wetwell Level Low (based on LIT).
    - 15) Active alarm screen.
    - 16) Alarm history screen.
    - 17) Analog scaling setup screen for analog points.
    - 18) Control Method (Normal or Back-up)
- 5. Remote Monitoring and Alarms:

- a. The following status and alarm conditions will be monitored at the SCADA System as well as other points listed in the I/O list contained in Part 4 - I/O List:
  - 1) Pump Run indication.
  - 2) Pump Stopped indication.
  - 3) Pump Runtime.
  - 4) Pump Seal-Failure Alarm.
  - 5) Pump Overtemp Alarm.
  - 6) Pump Failure indication.
  - 7) VFD Failure Alarm
  - 8) Low-Low Level Float Alarm.
  - 9) High-High Level Float Alarm.
  - 10) Wetwell Level.
  - 11) Wetwell Level High (based on LIT).
  - 12) Wetwell Level Low (based on LIT).
  - 13) Loss of Normal Power.
  - 14) Generator running.
  - 15) Generator failure.
  - 16) Fuel failure, if natural gas.
  - 17) Spare, if natural gas.
  - 18) Fuel tank low, if diesel.
  - 19) Fuel tank rupture, if diesel.
  - 20) Oil pressure alarm.
  - 21) Overcrank shutdown.
  - 22) Coolant high-temperature alarm.
  - 23) Coolant low-temperature alarm.
  - 24) Coolant low-level alarm.
  - 25) Block heater ON/OFF.
  - 26) Control switch not in auto position.
  - 27) Battery-charger malfunction alarm.
  - 28) Battery low-voltage alarm.
- 6. Instruments:
  - a. The following is a list of instruments to be provided by the system integrator (Refer to Section 40 72 00):
    - 1) Submersible Pressure Transducer.
    - 2) Low Level Float.
    - 3) (3) Intermediate Level Floats.
    - 4) High Level Float.
- 7. Control Panel: The following is a list of the minimum equipment to be included in the control panel. Refer to specification Section 40 90 10 for equipment specifications as well as applicable panel layout and wiring requirements.
  - a. Enclosure rating: Nema 4X.
  - b. Power requirements: 120VAC.
  - c. Programmable Logic Controller.
  - d. Seal-Failure and Overtemp detection: All necessary transformers and relays associated with moisture and overtemp detection shall be contained within the control panel and provided by the pump manufacturer.
  - e. Control Relays.
  - f. Signal Isolators.
  - g. GFI Receptacle.

- h. Terminal Blocks.
- i. Circuit breakers.
- j. Fuse cut-outs.
- k. UPS.
- l. Coordinate with the Authority for communication requirements.

### 3.03 TESTING

- A. Submit test plans and procedures, including test forms, to the Authority for review and approval within one week after the equipment has been delivered to the site.
  - 1. Demonstrate that each network connected device installed under this contract is properly installed and functioning.
  - 2. Demonstrate that the SCADA software modifications executed under this Contract has been installed and are functioning as intended.
  - 3. Demonstrate that the SCADA software is properly communicating with each I/O point on each PLC or other devices and that the field data is available at all network nodes.
  - 4. Demonstrate that all displays, trends, alarms, and reports have been configured and are properly operating.
  - 5. Demonstrate that all real-time data is being collected as historical data and is accessible from PCs on the existing LAN.
  - 6. Demonstrate that all control system configuration software is properly operating on the HMI workstation, and that the final configuration files can be uploaded, modified, and downloaded into the network attached control equipment.
- B. Unless otherwise approved in writing, all testing shall be performed in the presence of authorized Plant personnel from both the Operations and Maintenance.
- C. Test forms shall be prepared and submitted by the contractor prior to scheduling of each test.
  - 1. These forms shall be completed at the time of witnessed testing and signed by both the contractor and Authority's representatives.
- D. Perform or assist in the performance of all field tests listed in other sections of these contract specifications.

## PART 4 - DATA

### 4.01 I/O LIST

#### Discrete Inputs:

No.	Description	Condition	Source	Destination
1	Submersible Pump #1	Running	VFD	PLC



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2	Submersible Pump #1	Fault	VFD	PLC
3	Submersible Pump #1	Over-Temp	VFD	PLC
4	Submersible Pump #1	Seal-Leak	VFD	PLC
5	Submersible Pump #2	Running	VFD	PLC
6	Submersible Pump #2	Fault	VFD	PLC
7	Submersible Pump #2	Over-Temp	VFD	PLC
8	Submersible Pump #2	Seal-Leak	VFD	PLC
9	VFD #1	Fault	VFD	PLC
10	VFD #2	Fault	VFD	PLC
11	High-High Level Float	Alarm	Float	PLC
12	High Level Float	Indication	Float	PLC
13	Mid Level Float	Indication	Float	PLC
14	Low Level Float	Indication	Float	PLC
15	Low-Low Level Float	Alarm	Float	PLC
16	Loss of Normal Power	Alarm	ATS	PLC
17	Generator Running	Status	Generator	PLC
18	Generator Fault	Status	Generator	PLC
19	Fuel Tank Low	Alarm	Generator	PLC
20	Fuel Tank Rupture	Alarm	Generator	PLC
21	Commercial/Utility Power	Status	Generator	PLC
22	Spare (Natural Gas)	Status	Generator	PLC
23	Oil Pressure	Alarm	Generator	PLC
24	Overcrank Shutdown	Status	Generator	PLC
25	Coolant High Temperature	Alarm	Generator	PLC
26	Coolant Low Temperature	Alarm	Generator	PLC
27	Coolant Low Level	Alarm	Generator	PLC
28	Block Heater (On/Off)	Status	Generator	PLC
29	Control Switch (not auto)	Status	Generator	PLC
30	Battery Charger	Alarm	Generator	PLC
31	Batter Low Voltage	Alarm	Generator	PLC

Discrete Outputs:

No.	Description	Condition	Source	Destination
1	Submersible Pump #1	Run Command	PLC	VFD
2	Submersible Pump #2	Run Command	PLC	VFD

Analog Inputs:

No.	Description	Condition	Source	Destination
1	Submersible Pump #1	Speed Feedback	VFD	PLC
2	Submersible Pump #2	Speed Feedback	VFD	PLC
3	Submersible Pressure Transmitter	Level	Transmitter	PLC

Discrete Outputs:

No.	Description	Condition	Source	Destination
1	Submersible Pump #1	Speed Control	PLC	VFD
2	Submersible Pump #2	Speed Control	PLC	VFD

**END OF SECTION**

**SECTION 40 72 00 – INSTRUMENTATION FOR PROCESS SYSTEMS: LEVEL MEASUREMENT**

**PART 1 – GENERAL.**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Submersible Pressure Transducer Level Monitor
  - 2. Level Switches

**1.02 SYSTEM DESCRIPTION**

- A. Instrumentation shall work fundamentally with the Control System to operate pumps.

**1.03 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00.
- B. Product Data
  - 1. Catalog Cutsheets
  - 2. Engineering data defining materials of construction and suitable applications
- C. Shop Drawings
  - 1. Dimensional Drawings, including cable diameter
  - 2. Field Wiring Diagrams
- D. Quality Assurance/Control Submittals
  - 1. Factor calibration report including calibration data, date of calibration and accuracy.
  - 2. Each instrument shall be fully factory inspected and tested for function, operation and continuity of circuits.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Packing, Shipping, Handling, and Unloading
  - 1. In accordance with manufacturer's recommendations.
- B. Storage and Protection
  - 1. Store and protect in accordance with manufacturer's recommendations.

## **PART 2 – PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Level Switch
  - 1. Flygt or equal.
- B. Submersible Pressure Transducer Level Monitor
  - 1. Motor Protection Electronics, Inc. or equal.

### **2.02 LEVEL SWITCH**

- A. General
  - 1. Contact System shall be a Microswitch
  - 2. Output shall be dry contact with max load rating of (AC: 250V @16A or DC:220V@.5A or 24V@16A)
  - 3. The operating temperature shall be between 0 to 60 °C
  - 4. The cable shall be sheathed with a highly flexible oil resistant material having adequate tensile strength.
  - 5. The float housing material shall be made of Polypropylene
  - 6. All floats shall be provided with counter weights

### **2.03 SUBMERSIBLE PRESSURE TRANSDUCER LEVEL MONITOR**

- A. Materials:
  - 1. Sensor wetted parts: 316 Stainless Steel.
  - 2. Cable: polyurethane waterproof assembly.
- B. Design and fabrication:
  - 1. Sensor:
    - a. A stainless steel diaphragm and silicon oil fill shall be provided to isolate and protect the sensor from the liquid being measured.
    - b. Sensor shall be rated for pressure ranges based on overflow levels or full containment levels.
    - c. Cable strength shall be ample to support the weight of the sensor. Sensor shall be of adequate weight to reduce movement in a moving liquid.
    - d. Sensor shall be fitted with an anti-clog attachment.
    - e. Provide manufacturer's cable of sufficient length to reach junction box at easily accessible location without splicing.
  - 2. Operating Voltage: 13-29 VDC

3. Output Signal: 4-20 mA, two wire
4. Operating temperature: 32 to 140 °F.
5. Long term stability: +0.1 percent.
6. Temperature Effects: +0.3 percent of full scale.
7. Accuracy: +/- 0.5% full scale
8. Intrinsic Safety: Certified for use with IS Barriers.

## 2.07 ACCESSORIES

### A. Level Measurement Instrumentation Bracket

1. Float switches and pressure transducer shall hang from 3/16 diameter hooks welded to a mounting bracket constructed entirely of 304 Stainless Steel. One hook shall be provided for each instrument. Bracket dimensions shall be designed based on wet well dimensions.
2. A cable grip shall be used per instrument for hanging. Cable grips shall be constructed of 304 stainless steel and shall be of adequate strength to support the weight of the instrument.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

#### A. Mounting

1. Mount instrumentation bracket to concrete wet well top slab using 316 stainless steel hardware.
2. Mount instrumentation in a location such that it will be readily accessible for operation and maintenance.
3. Mount instrumentation in a location such that it is not impacted by wet well turbulence or subject to interference with other equipment or cables.
4. If wet well turbulence results in appreciable movement of the transducer, provide a fixed mounting apparatus (i.e. stilling well or solid pipe conduit)

#### B. Interface with Other Work

1. Coordinate routing and installation of power/control cables with the Electrical Work.

### 3.02 FIELD QUALITY CONTROL

A. Site Tests

1. Conduct field measurement tests to demonstrate in-field accuracy of transducer at various wet well depths (low, operational levels, high). Provide written test reports.
2. Manually manipulate float switches to demonstrate pump operation.

B. Manufacturers' Field Services

1. Installation Assistance

- a. Provide the services of a qualified factory engineer to supervise the installation, to test and make any adjustments required, and to place the completed system in operation.

2. System Operation Training

- a. The Contractor shall have the instrumentation supplier provide a factory trained engineer to instruct the Authority's operating personnel in the use, operation, care, and maintenance of the process control instrumentation.
- b. The training shall be conducted on-site and be presented in a manner to impart thorough understanding of the systems and equipment provided.
- c. The training shall be given to the personnel designated by the Authority who will be responsible for the operation during each work shift. The personnel shall sign a certificate presented by the Contractor that they have been trained on the plant equipment and they thoroughly understand the operation, care and maintenance of the equipment.
- d. When the Authority is ready to have his personnel trained, the Contractor will be so notified by the Authority. The Contractor will then ensure that the manufacturer's representatives are available on-site to conduct the required training.
  - i. Provide for one (1) eight (8) hour working day total to instruct Operators for the equipment supplied. The Authority will require the Contractor to integrate such training with overall training for the work.

3.03 ELECTRICAL WORK

A. Signal wiring shall be carried in raceways or conduit provided in accordance with other sections of the Specifications.

1. Shielded twisted pairs carrying 4-20 mAdc and other low level signals shall be run in conduits or raceways separate from all other control and power wiring.
  - a. All analog circuits shall be run as twisted pairs or triads.
  - b. In no case shall a circuit be made up using conductors from different pairs or triads.

- c. Triads shall be used wherever three (3) wire circuits are required.
      - d. Triads shall not be formed by using two (2) pairs.
    - 2. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.
    - 3. Signal circuits shall, in general, be run without splices between instruments, terminal boxes or panels.
  - B. Shields shall, in general, be bonded to the ground bus at the control panel and isolated at all other locations.
    - 1. Terminal blocks shall be provided for interconnecting shield drain wires at all junction boxes.
  - C. Alternating current power supply connections for panel mounted equipment shall be by cord and plug (where practicable).
    - 1. Field mounted units shall be wired in solid and provided with a power disconnect switch either internally or adjacent to the unit.
    - 2. Where multiple field mounted units are fed from a single circuit breaker, each field mounted unit shall be protected by individual draw-out fuses.
- 3.04 ADJUSTING
- A. Adjust instrumentation elevations as necessary to properly control the pumps.

**END OF SECTION**

**SECTION 43 25 00 – SUBMERSIBLE LIQUID PUMPS**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Raw Sewage Submersible Pumps
  - 2. Accessories (discharge connection and guiderails)

**1.02 REFERENCES**

- A. American Society for Testing and Materials (ASTM): Latest Edition
  - 1. ASTM A-48: Standard Specification for Gray Iron Castings
  - 2. ASTM A479: Standard Specification for Stainless Steel Bars
  - 3. ASTM A-532: Standard Specification for Abrasion-Resistant Cast Irons
- B. National Electric Manufacturers Association

**1.03 SYSTEM DESCRIPTION**

- A. Furnish, install and place into operation a functional pumping system complete with motors, variable frequency drives, discharge connection, anchor bolts, guide rails, controls and all accessory equipment for a complete working installation.
- B. Pumps and Controls shall be provided by a single responsible entity. Refer to Division 40 for Instrumentation and Control System Equipment requirements.
- C. Pump manufacturer's cable shall be of sufficient length to be installed without splicing from the pump location to the control panel termination while providing a minimum of 2' coiled cable within the wet well.

**1.04 SUBMITTALS**

- A. Comply with Section 01 33 00.
- B. Product Data
  - 1. Characteristic Pump Performance Curves
  - 2. Electrical Motor Data
  - 3. Typical Installation Guides
  - 4. Technical Manuals
  - 5. Operation and Maintenance Data: As defined in Section 01 73 00
  - 6. Parts List

- C. Shop Drawings
  - 1. Pump Outline Drawing, including baseplate
  - 2. Station Drawing for Accessories
- D. Quality Assurance/Control Submittals
  - 1. Test Reports: Prior to shipment of pumps from the factory, complete test runs shall be made on each pump under the capacity and head conditions specified. Characteristics of centrifugal pumps may have a tolerance of plus 10 percent of rated capacity at rated head or plus 5 percent of rated head at rated capacity. No minus tolerance will be acceptable. Certified copies of these tests in triplicate shall be furnished. The curves provided shall show the results of tests for capacities, heads, efficiencies and brake horsepower throughout the entire range of the pump being furnished.
  - 2. Manufacturer's Equipment Storage Requirements
  - 3. Manufacturer's Standard Recommended Start-Up Report Form.

1.05 QUALITY ASSURANCE

- A. In order to achieve standardization of operation, maintenance, spare parts, and manufacturer's service, pumps complete with mechanical seals and motor units shall be manufactured by Flygt. Where applicable based on specific station design conditions, pump model shall be one of the following:
  - 1. Flygt Model NP-3102.095 (463 Impeller)
  - 2. Flygt Model NP-3127.095 (488 Impeller)
  - 3. Flygt Model NP-3153.095 (276 Impeller)
  - 4. Where one of the aforementioned models does not meet the design conditions of the specific station, submit an alternate Flygt Model recommendation to the Authority for review.
- B. Regulatory Requirements
  - 1. Comply with all conditions of the Pennsylvania Department of Environmental Protection Water Quality Management Permit (where applicable)
  - 2. Comply with all conditions of the University Area Joint Authority Sewer Extension Agreement (where applicable)
  - 3. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities (latest edition). Wet wells
- C. The pump(s) shall be heavy duty, electric submersible, centrifugal non-clog type units designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use. The pumps provided shall be capable of operating in an ambient liquid temperature of 104 °F.
- D. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged.



The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Comply with Manufacturer's recommendations.
- B. Storage and Protection: Comply with Manufacturer's recommendations. Protect equipment from damage.

1.07 SYSTEM START UP

- A. The equipment manufacturer shall furnish the services of a qualified factory trained field service engineer for an eight-hour work day at the site to inspect the installation and instruct the owner's personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, the contractor shall have the manufacturer conduct the following:
  - 1. Megger stator and power cables
  - 2. Check seal lubrication
  - 3. Check for proper rotation
  - 4. Check power supply voltage
  - 5. Measure motor operating load and no load current
  - 6. Check level control operation and sequence
- B. During initial inspection, the manufacturer's service representative shall review recommended operation and maintenance procedures with the owner's personnel.

1.08 MAINTENANCE

- A. Extra Materials
  - 1. Provide one (1) spare impeller
  - 2. Where the installed pump model is not listed in Paragraph 1.05 A, provide a complete spare pump.

**PART 2 – PRODUCTS**

2.01 MANUFACTURERS

A. SUBMERSIBLE LIQUID PUMPS

- 1. Flygt

2.02 SUBMERSIBLE LIQUID PUMPS

A. Pump Design Configuration

- 1. The pump shall be supplied with a mating cast iron discharge connection and be capable of delivering the design flow and the design head conditions. The pump(s) 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. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the wet well floor. Each pump shall be fitted with adequate length of stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. Pump Construction

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumped media, 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.
2. 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 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.

C. Cable Entry Seal

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. 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 sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

D. Motor

1. 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 pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and

shall be connected to the motor 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. Motor shall be FM rated explosion proof Class 1, Division 1, Groups C & D.

2. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of  $\pm 10\%$ . The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.
3. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

E. Bearings

1. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a two row angular contact ball bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

F Mechanical Seals

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. 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 are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.
2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have

one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

3. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
4. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

G. Pump Shaft

1. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves are not be acceptable.

H. Impeller

1. The impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

I. Volute

1. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

J. Protection

1. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will

activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

2. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

## 2.03 ACCESSORIES

### A. Guide Rail System

1. Provide a guide rail system for each pump consisting of two 304 stainless steel schedule 40 guide rails with upper guide rail mounting bracket, and intermediate guide brackets every 10 feet.
2. Guide rail system shall facilitate the removal and installation of the pump and shall align the pump with the discharge elbow as it is lowered into place.
3. Guide rails under 20' in total length shall be continuous.
4. Diameter of the guide rail system shall be as recommended by the pump manufacturer for the specific model of pump used.
5. All hardware to be 304 stainless steel.

### B. Discharge Connection

1. Discharge connection shall be manufactured by the pump manufacturer and shall be specifically paired with the pump model.
2. Discharge connection shall support the total weight of the pumping unit. The base shall be bolted directly to the floor with the 90 degree elbow having a 125 lb. ANSI flange discharging vertically.

## 2.04 FINISHES

### A. Manufacturers standard finish

## PART 3 – EXECUTION

### 3.01 PREPARATION

#### A. Protection

1. Protect the wet well liner from damage during installation of pumps and accessories. If damage occurs, provide a field welded repair patch in accordance with the liner manufacturer's recommendations.

#### B. Wet Well Preparation

- 1 Coordinate installation of wet well concrete fillet.

### 3.02 INSTALLATION

- A. Maintain Manufacturer's recommended clearance between pumps and between the wet well floor and the pump suction.
- B. Discharge Connection (aka pump base) shall be grouted after initial fitting and alignment, but before final bolting of the connection piping. After final alignment and bolting, pump connections shall be tested for applied piping stresses by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to ensure that piping stresses are not transmitted to the pump flanges.
- B. Install, level, and align pumps as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

### 3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Pre-Startup Protection
  - 1. Coordinate system pre-startup with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Authority.
  - 2. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.
  - 3. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.
  - 4. Verify that all spare parts for the pumping equipment are on site.
  - 5. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.
  - 6. Demonstrate pump installation (including proper seal to discharge connection) and removal using guide rail system.
- B. Pumping Equipment:
  - 1. Prior to acceptance by the Authority, an operational test of all pumps drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics. Testing performed upon each pump shall include the following:
    - a. Impeller, motor rating and electrical connections shall be checked for compliance with this specification.
    - b. Prior to submergence, each pump shall be run dry to establish correct rotation.

- c. Each pump shall be run submerged in water.
- d. Motor and cable insulation shall be tested for moisture content or insulation defects.
- e. Prior to start-up, clean wet well by removing construction debris and foreign material.

B. Manufacturers' Field Services

- 1. Refer to Paragraph 1.07, herein.

3.04 PROTECTION

- A. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.
- B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

**END OF SECTION**

## **APPENDIX A – LIST OF ACCEPTABLE MANUFACTURERS**

**Note:** This list identifies acceptable manufacturers for commonly used materials. Refer to the detailed specifications for items not listed. Although a manufacturer may be listed, all materials must comply with the detailed specifications. Equal materials and equipment will be considered with submission of acceptable justification demonstrating compliance with specification requirements. To efficiently operate and maintain specific equipment, the Authority has standardized around one manufacturer.

### **SECTION 03 40 00 – PRECAST CONCRETE**

- A. Precast Reinforced Concrete
  - 1. Terre Hill Concrete Products
  - 2. Oldcastle Infrastructure
  - 3. M&W Precast & Construction Supply
  - 4. McCarroll Precast

### **SECTION 08 31 13 – ACCESS HATCHES AND FRAMES**

- A. Floor Access Hatch
  - 1. Bilco
  - 2. Halliday Products
  - 3. U.S.F Fabrication

### **SECTION 09 91 00 – PAINTING**

- A. Paint Materials
  - 1. Tnemec
  - 2. Carboline
  - 3. Sherwin-Williams, Inc.

### **SECTION 26 29 23 – VARIABLE FREQUENCY MOTOR CONTROLLERS**

- A. Variable Frequency Drives
  - 1. Rockwell Automation, Inc.: Allen-Bradley, Powerflex 400 (for Standardization)

### **SECTION 26 32 00 – PACKAGED GENERATOR ASSEMBLIES**

- A. Packaged Engine Generator Assemblies
  - 1. Cummins Power Generation



**SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCHES**

- A. Automatic Transfer Switches
  - 1. Cummins Power Generation

**SECTION 33 11 00 – RECLAIMED WATER UTILITY DISTRIBUTION PIPING**

- A. Ductile Iron Pipe and Fittings
  - 1. U.S. Pipe
  - 2. American
- B. Pipe Restraints (Ductile Iron and PVC)
  - 1. EBAA Iron
  - 2. ROMAC Industries, Inc.
- C. PVC Pipe
  - 1. JM Eagle
  - 2. National Pipe & Plastics, Inc.
  - 3. North American Pipe Corporation
  - 4. Diamond Plastics
  - 5. Royal
- D. HDPE Pipe
  - 1. JM Eagle
  - 2. Charter Plastics
- E. Couplings and Coupling Adapters
  - 1. EBAA Iron
  - 2. Romac Industries
  - 3. Smith-Blair

**SECTION 33 12 00 – RECLAIMED WATER UTILITY DISTRIBUTION EQUIPMENT**

- A. Gate Valves
  - 1. American Flow Control

- 2. Mueller Co.
- B. Valve Boxes
  - 1. Tyler Union
  - 2. Bingham and Taylor
  - 3. US Foundry
- C. Service Connection Components
  - 1. Ford Meter Box Company, Inc.
  - 2. Mueller Co.
  - 3. A.Y. McDonald
- D. Fire Hydrants
  - 1. American Flow Control (for standardization)
- E. Backflow Prevention
  - 1. WATTS
  - 2. ZURN
  - 3. Apollo
- F. Pressure Reducing Valve
  - 1. Cla-Val
  - 2. Bermad
- G. Air Release Valve
  - 1. Crispin
  - 2. Val-Matic Valve & Manufacturing Corporation
  - 3. Cla-Val
- H. Hard Hydrant
  - 1. Woodford Manufacturing
  - 2. Josam Co.
- I. Reclaimed Water Meters
  - 1. Sensus (for standardization)

**SECTION 33 31 00 – SANITARY UTILITY SEWERAGE PIPING AND ACCESSORIES**

- A. Ductile Iron Pipe and Fittings (Gravity and Forcemain)
  - 1. U.S. Pipe
  - 2. American
- B. Pipe Restraints (Ductile Iron and PVC)
  - 1. EBAA Iron
- C. PVC Pipe (Gravity, Forcemain and Low Pressure)
  - 1. JM Eagle
  - 2. National Pipe & Plastics, Inc.
  - 3. North American Pipe Corporation
  - 4. Diamond Plastics
  - 5. Royal
- D. PVC Pipe (Schedule 40 Service Laterals)
  - 1. Charlotte Pipe and Foundry Company
  - 2. National Pipe & Plastics, Inc.
  - 3. Cresline
- E. HDPE Low Pressure Sewer Pipe
  - 1. JM Eagle
  - 2. National Pipe & Plastics, Inc.
  - 3. Charter Plastics
  - 4. ISCO Industries
- F. Swing Check Valves
  - 1. Dezurick
  - 2. Val-Matic
- G. Plug Valves
  - 1. Dezurick
  - 2. Val-Matic

F. Couplings and Coupling Adapters

1. EBAA Iron
2. Romac Industries
3. Smith-Blair

G. Combination Air/Vacuum Valves

1. Crispin
2. Golden Anderson
3. Val-Matic

**SECTION 33 32 16 – PACKAGED GRINDER PUMP UNITS**

A. Packaged Grinder Pump Units

1. Environmental One Corporation (standardized for UAJA owned)
2. Or Equal for Privately Owned

**SECTION 33 39 13 – SANITARY UTILITY SEWERAGE MANHOLES, FRAMES, AND COVERS**

A. Manholes

1. Terre Hill Concrete Products
2. Oldcastle Infrastructure
3. M&W Precast & Construction Supply
4. McCarroll Precast

B. Manhole Frames and Coves

1. East Jordan
2. Neenah Enterprises, Inc.
3. Central Clay
4. US Foundry

C. Cleanout Frame and Cover

1. Vestal Manufacturing Enterprises, Inc.
2. Bingham & Taylor

D. Pipe to Manhole Connectors

1. A Lok Products Corporation

2. Press-Seal Gasket Corporation
3. Hamilton Kent

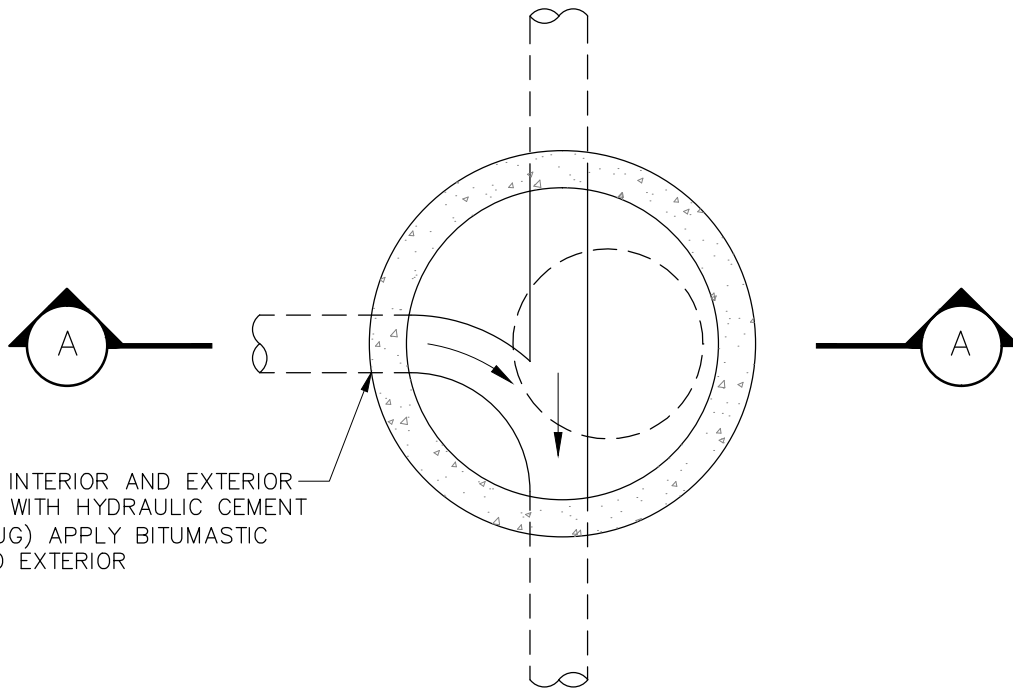
**SECTION 40 63 00 – CONTROL SYSTEM EQUIPMENT**

- A. Programmable Logic Controller
  1. Allen-Bradley: CompactLogix 1769 (for standardization)
- B. Operator Interface Terminal
  1. Allen Bradley: PanelView Plus 1,000 Color (for standardization)
- C. Enclosures
  1. Hoffman

**SECTION 43 25 00 – SUBMERSIBLE LIQUID PUMPS**

- A. Submersible Liquid Pumps
  1. Flygt (for standardization)

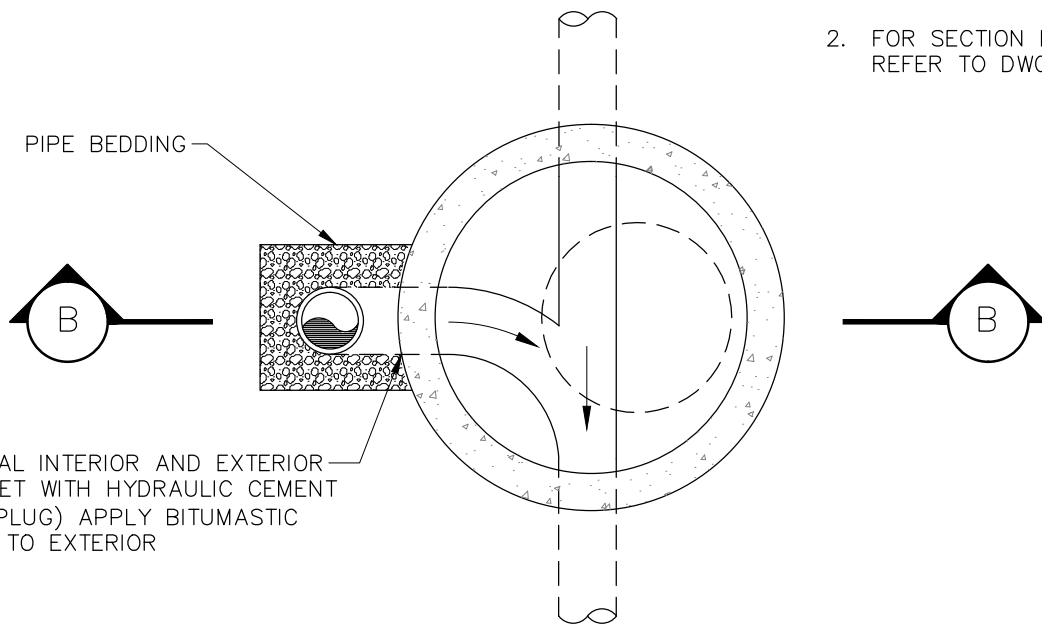
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TYPICAL MANHOLE

NOTES:

1. FOR SECTION A-A  
REFER TO DWG. NO. 2.
2. FOR SECTION B-B  
REFER TO DWG. NO. 3.



DROP MANHOLE

**SECTIONAL PLAN VIEW OF TYPICAL AND DROP MANHOLES**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

**SANITARY SEWER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

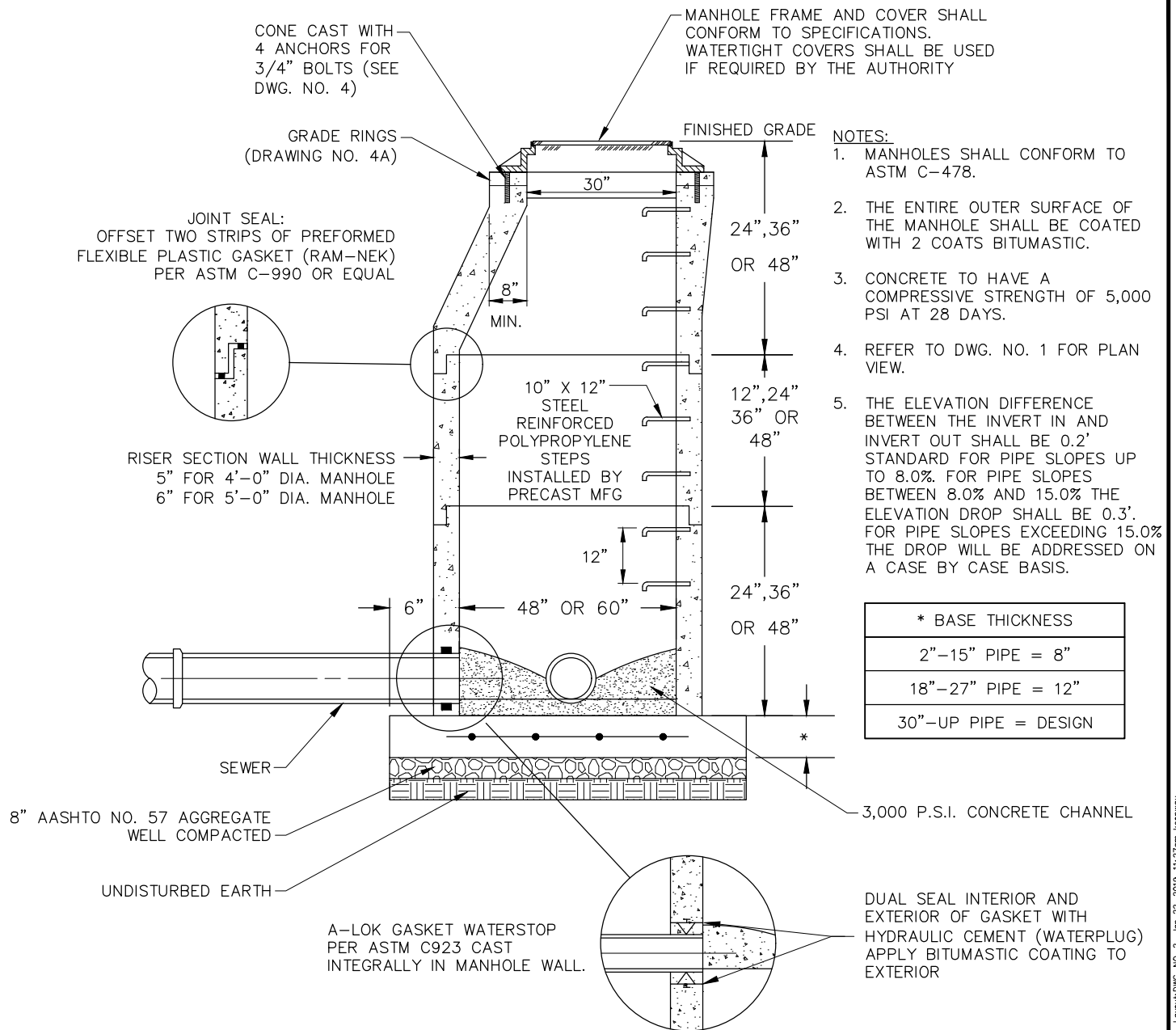
DRAWING NO.

**1**

SHEET NO.

**1 OF 22**

PROJECT 001178.0562



## TYPICAL MANHOLE SECTION A-A PRECAST BASE AND WALL SECTIONS

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

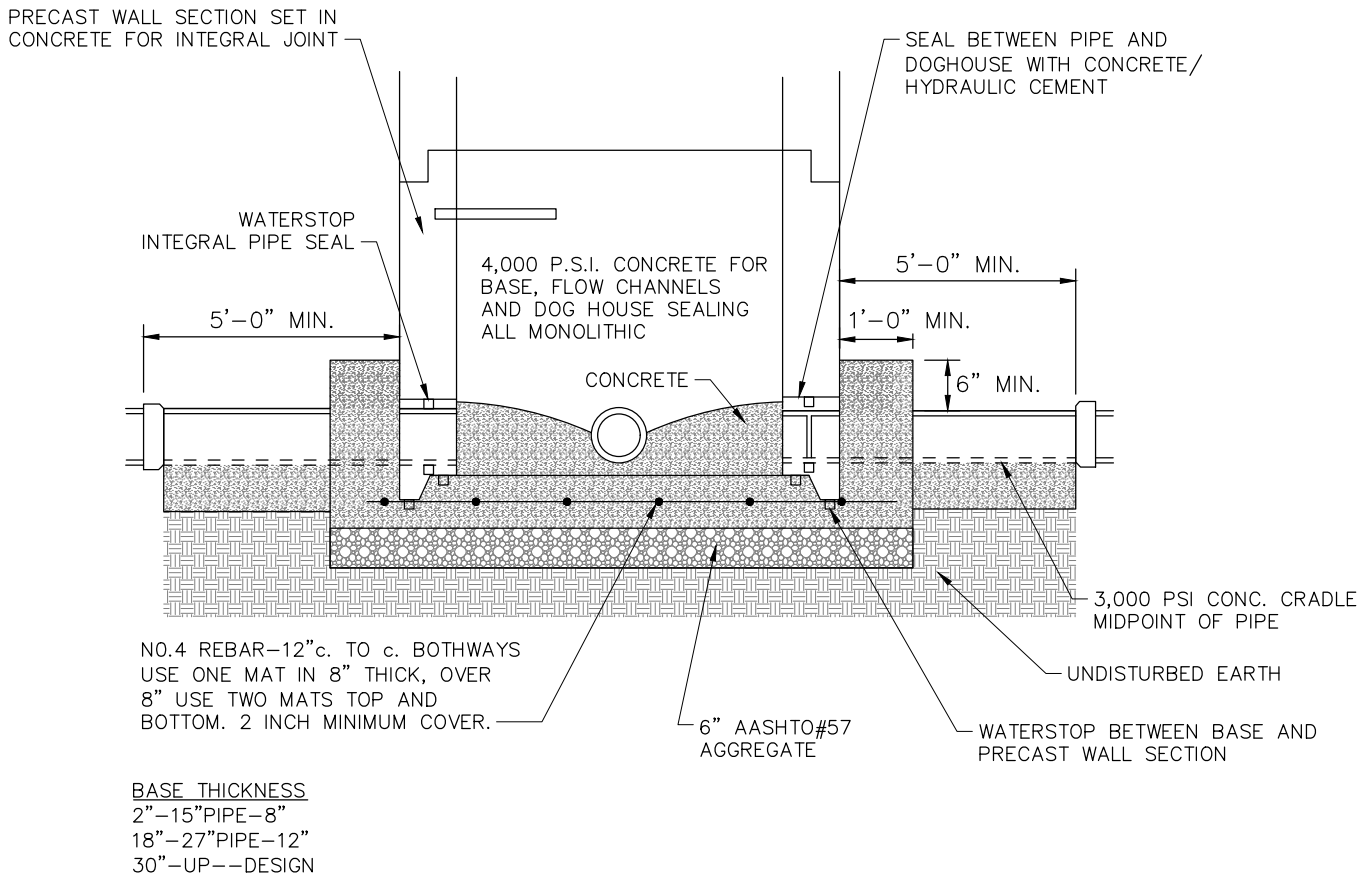
CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. – BRB
DESIGN –
CADD – KEC
CHECKED –
SCALE – AS NOTED
DATE – JAN. 2019

DRAWING NO.
<b>2</b>
SHEET NO.
<b>2 OF 22</b>
PROJECT 001178.0562

**NOTE:**  
USE DOG HOUSE APPLICATION WHEN  
CONNECTING INTO EXISTING SANITARY SEWER  
LINE.



### **FIELD POURED BASE WITH PRECAST WALL SECTIONS**



UNIVERSITY AREA JOINT AUTHORITY

## **SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. - BRB
DESIGN-
CADD- KEC
CHECKED-
SCALE- NTS
DATE- JAN. 2019

DRAWING NO.

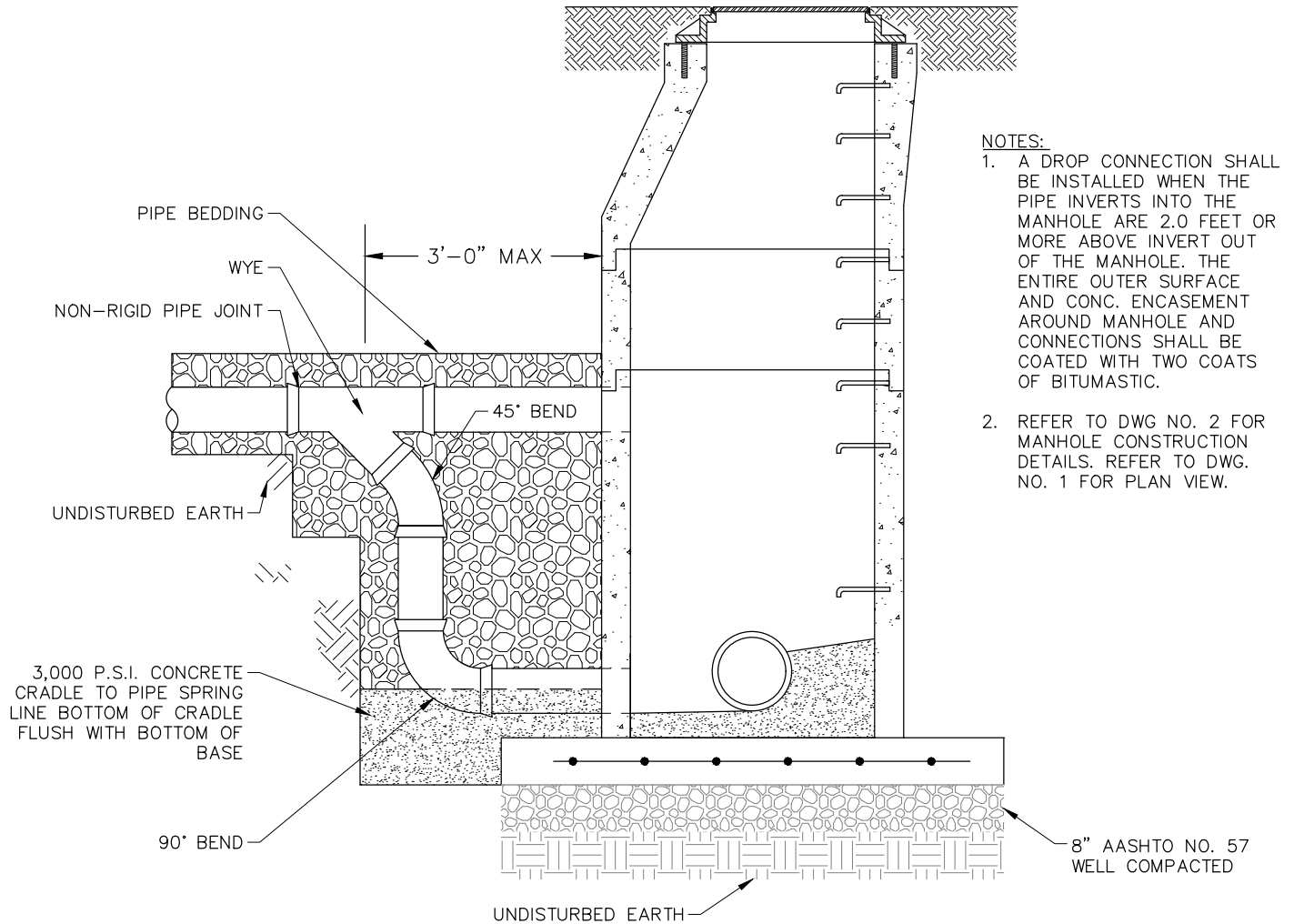
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SHEET NO.

**3 OF 22**

PROJECT 001178.0562





**NOTES:**

1. A DROP CONNECTION SHALL BE INSTALLED WHEN THE PIPE INVERTS INTO THE MANHOLE ARE 2.0 FEET OR MORE ABOVE INVERT OUT OF THE MANHOLE. THE ENTIRE OUTER SURFACE AND CONC. ENCASEMENT AROUND MANHOLE AND CONNECTIONS SHALL BE COATED WITH TWO COATS OF BITUMASTIC.
2. REFER TO DWG NO. 2 FOR MANHOLE CONSTRUCTION DETAILS. REFER TO DWG. NO. 1 FOR PLAN VIEW.

## TYPICAL DROP MANHOLE SECTION B-B PRECAST BASE AND WALL SECTIONS

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

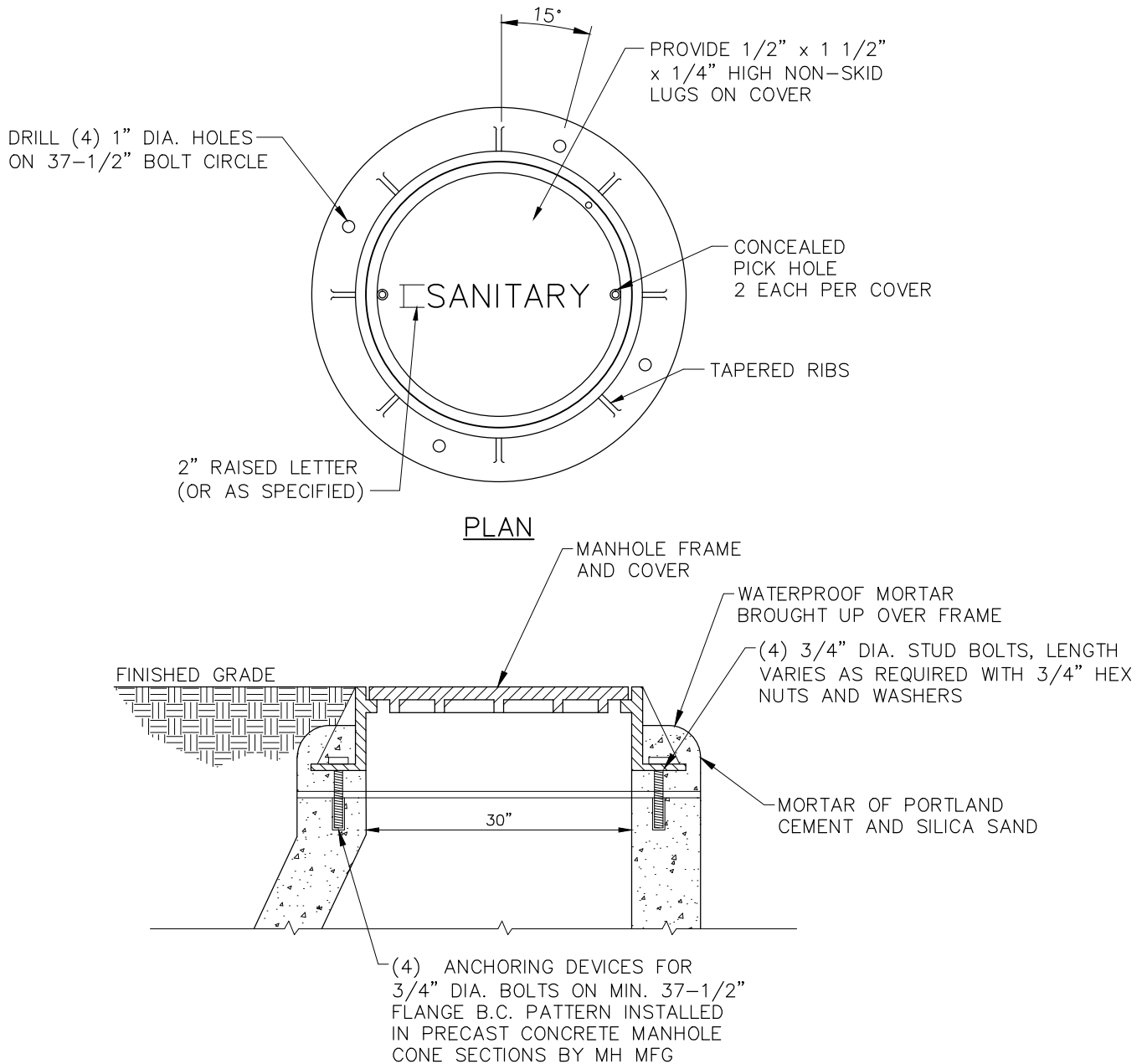
### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JAN. 2019

DRAWING NO.
<b>3</b>
SHEET NO.
<b>4 OF 22</b>
PROJECT 001178.0562



### SECTION

#### NOTES:

1. THE WORD "SANITARY" MUST BE ON THE MANHOLE COVER.
2. PRECAST CONCRETE RINGS ARE REQUIRED ONLY WHERE MANHOLE FRAME AND COVER MUST CONFORM TO GRADE OF STREET. THE TOPS OF ALL WATERTIGHT MANHOLE FRAMES AND COVERS SHALL BE NO LESS THAN (1) FOOT ABOVE GRADE AS DIRECTED BY AUTHORITY. MAX. HEIGHT ADJUSTMENT W/RINGS IS 12".

## **MANHOLE FRAME AND COVER INSTALLATION FOR PRECAST CONCRETE MANHOLES**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

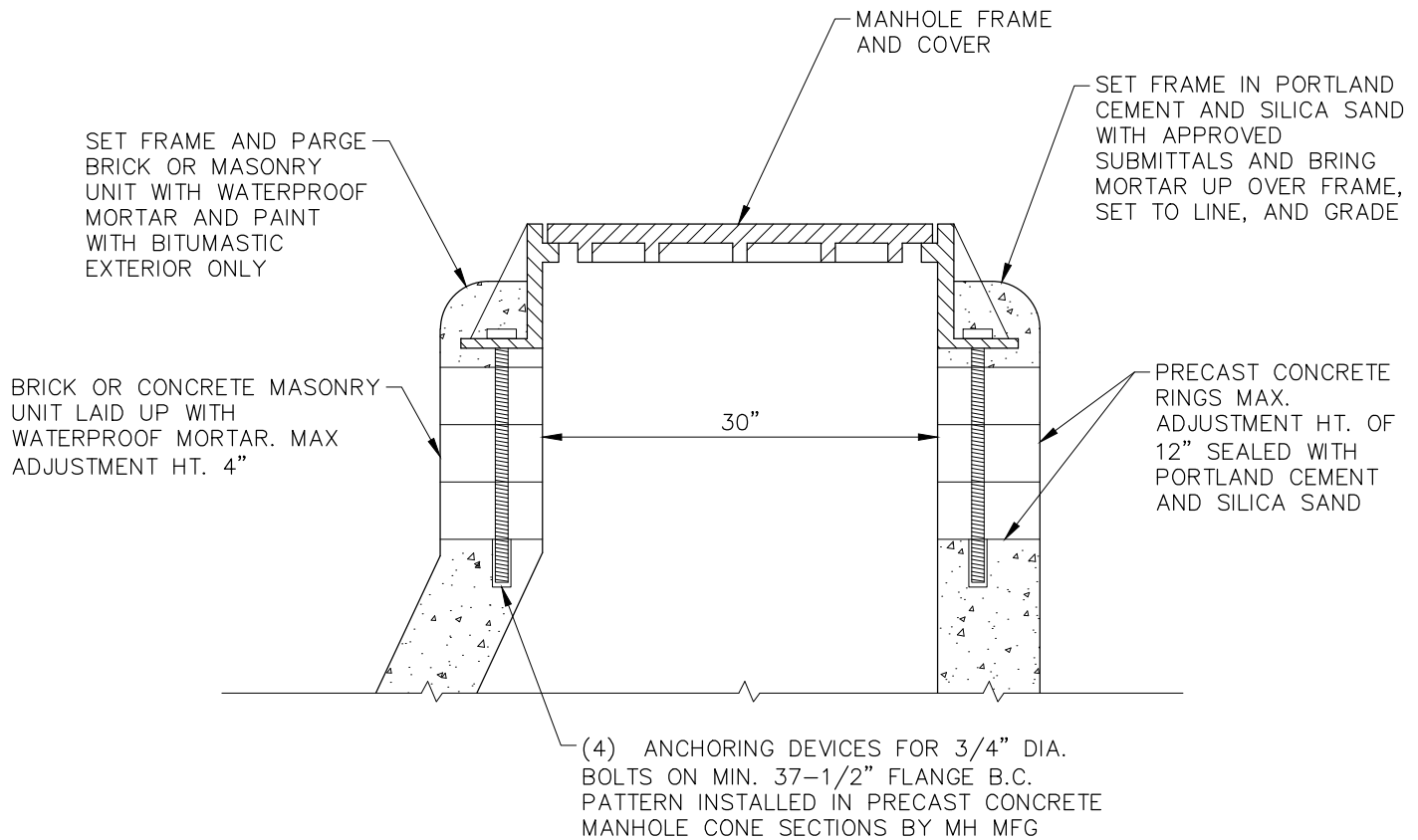
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CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
<b>4</b>
SHEET NO.
<b>5 OF 22</b>
PROJECT 001178.0562



# SECTION

## **MANHOLE FRAME ADJUSTMENT 0" TO 12"**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

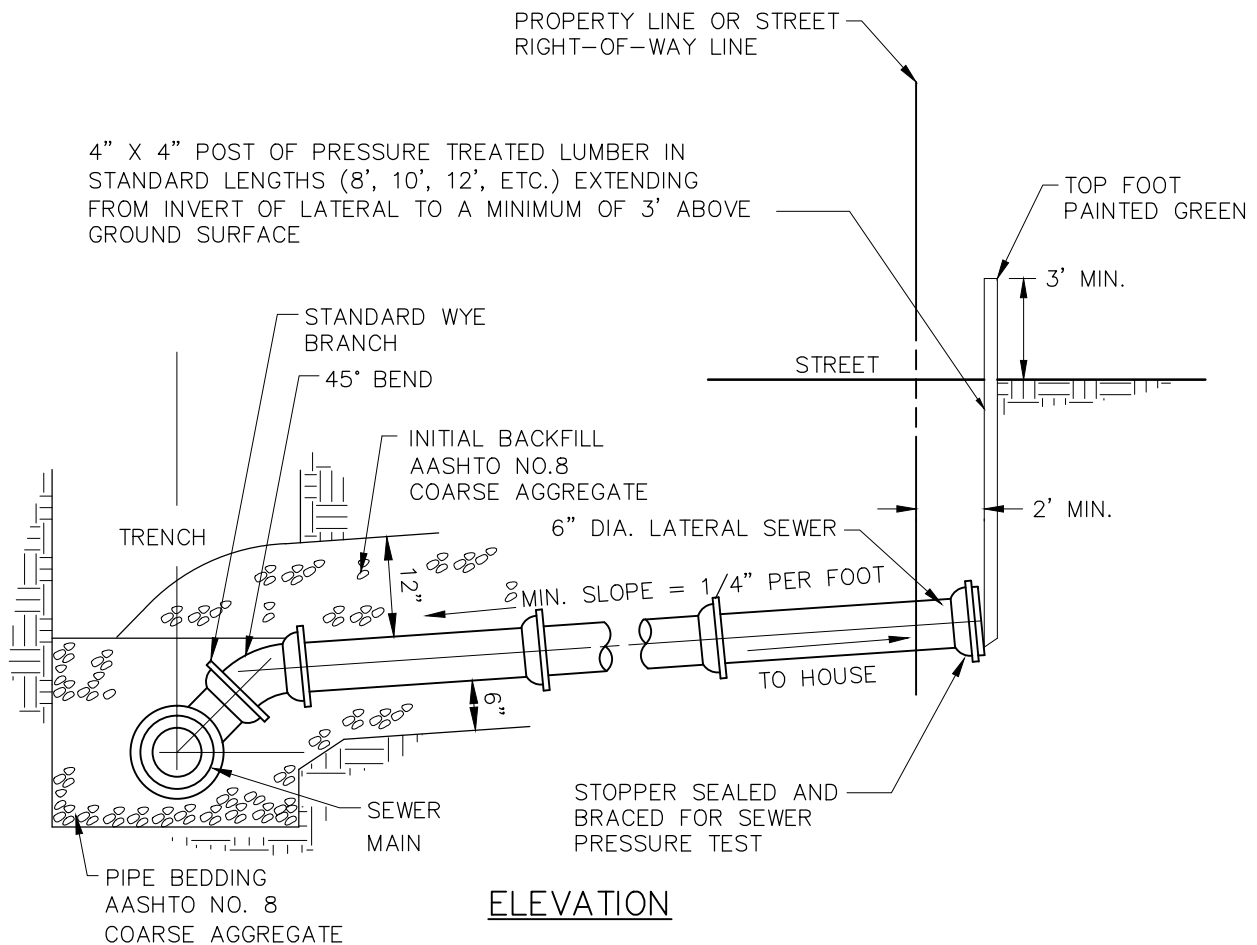
## **SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
<b>4A</b>
SHEET NO.
<b>6 OF 22</b>
PROJECT 001178.0562



**NOTES:**

1. IN THE CONSTRUCTION OF LATERALS, THE CONTRACTOR MUST COORDINATE HIS EFFORTS WITH THE AUTHORITY SO AS TO PROVIDE THE PROPER SERVICE TO THE PROPERTY OWNERS. IF IN THE JUDGEMENT OF THE AUTHORITY THE LATERAL CONSTRUCTED BY THE CONTRACTOR DOES NOT PROVIDE ADEQUATE SERVICE TO THE PROPERTY OWNER, THE CONTRACTOR SHALL RECONSTRUCT THE LATERAL TO THE PROPER GRADE AT HIS (CONTRACTOR) EXPENSE. IT IS THE POLICY OF THE AUTHORITY TO PROVIDE BASEMENT SERVICE (LOWEST ELEVATION) TO ALL LOTS.
2. CONCRETE ENCASE LATERAL FOR A DISTANCE OF 5' ON EITHER SIDE OF A WATER OR STORM SEWER CROSSING. ENCASEMENT SHALL BE 6" MIN AROUND PIPE WITH 3,000 PSI CONCRETE.

## LATERAL AND MARKER DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

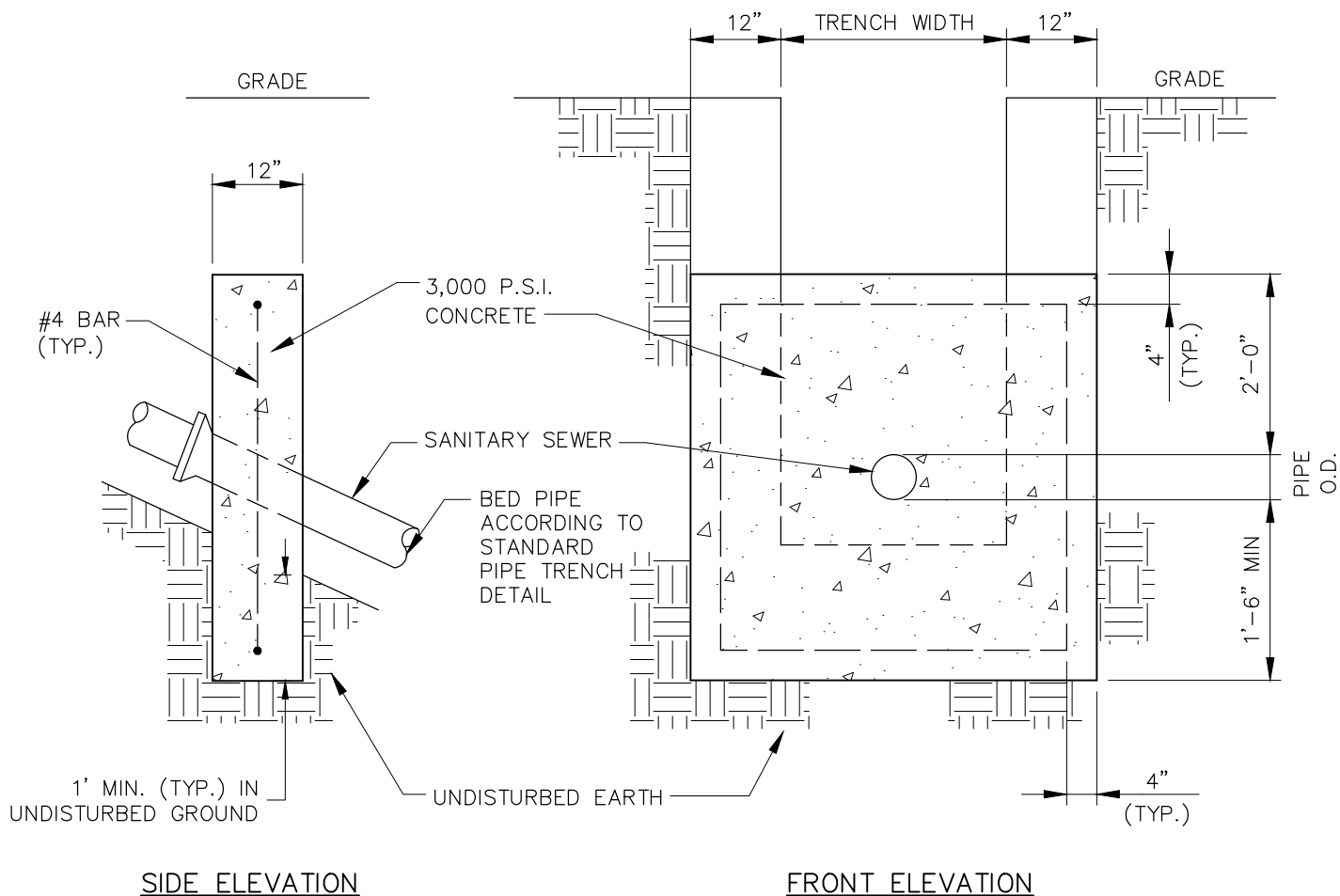
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CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
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CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
<b>5</b>
SHEET NO.
<b>7 OF 22</b>
PROJECT 001178.0562



MAXIMUM SPACING CHART	
SLOPE	SPACING
20% TO 35%	36'
35% TO 50%	24'
50% AND OVER	16'

## PIPE ANCHOR FOR STEEP SLOPE SEWERS

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB  
DESIGN—  
CADD— KEC  
CHECKED—  
SCALE— AS NOTED  
DATE— JUNE 2015

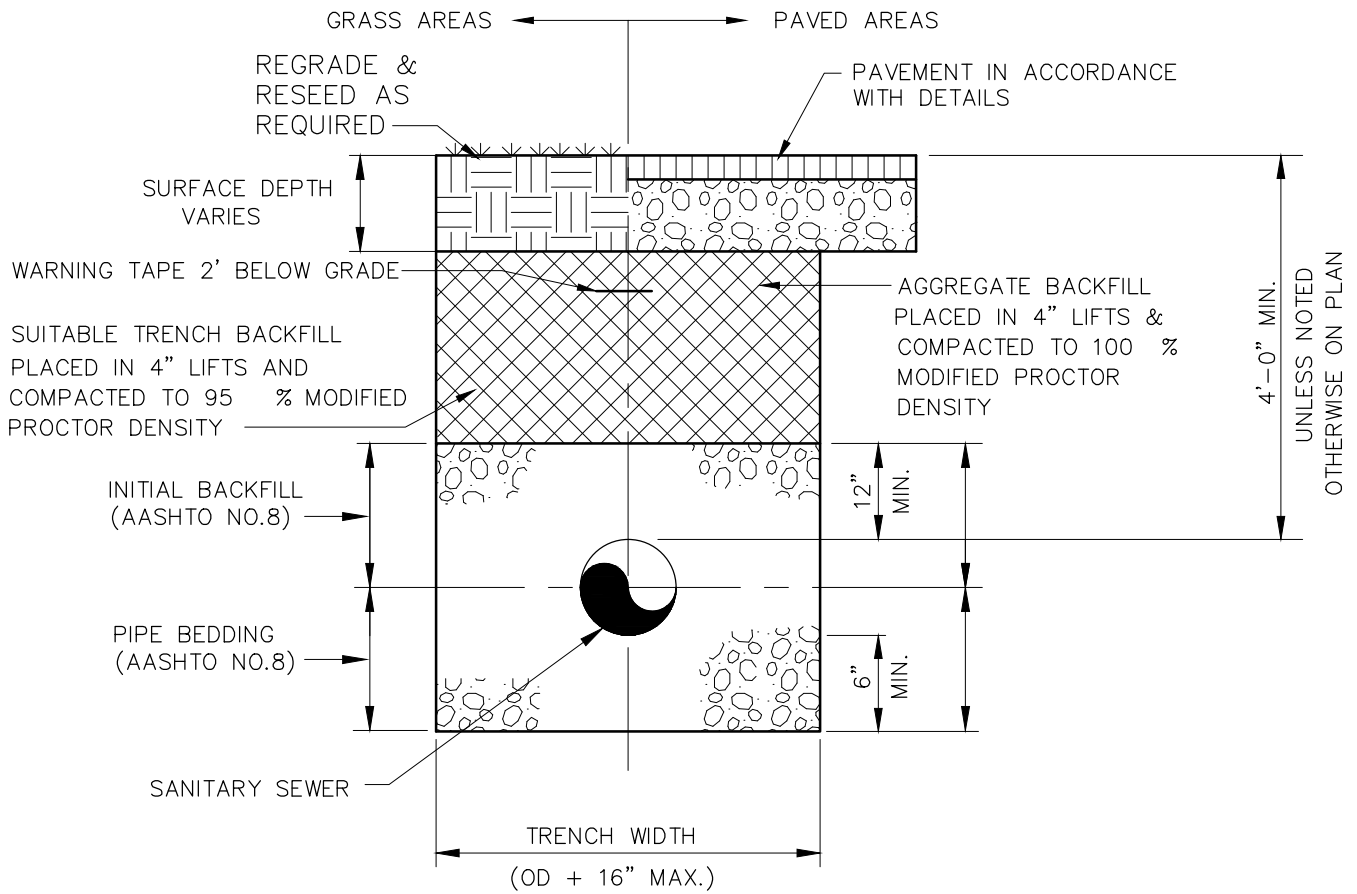
DRAWING NO.

**5B**

SHEET NO.

**8 OF 22**

PROJECT 001178.0562



## PIPE TRENCH

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
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SCALE— AS NOTED
DATE— JUNE 2015

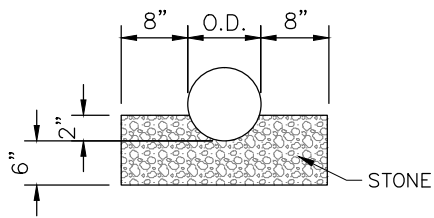
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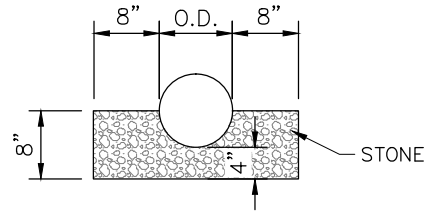
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9 OF 22

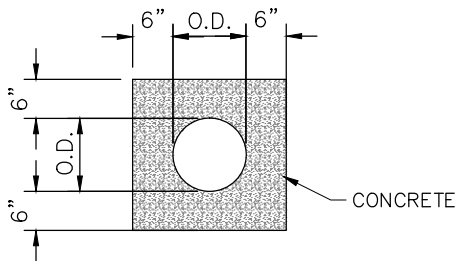
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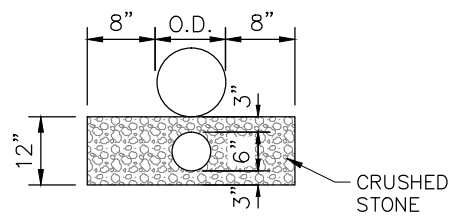
**TYPE I**



**TYPE II**



**COMPLETE ENCASEMENT**



**UNDERDRAINS**



UNIVERSITY AREA JOINT AUTHORITY

**SANITARY SEWER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— NTS
DATE— SEPT. 2015

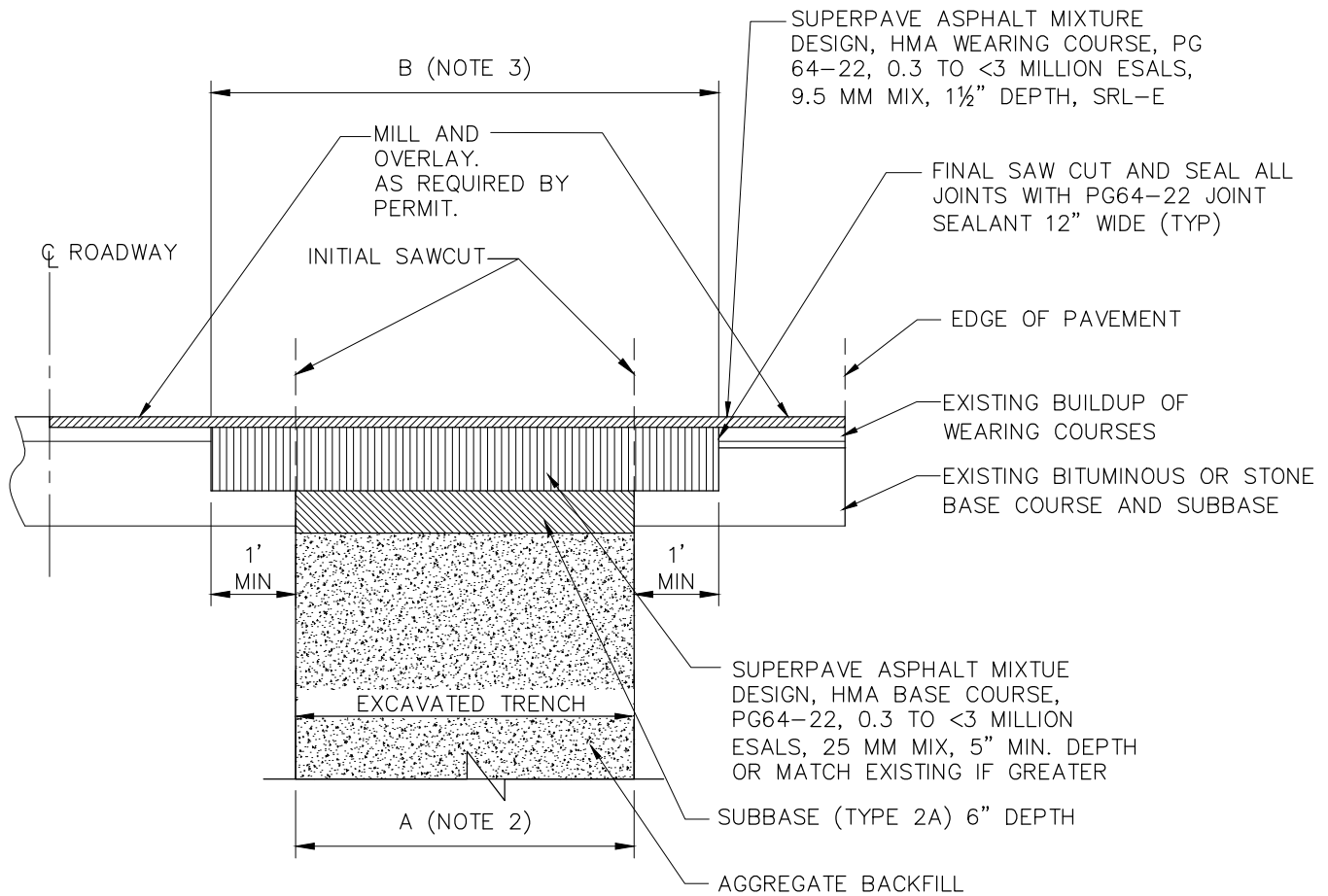
DRAWING NO.

**6**

SHEET NO.

**10 OF 22**

PROJECT 001178.0562



**NOTES:**

1. PADOT REQUIREMENTS SHALL GOVERN ANY ITEM OF WORK WITHIN THE R-O-W OF PADDOT. REFER TO PUBLICATION 408 AND APPLICABLE HOP.
2. TRENCH WIDTHS FOR PIPES IN STATE HIGHWAY RIGHT-OF-WAYS SHALL BE PIPE DIAMETER AT BELL/FLANGE PLUS TWO FEET (A). THIS SHALL ALSO BE THE PAY WIDTH WHEN ROCK EXCAVATION IS CLASSIFIED
3. PAVEMENT RESTORATION PAY WIDTHS SHALL BE PIPE DIAMETER AT BELL/FLANGE PLUS FOUR FEET (B).
4. REFER TO PROJECT CONSTRUCTION DRAWINGS, PENNDOT PUB 408, R.C. STANDARD NO.'S RC-26 & RC-30, AND HIGHWAY OCCUPANCY PERMIT FOR DETAILS NOT SHOWN ON THIS DRAWING.
5. EXPOSED VERTICAL AND HORIZONTAL SURFACES SHALL BE PREPARED AS PER PUB. 408, SECTION 401.3(f).
6. IF THE INITIAL SAWCUT IS WITHIN 3' OF THE CURB, EDGE OF PAVEMENT, OR EXISTING PAVEMENT JOINT, THE ENTIRE AREA SHALL BE REPLACED.

## STATE REPAVING REQUIREMENTS AND PAY WIDTHS FOR ROCK EXCAVATION AND REPAVEMENT RESTORATION

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

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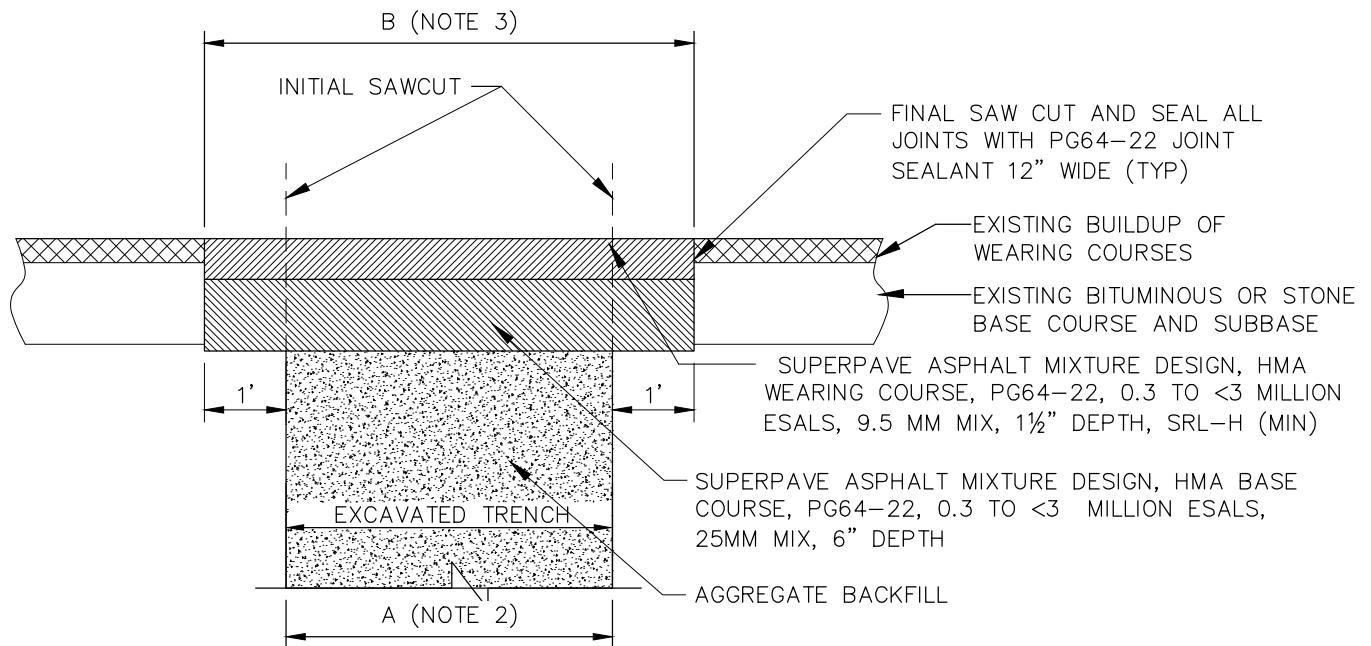
7

SHEET NO.

11 OF 22

PROJECT 001178.0562





**NOTES:**

1. EXPOSED VERTICAL AND HORIZONTAL SURFACES SHALL BE PREPARED AS PER PUB. 408, SECT. 401.3(f).
2. TRENCH WIDTHS FOR PIPES IN LOCAL (TOWNSHIP, BOROUGH, PRIVATE) RIGHT OF WAYS SHALL BE PIPE DIAMETER AT THE BELL/FLANGE PLUS 1.33 FEET (A). THIS SHALL BE THE PAYMENT WIDTH WHEN ROCK EXCAVATION IS CLASSIFIED.
3. PAYMENT RESTORATION PAY WIDTHS SHALL BE PIPE DIAMETER AT THE BELL/FLANGE PLUS 3.33 FEET (B).
4. THE PAY WIDTH FOR STREET REPAVING ALSO APPLIES TO DRIVEWAY REPAVING.
5. IF THE FINAL SAWCUT IS WITHIN 3' OF THE CURB, EDGE OF PAVEMENT, OR EXISTING PAVEMENT JOINT, THE ENTIRE AREA WILL BE REPLACED.

## LOCAL REPAVING REQUIREMENTS AND PAY WIDTHS FOR ROCK EXCAVATION AND REPAVEMENT RESTORATION

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

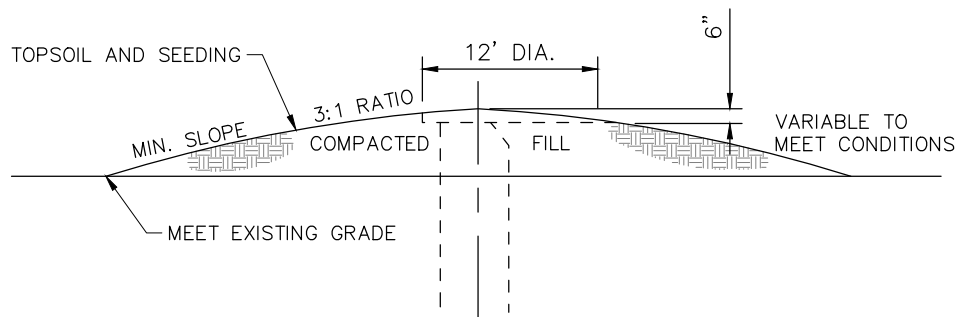
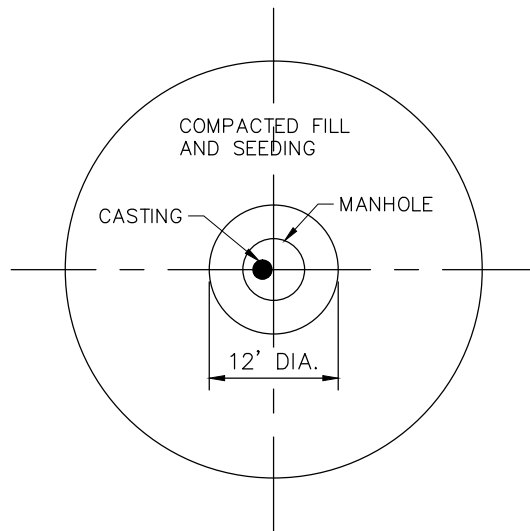
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**8**

SHEET NO.

**12 OF 22**

PROJECT 001178.0562



**TYPICAL MANHOLE ISLAND**



UNIVERSITY AREA JOINT AUTHORITY

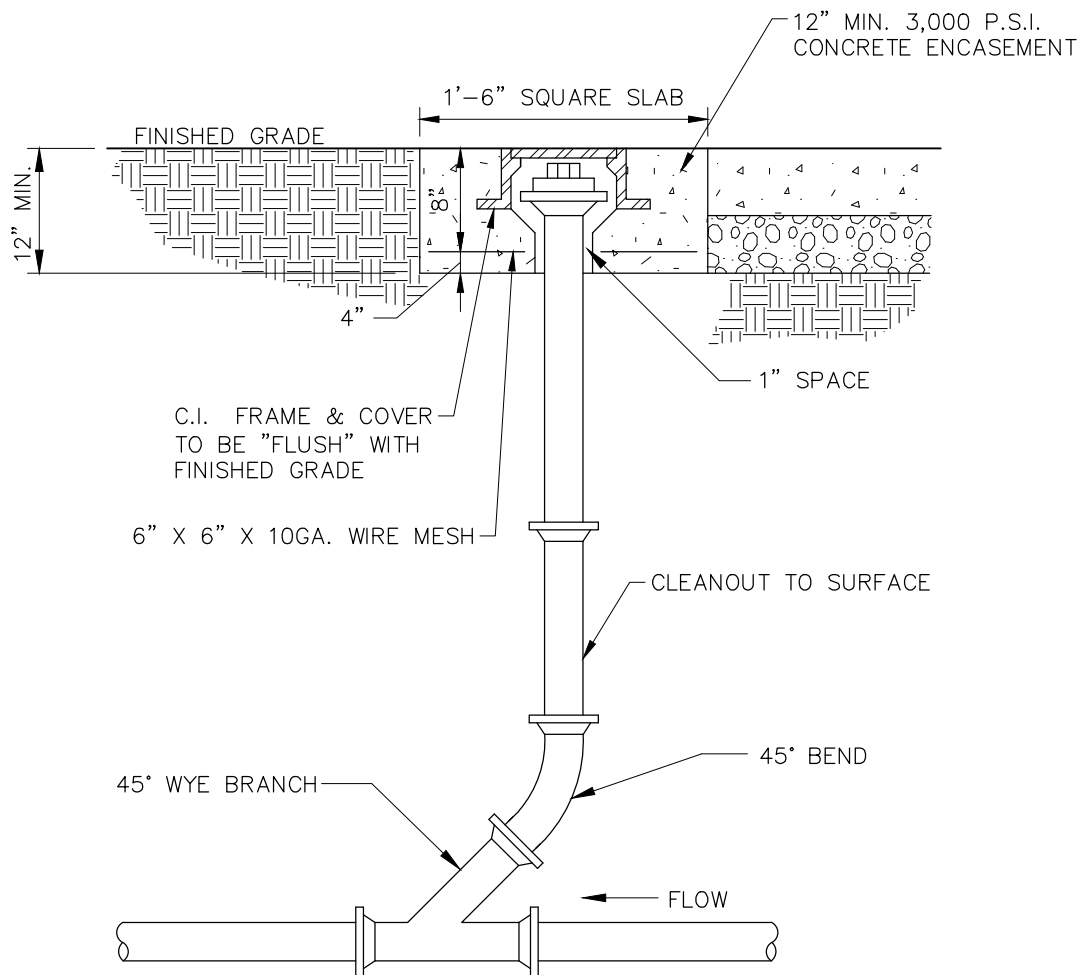
**SANITARY SEWER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
CADD— KEC
CHECKED—
SCALE— NTS
DATE— SEPT. 2015

DRAWING NO.
<b>9</b>
SHEET NO.
<b>13 OF 22</b>
PROJECT 001178.0562



**NOTES:**

1. DETAILS FOR CLEANOUTS IN PRIVATE, RESIDENTIAL LAWN OR NON-TRAFFIC AREAS ARE THE SAME EXCEPT THE CONCRETE ENCASEMENT MAY BE OMITTED.

## CLEANOUT CONSTRUCTION DETAIL FOR PRIVATE COLLECTION SYSTEM

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
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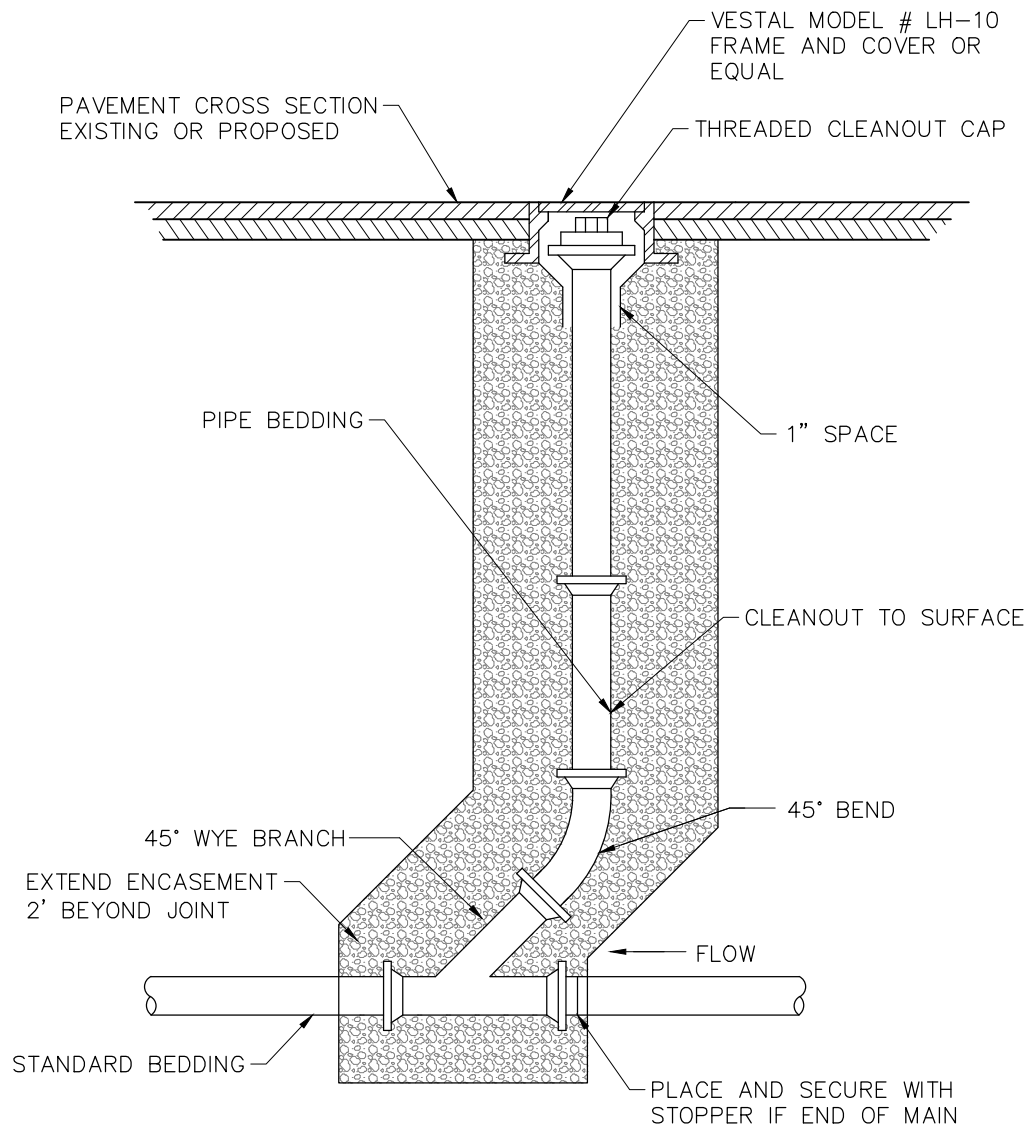
DRAWING NO.

10

SHEET NO.

14 OF 22

PROJECT 001178.0562



**NOTES:**

1. REFER TO DWG. NO. 4 FOR COVER INSTALLATION DETAIL.

## CLEANOUT CONSTRUCTION DETAIL FOR PAVED AREAS



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
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SCALE— AS NOTED
DATE— JUNE 2015

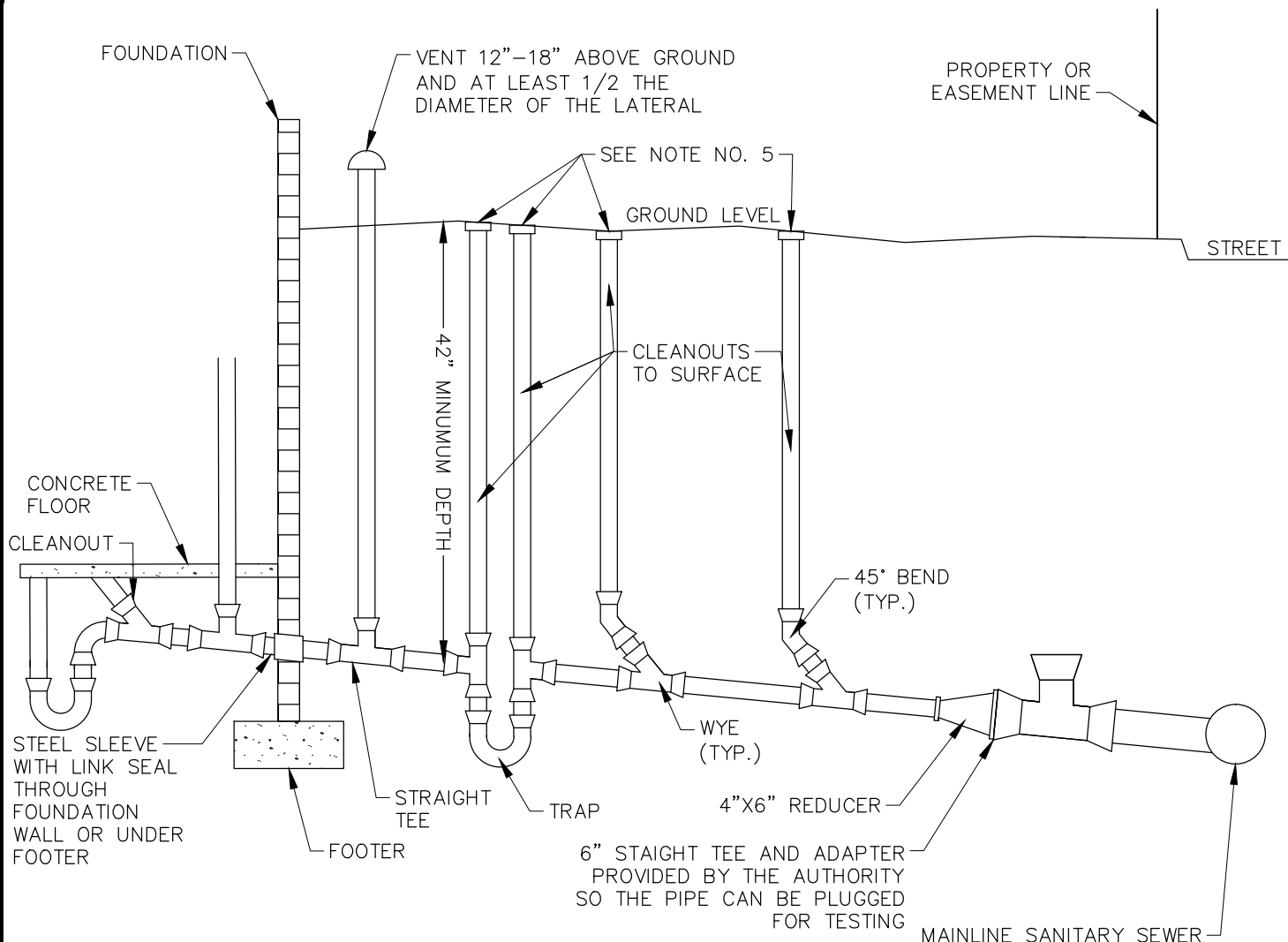
DRAWING NO.

**10A**

SHEET NO.

**15 OF 22**

PROJECT 001178.0562



#### LATERAL SPECIFICATIONS:

1. 4" DIAMETER IS THE MINIMUM SIZE. LARGER SIZES WILL BE SPECIFIED BY THE AUTHORITY WHEN THE AMOUNT OF FLOW WARRANTS IT.
2. SLOPE SHALL BE 1/4" PER FOOT UNLESS APPROVED OTHERWISE BY THE AUTHORITY.
3. CLEANOUTS MUST BE INSTALLED EVERY 50' ON 4" PIPE AND EVERY 100' ON 6" PIPE.
4. LATERALS SHALL BE LAID IN AGGREGATE CUSHION AND BEDDING, REFER TO STANDARD PIPE TRENCH DETAIL
5. CLEANOUT TERMINAL(S) SHALL HAVE TREATMENT AT RESPECTIVE LOCATION. REFER TO DWG. NO.'S 10 & 10A.
6. ALL PIPING MATERIALS INCLUDING TRAPS FOR GRAVITY APPLICATIONS SHALL BE SCHEDULE 40 PVC. ANSI/ASTM D2665.
7. ALL SCHEDULE 40 PVC PIPE USED FOR PRESSURE APPLICATIONS MAY BE STAMPED ASTM D2665 BUT MUST ALSO INCLUDE A SECOND NUMBER, EITHER ASTM D1785 OR ASTM F480, WHICH ARE PRESSURE DESIGNATIONS.

#### INSPECTION:

1. WORK MUST BE INSPECTED AND TESTED BEFORE BACKFILLING.
2. THERE IS NO CHARGE FOR ONE-TIME INSPECTION UNLESS THE LATERAL IS LONGER THAN 150' AND/OR IF THE PIPE IS MORE THAN 4" IN DIAMETER.
3. INSPECTIONS REQUIRING MORE THAN ONE VISIT TO THE SITE WILL BE BILLED AT THE RATE IN EFFECT AT THE TIME OF INSPECTION.

## **TYPICAL SANITARY SEWER LATERAL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### **SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN—
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SCALE— AS NOTED
DATE— JUNE 2015

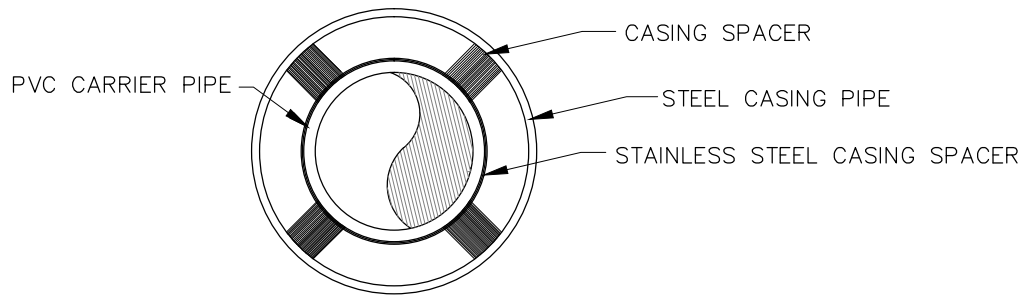
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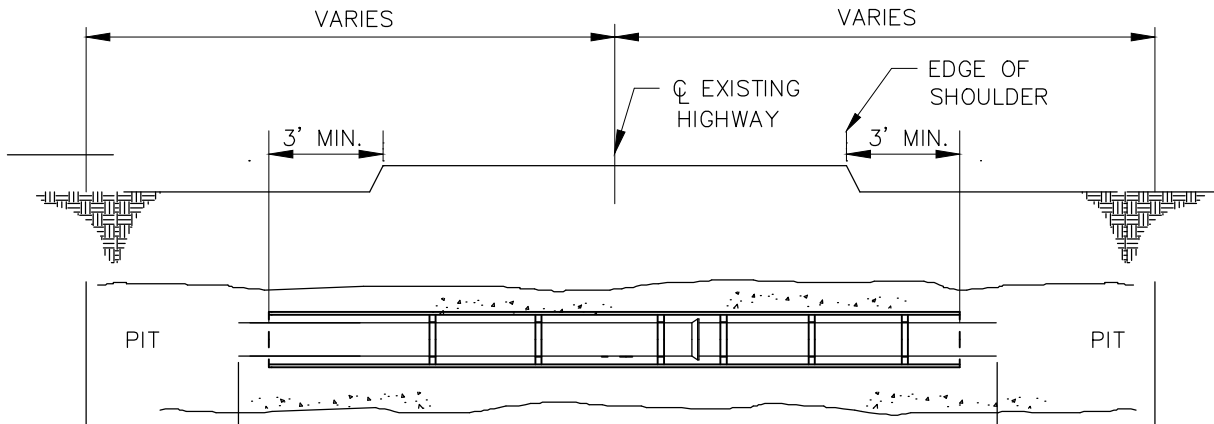
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**16 OF 22**

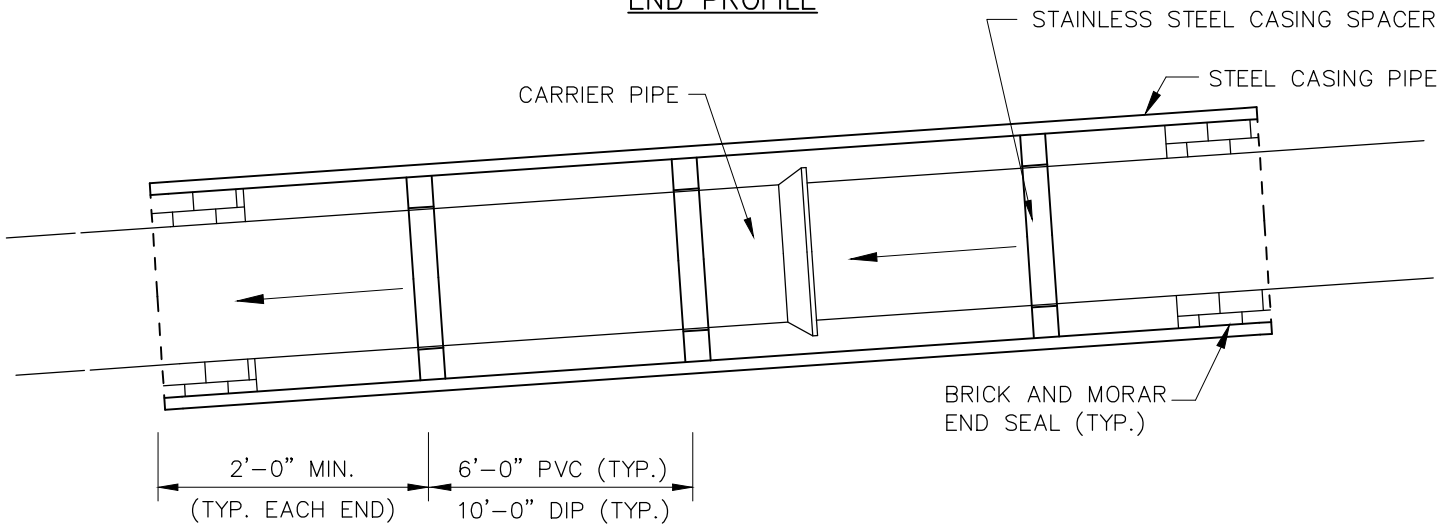
PROJECT 001178.0562



MAIN LINE SECTION



END PROFILE



SECTION

NOTES:

1. SEE HIGHWAY CROSSINGS FOR SPECIFIC LENGTHS AND LOCATIONS.

**BORE CROSSING DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

**SANITARY SEWER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

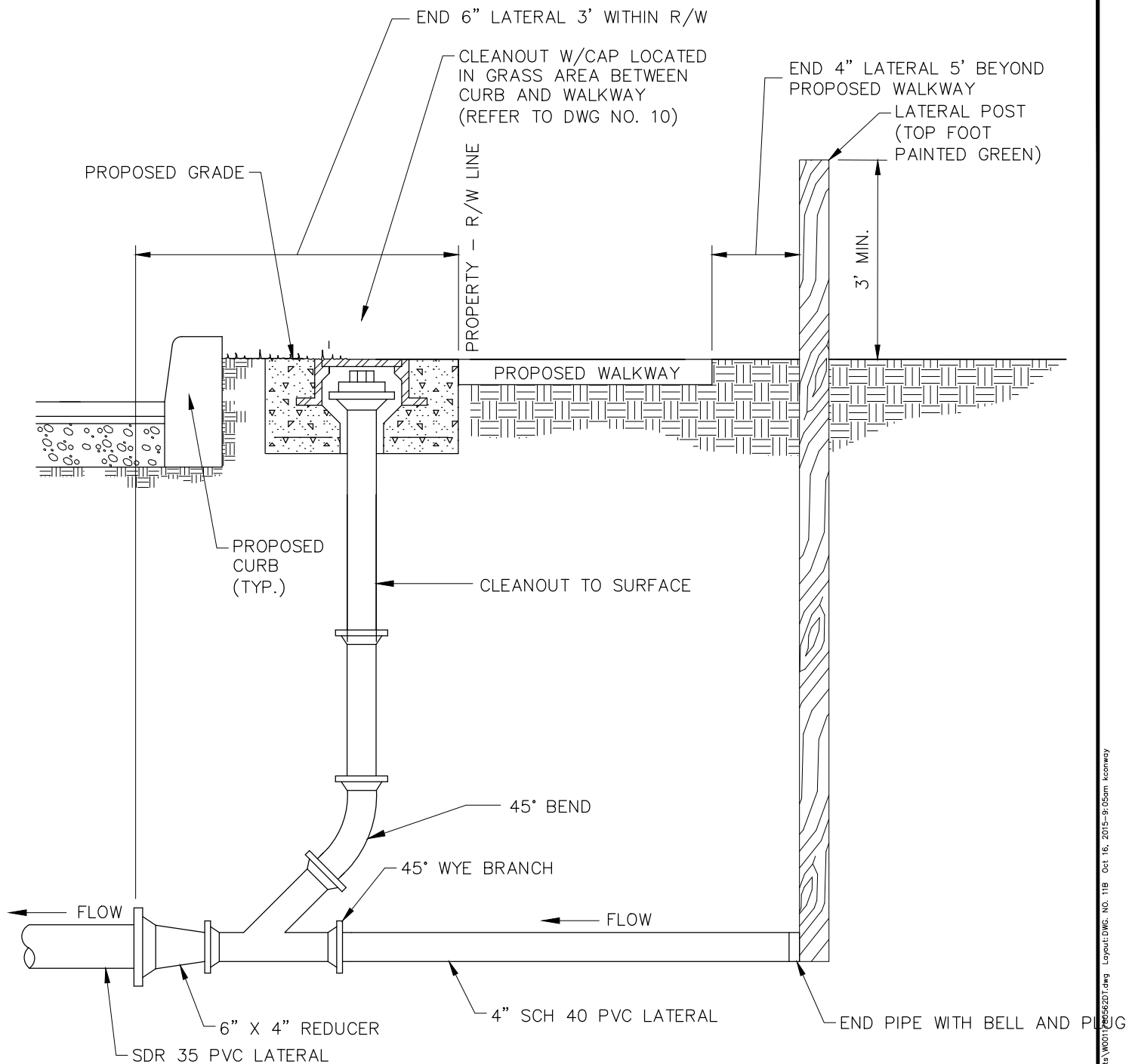
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PENNSYLVANIA

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DATE— JUNE 2015

DRAWING NO.
<b>11A</b>
SHEET NO.
<b>17 OF 22</b>
PROJECT 001178.0562

File name: C:\Civil 3D Projects\001178\_0562\Plan Sets\W001178056201.dwg Layout:DWG, NO. 11A Oct 16, 2015-9:04am kconway



## SANITARY SEWER LATERAL DETAIL (FOR SIDEWALK ON PROPERTY OUT OF R-O-W)

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. - BRB
DESIGN -
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CHECKED -
SCALE - AS NOTED
DATE - JUNE 2015

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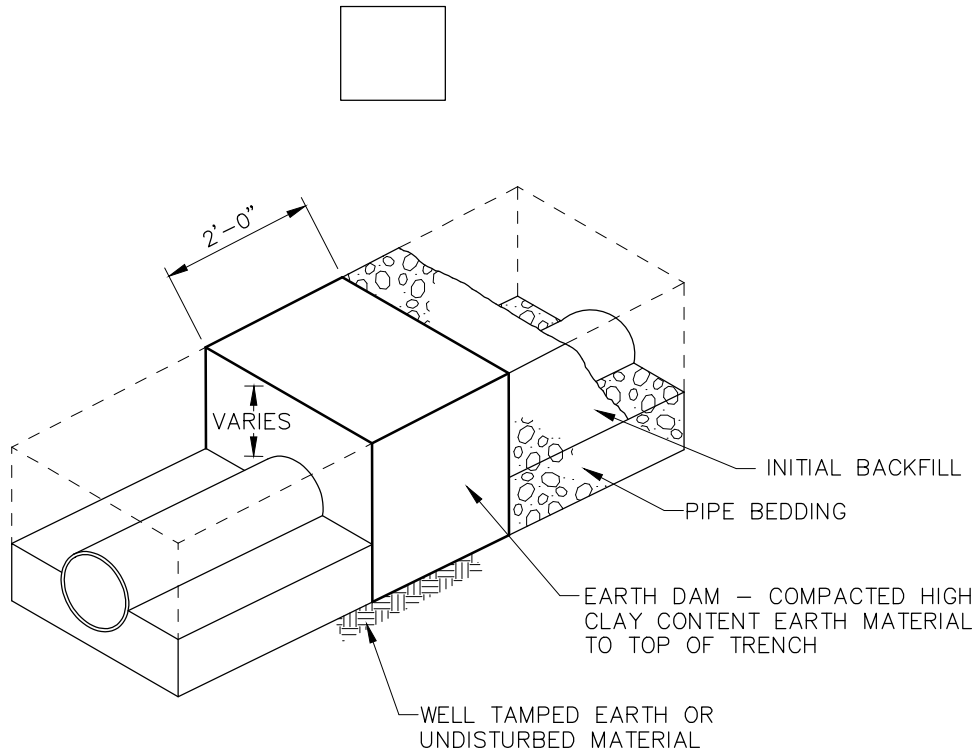
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SHEET NO.

**18 OF 22**

PROJECT 001178.0532

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**CLAY DIKE DETAIL**  
NOT TO SCALE

File name: C:\Civil 3D Projects\001178\_0562\Plan Sets\001178\_0562\DWG Layout.DWG, NO. 12 Oct 19, 2015-11:22am estover



UNIVERSITY AREA JOINT AUTHORITY

**SANITARY SEWER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

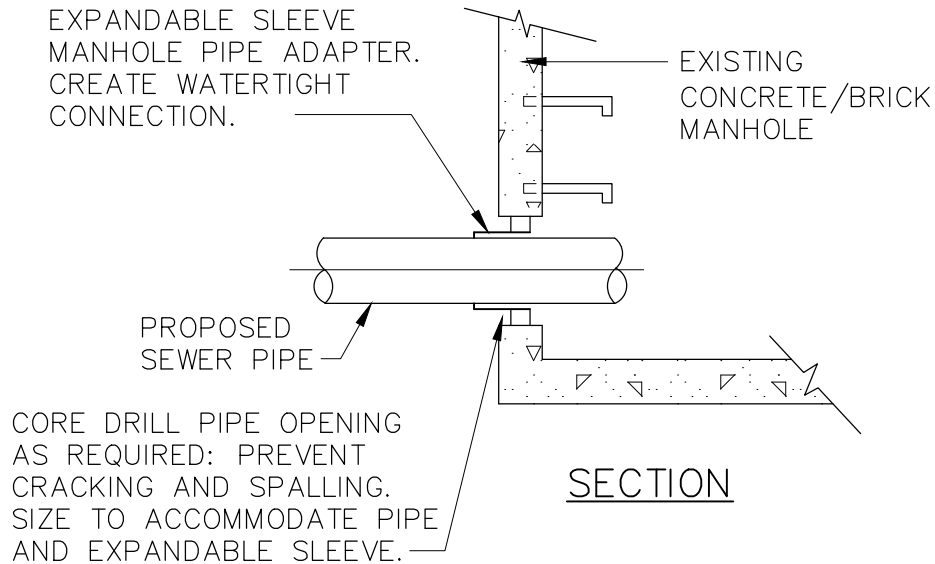
CENTRE COUNTY

PENNSYLVANIA

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SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
<b>12</b>
SHEET NO.
<b>19 OF 22</b>
PROJECT 001178.0562





NOTES:

1. KEEP GROUNDWATER, SURFACE WATER AND DEBRIS FROM ENTERING EXISTING FACILITIES.
2. MAINTAIN EXISTING FLOW DURING CONSTRUCTION.
3. BREAKOUT EXISTING CONCRETE/BRICK BENCH AS REQUIRED AND FORM NEW CHANNEL WITH NON-SHRINK GROUT TO ALLOW FOR PROPER FLOW. SEE TYPICAL MANHOLE CHANNEL DETAIL.
4. PREFABRICATED MANHOLE ADAPTER WITH SMOOTH EXTERNAL OR CORRUGATED PIPE ADAPTER SHALL BE UTILIZED WITH POLYPROPYLENE PIPE.

## CONNECTION TO EXISTING MANHOLE DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

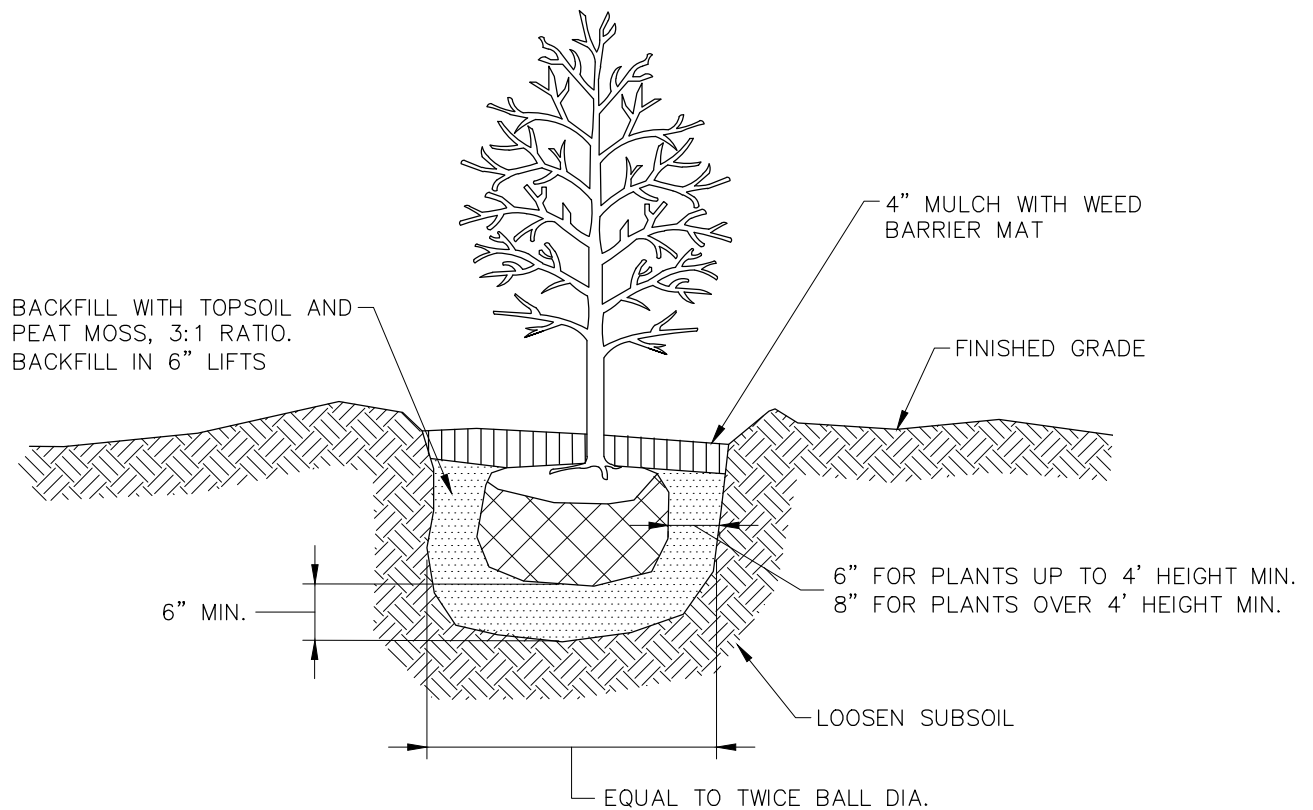
### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
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SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
<b>13</b>
SHEET NO.
<b>20 OF 22</b>
PROJECT 001178.0562



## SHRUB PLANTING DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

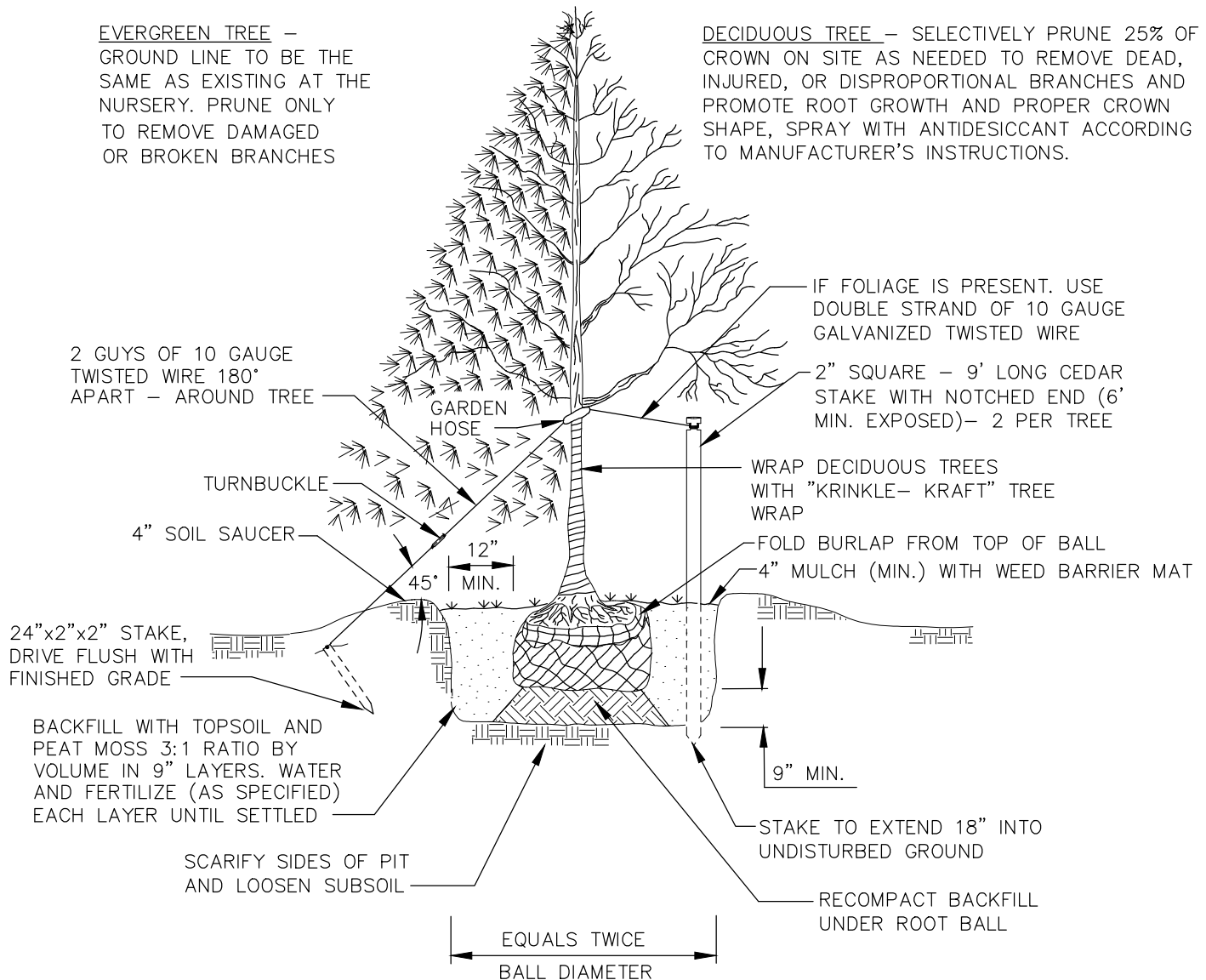
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DESIGN—
CADD— KEC
CHECKED—
SCALE— AS NOTED
DATE— JUNE 2015

DRAWING NO.
14
SHEET NO.
21 OF 22
PROJECT 001178.0562

EVERGREEN TREE –  
GROUND LINE TO BE THE  
SAME AS EXISTING AT THE  
NURSERY. PRUNE ONLY  
TO REMOVE DAMAGED  
OR BROKEN BRANCHES

DECIDUOUS TREE – SELECTIVELY PRUNE 25% OF  
CROWN ON SITE AS NEEDED TO REMOVE DEAD,  
INJURED, OR DISPROPORTIONAL BRANCHES AND  
PROMOTE ROOT GROWTH AND PROPER CROWN  
SHAPE, SPRAY WITH ANTIDESICCANT ACCORDING  
TO MANUFACTURER'S INSTRUCTIONS.



NOTES:

1. STAKE ALL EVERGREEN TREES UNDER 12'.
2. GUY TREES 12' AND OVER AS SPECIFIED FOR DECIDUOUS TREES.
3. TREE SHALL BEAR SAME RELATION TO FINISHED GRADE AS IT BORE TO PREVIOUS GRADE.
4. NEVER CUT LEADERS.
5. IN PAVED AREAS – STONE SAUCER IN A SQUARE.
6. IN GRASS AREAS – MUCH SAUCER IN A CIRCLE.
7. AFTER PLANTING – THE SAUCER SHOULD BE FLOODED WITH WATER TWICE IN THE FIRST 4 HOURS.

## TREE PLANTING AND GUYING DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### SANITARY SEWER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

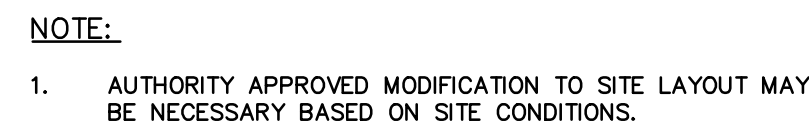
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CHECKED –
SCALE – AS NOTED
DATE – JUNE 2015

DRAWING NO.
<b>15</b>
SHEET NO.
<b>22 OF 22</b>
PROJECT 001178.0562



## INSTRUMENT AND FLOAT SWITCH BRACKET

SCALE: N.T.S.



## TYPICAL SITE LAYOUT

SCALE: 1" = 10'



SCALE: N.T.S.

**UNIVERSITY AREA JOINT AUTHORITY**  
**1576 SPRING VALLEY ROAD**  
**STATE COLLEGE, PA 16801**



**UNIVERSITY AREA JOINT AUTHORITY  
1576 SPRING VALLEY ROAD  
STATE COLLEGE, PA 16801**

**TYPICAL PUMP STATION DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

**FERGUSON TOWNSHIP**

CENTRE COUNTY

## PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— JCP
CHECKED—BRB
SCALE— AS NOTED
DATE— MAR. 2015

DRAWING NO.

**PS-1**

SHEET NO.

OF **3**

PROJECT 001178.0562





1. IF JUNCTION BOXES CANNOT BE LOCATED UNDER CONTROL PANEL, LOCATE JUNCTION BOXES TO RIGHT OF PANEL. ADJUST GENERATOR LOCATION AS REQUIRED.

1	SHORT/TALL PANEL REVISED	08.04.2015	KEC
NO.	REVISION	DATE	BY



**UNIVERSITY AREA JOINT AUTHORITY  
1576 SPRING VALLEY ROAD  
STATE COLLEGE, PA 16801**

# ELECTRICAL SITE PLAN AND PUMP STATION PLAN FOR UNIVERSITY AREA JOINT AUTHORITY

**FERGUSON TOWNSHIP**

**CENTRE COUNTY**

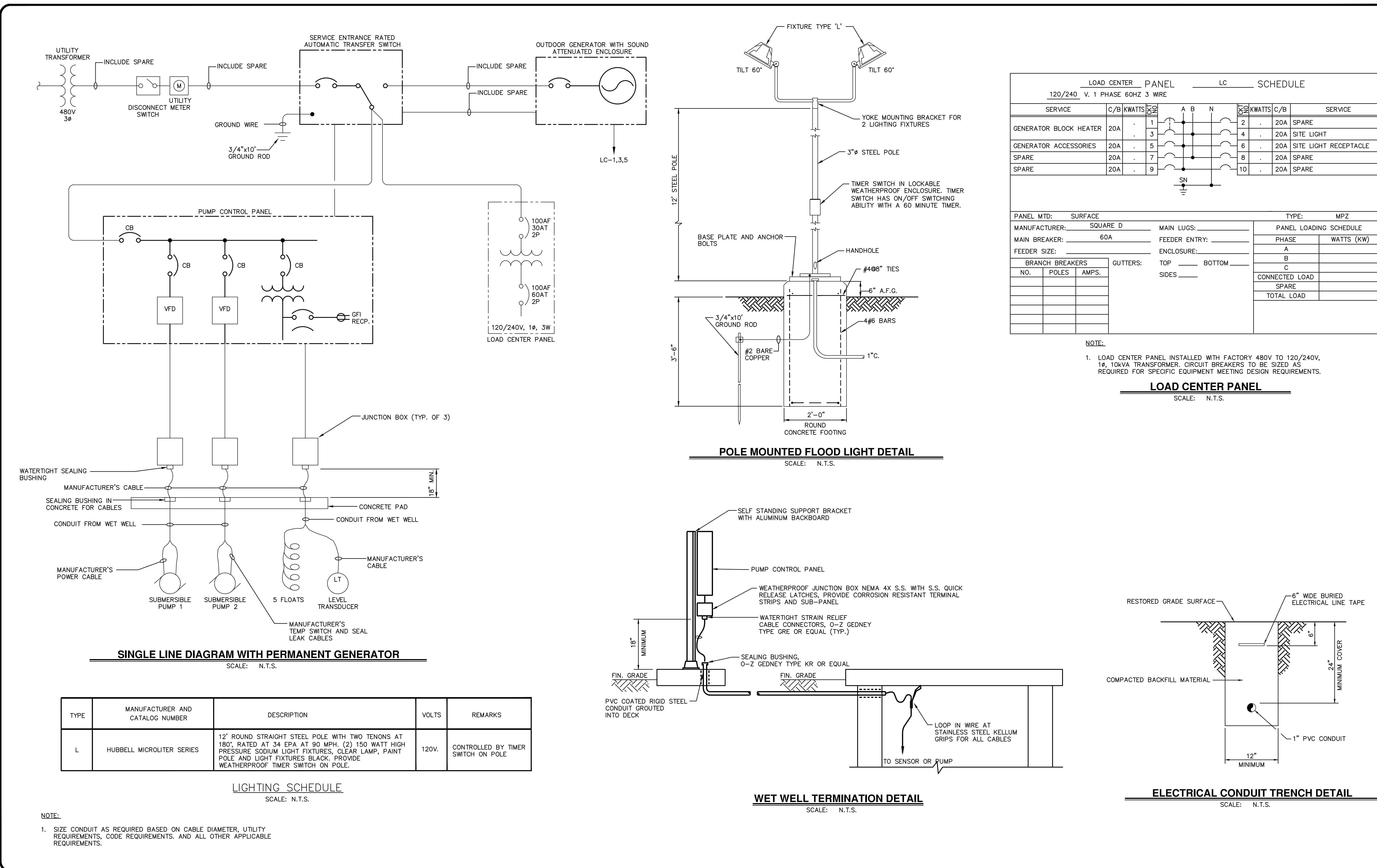
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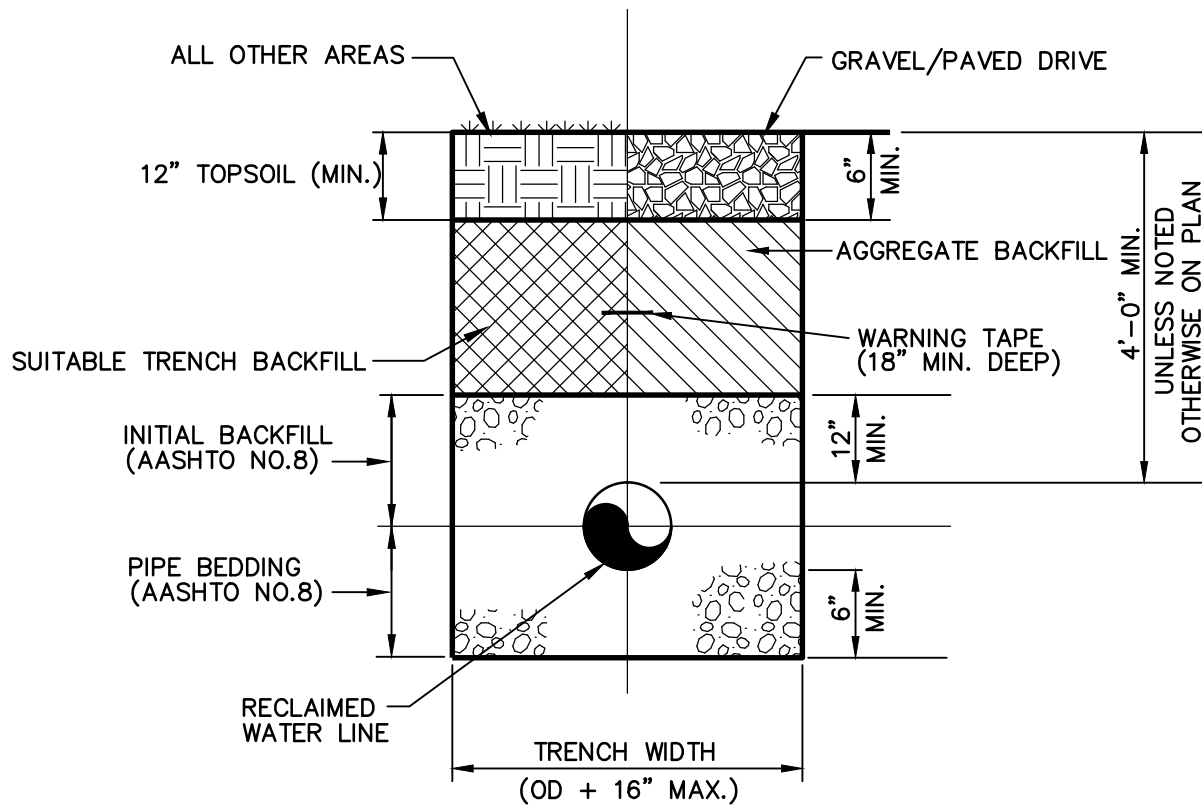
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CHECKED—BRB
SCALE— AS NOTED
DATE— MAR. 2015

DRAWING NO.  
**E-1**

SHEET NO.  
**2** OF **3**

OBJECT 001178.0562





NOTE:

1. WARNING TAPE TO READ "CAUTION: BURIED RECLAIMED WATER BELOW"

## RECLAIMED WATER MAIN TRENCH DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

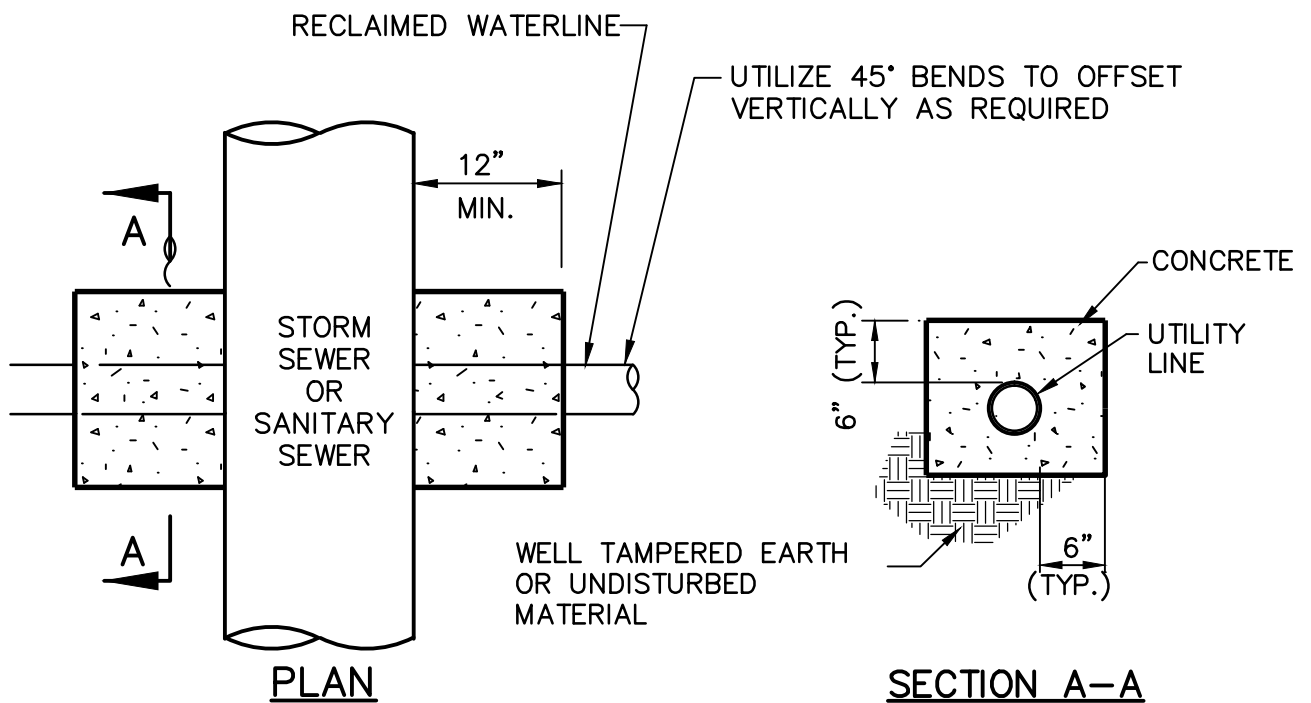
### RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— KEC
CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO.
1
SHEET NO.
1 OF 12
PROJECT 001178.0562



**NOTE:**

PROVIDE CONCRETE ENCASEMENT WHERE THE DISTANCE BETWEEN THE INVERT OF THE UTILITY AND THE WATERLINE IS LESS THAN 18", OR WHERE SHOWN ON THE PLANS.

**UTILITY CROSSING DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

**RECLAIMED WATER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— KEC
CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO.

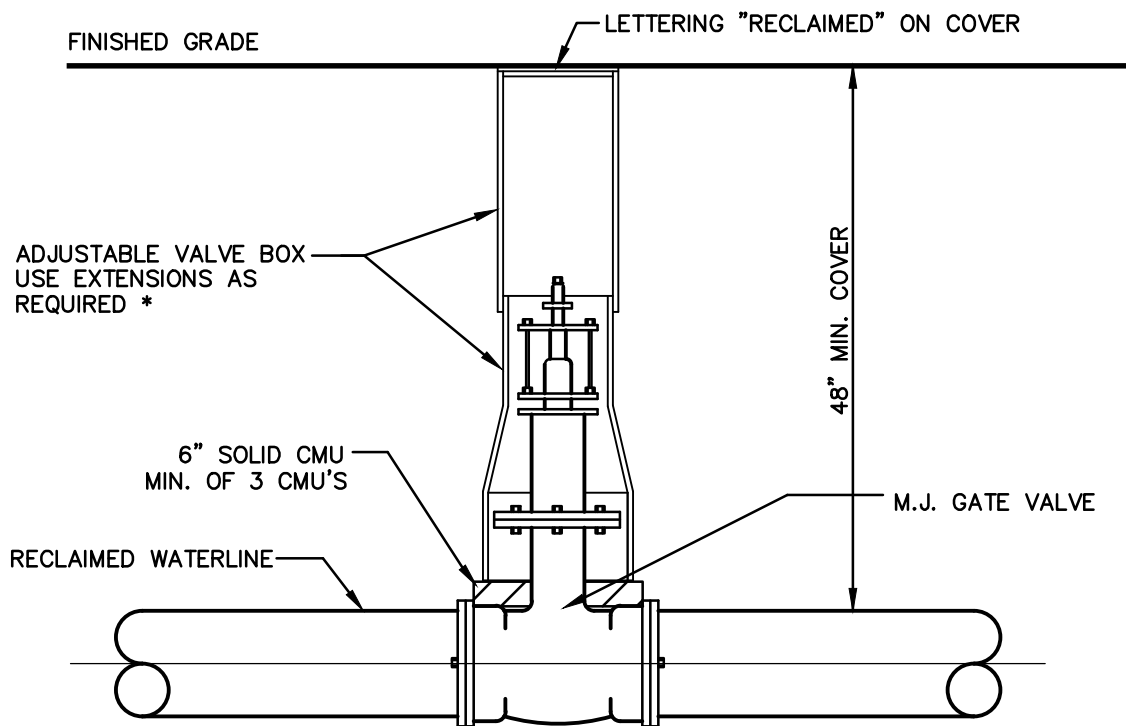
**2**

SHEET NO.

**2 OF 12**

PROJECT 001178.0562





**NOTE:**

1. IF EXTENSIONS ARE NECESSARY CONTRACTOR SHALL SET "PLUMB" AND ALIGN PROPERLY FOR ACCESS TO OPERATING NUT.

## TYPICAL GATE VALVE AND VALVE BOX DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

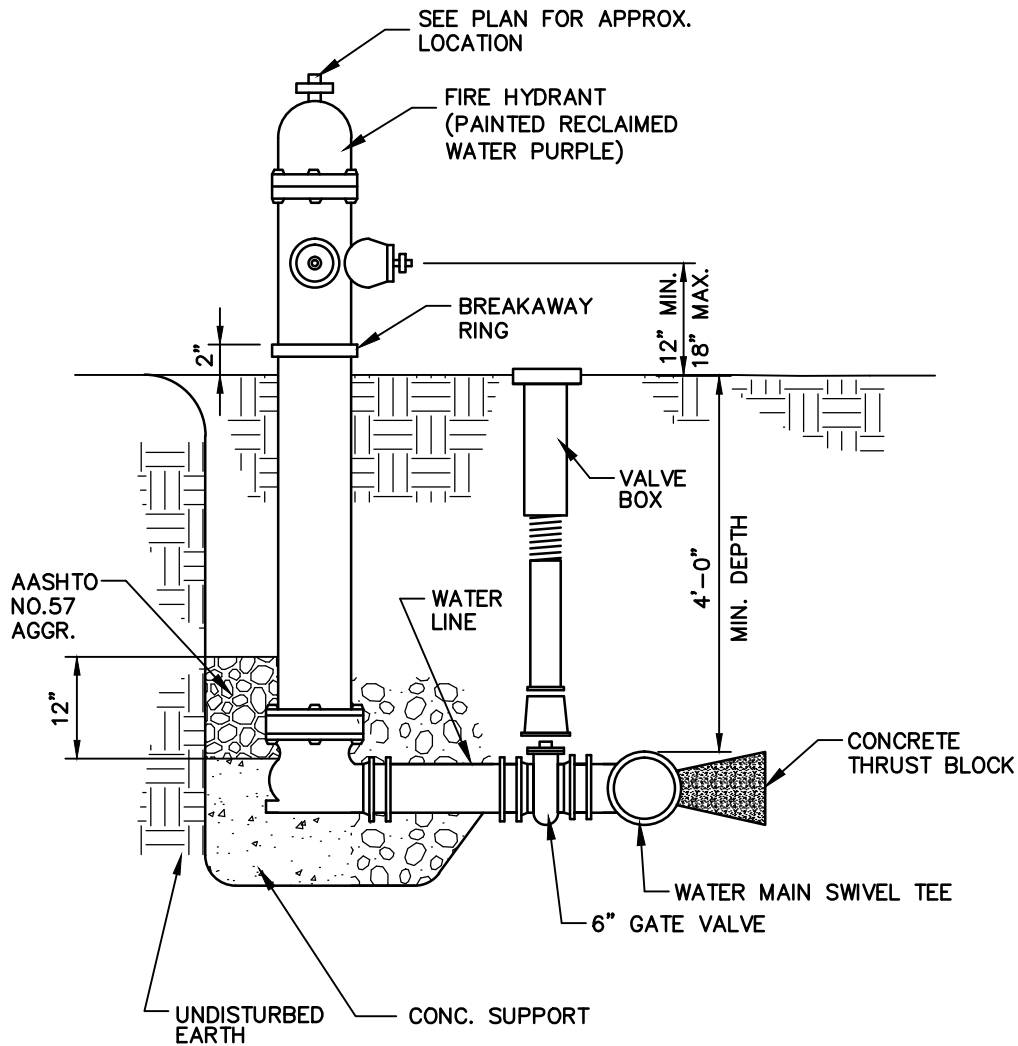
### RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— KEC
CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO.
<b>3</b>
SHEET NO.
<b>3 OF 12</b>
PROJECT 001178.0562



**NOTE:**

1. DRAIN HOLE IN HYDRANT MUST NOT BE OBSTRUCTED W/ CONCRETE

**FIRE HYDRANT ASSEMBLY DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

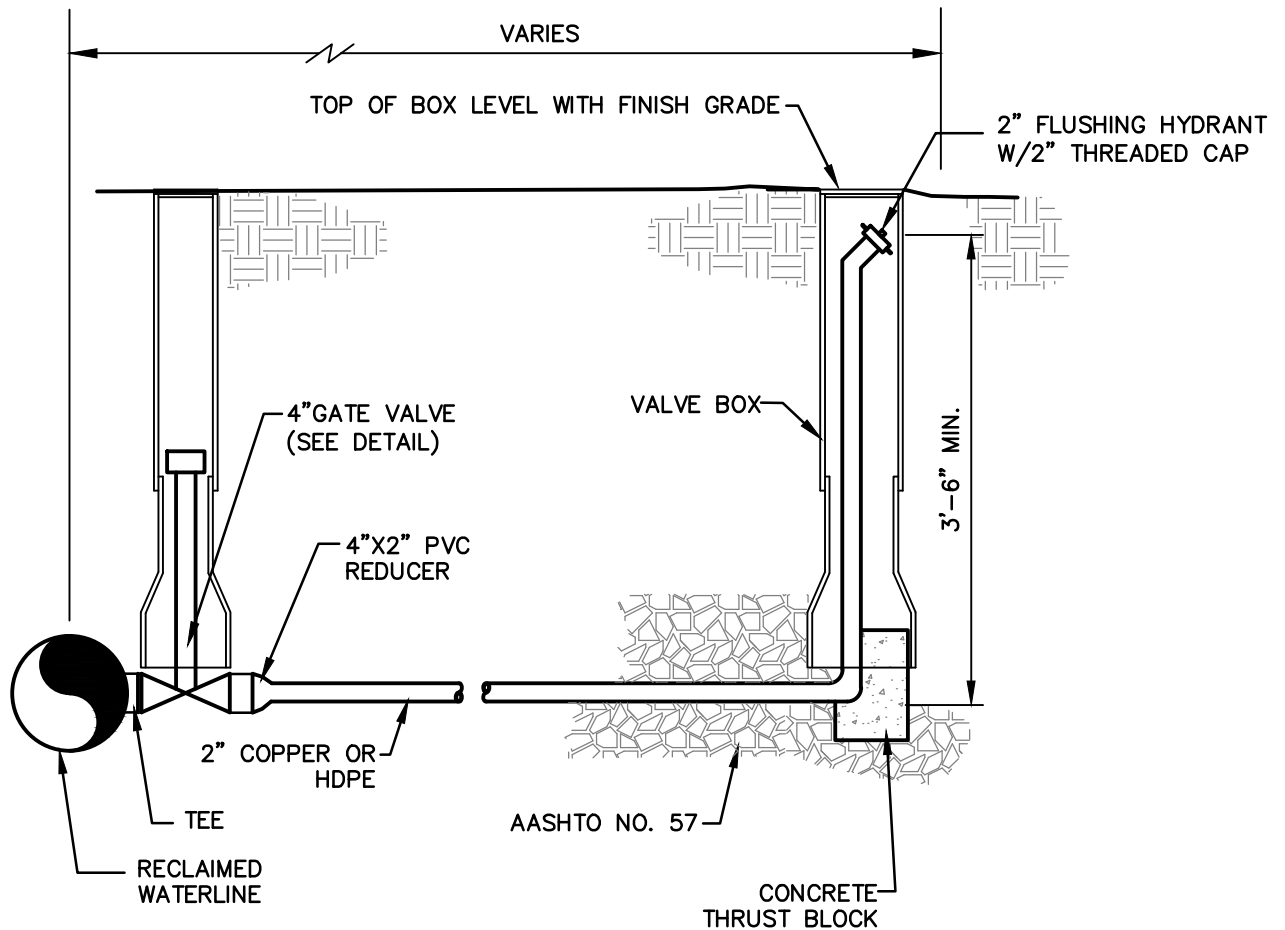
**RECLAIMED WATER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
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CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO. <b>4</b>
SHEET NO. <b>4 OF 12</b>
PROJECT 001178.0562



### **TERMINAL BLOW-OFF DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

### **RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. —	BRB
DESIGN—	BRB
CADD—	KEC
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SCALE—	AS SHOWN
DATE—	JUNE 2015

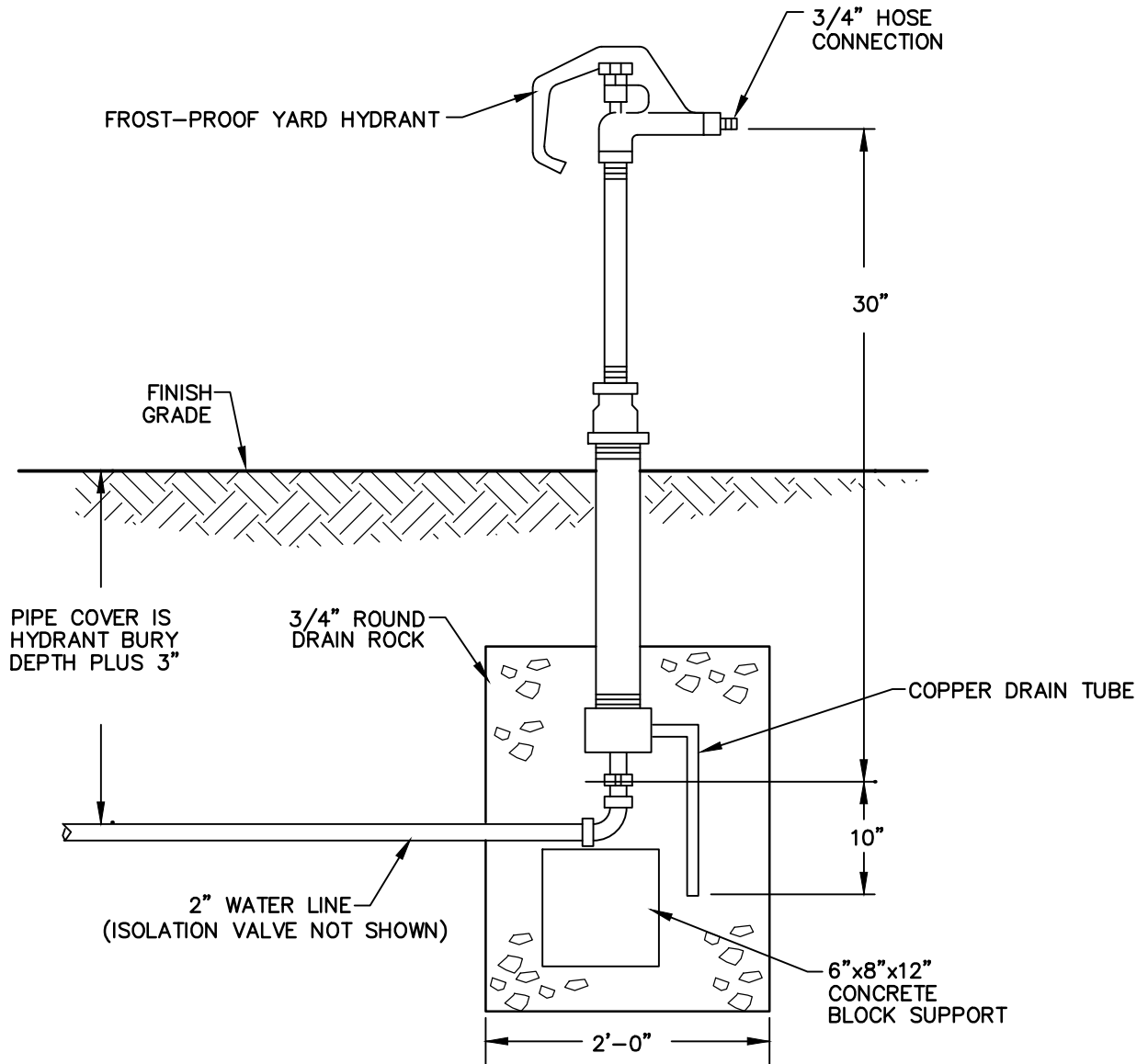
DRAWING NO.

**5**

SHEET NO.

**5 OF 12**

PROJECT 001178.0562



NOTE:

1. CONTRACTOR TO PROVIDE VALVE AND VALVE BOX

## FROST-FREE YARD HYDRANT DETAIL

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

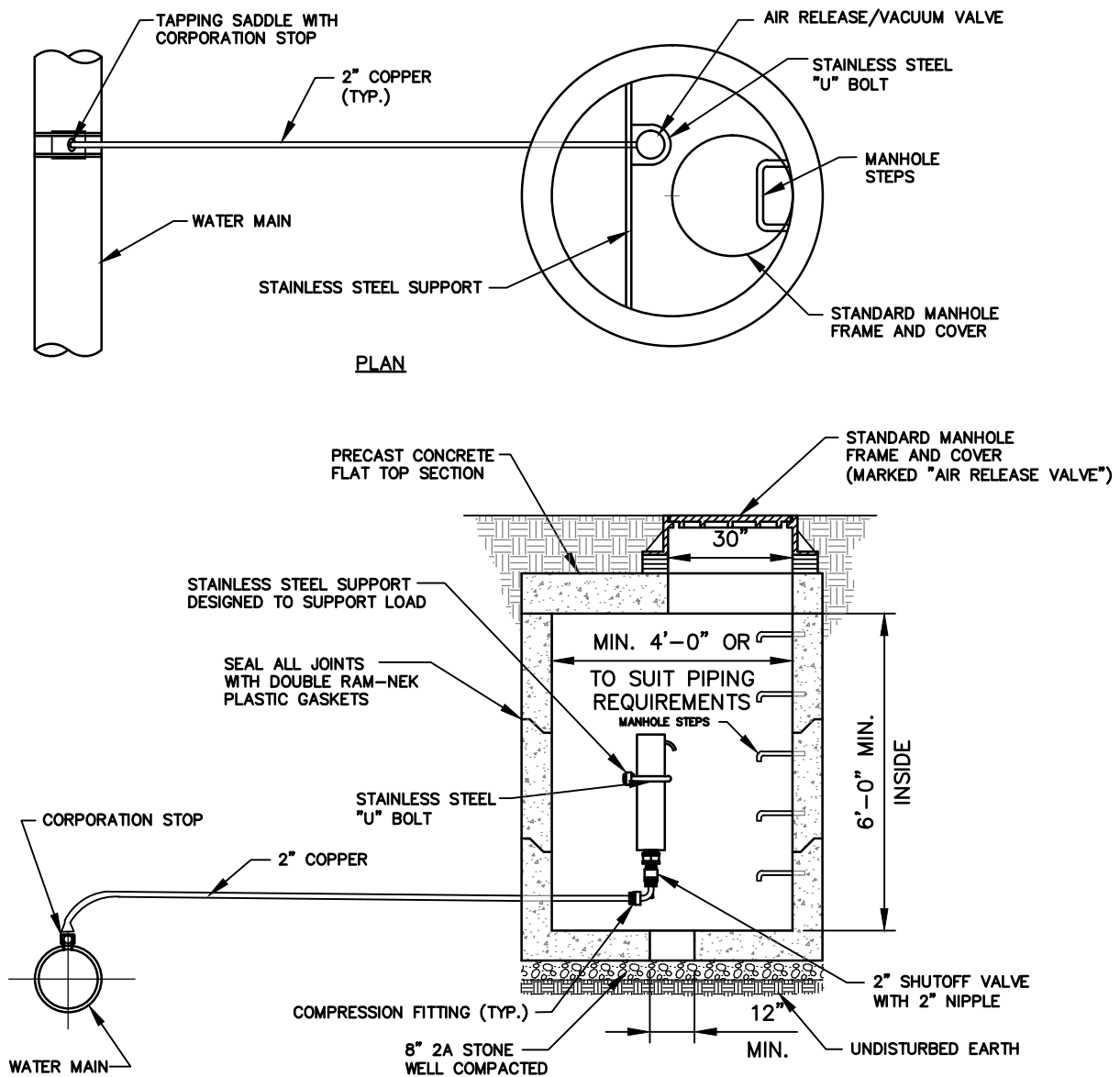
### RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. - BRB
DESIGN- BRB
CADD- KEC
CHECKED-
SCALE- AS SHOWN
DATE- JUNE 2015

DRAWING NO.
6
SHEET NO.
6 OF 12
PROJECT 001178.0562



NOTE: DELETE SUMP IN AREAS WITH HIGH WATER TABLE.

### **AIR RELEASE/VACUUM VALVE**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

## **RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. -	BRB
DESIGN -	BRB
CADD -	KEC
CHECKED -	
SCALE -	AS SHOWN
DATE -	JUNE 2015

DRAWING NO.

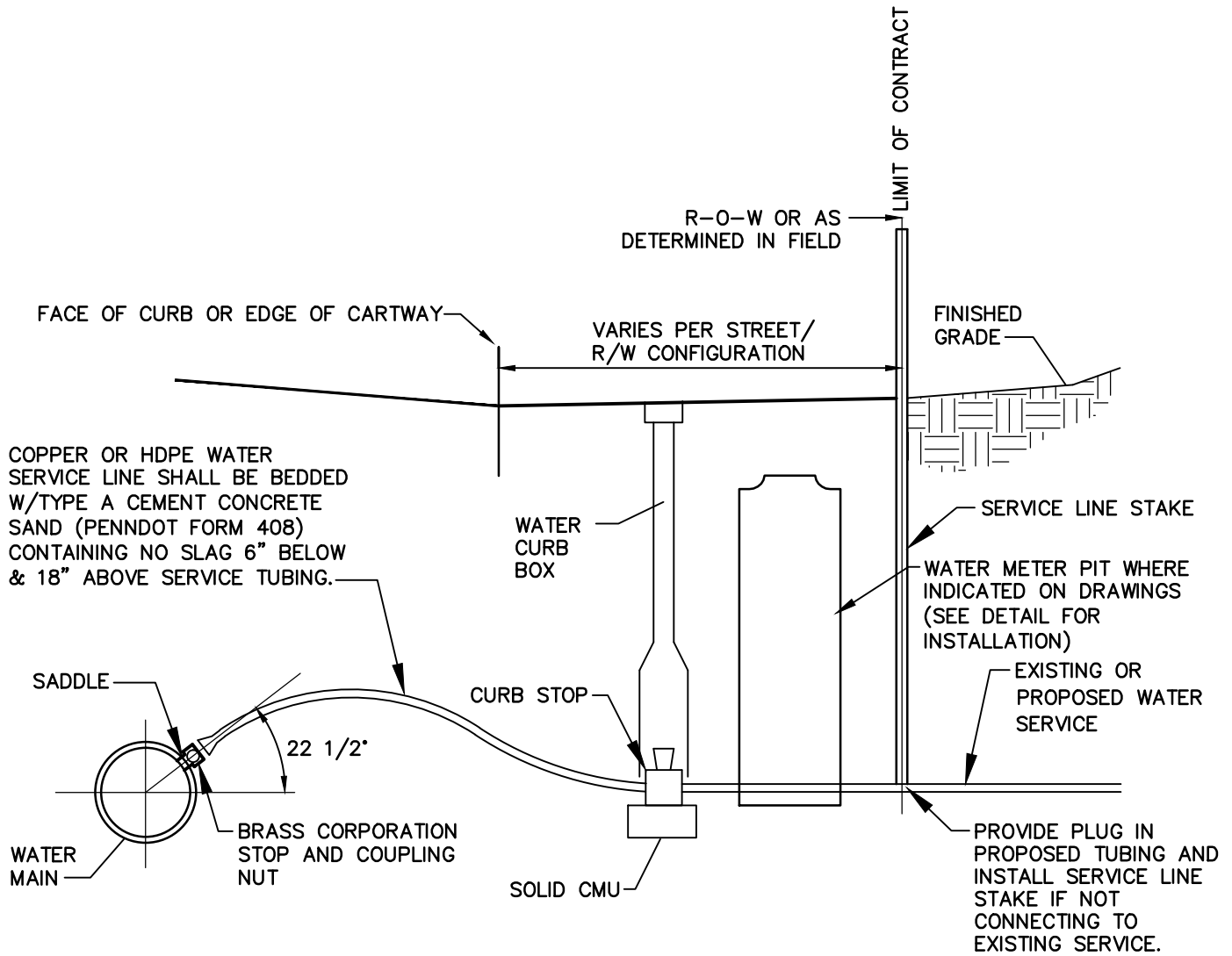
7

SHEET NO.

7 OF 12

PROJECT 001178.0562





**(SERVICE LINES 2" DIA. AND LESS)**

## **WATER SERVICE LINE DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

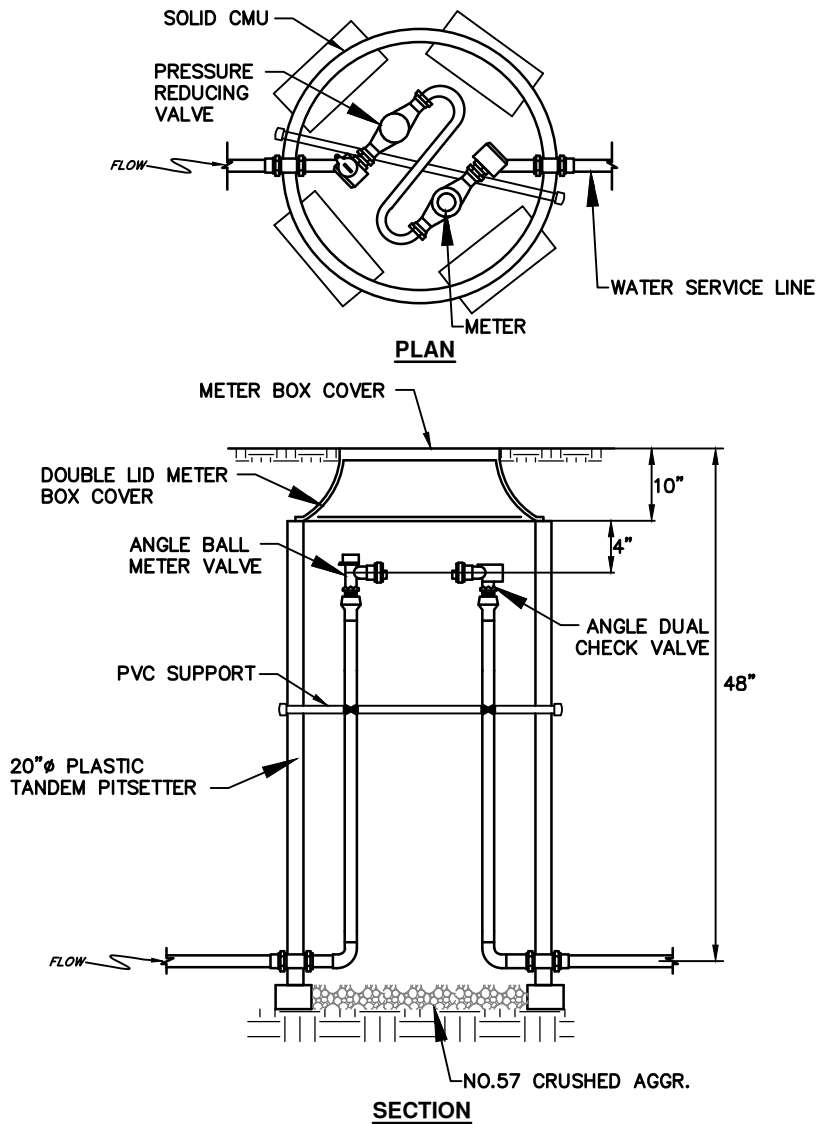
### **RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. -	BRB
DESIGN -	BRB
CADD -	KEC
CHECKED -	
SCALE -	AS SHOWN
DATE -	JUNE 2015

DRAWING NO.	
<b>9</b>	
SHEET NO.	
<b>9 OF 12</b>	
PROJECT	001178.0562



## METER PIT W/ PRESSURE REDUCING VALVE DETAIL (LOW FLOW)

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

## RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY

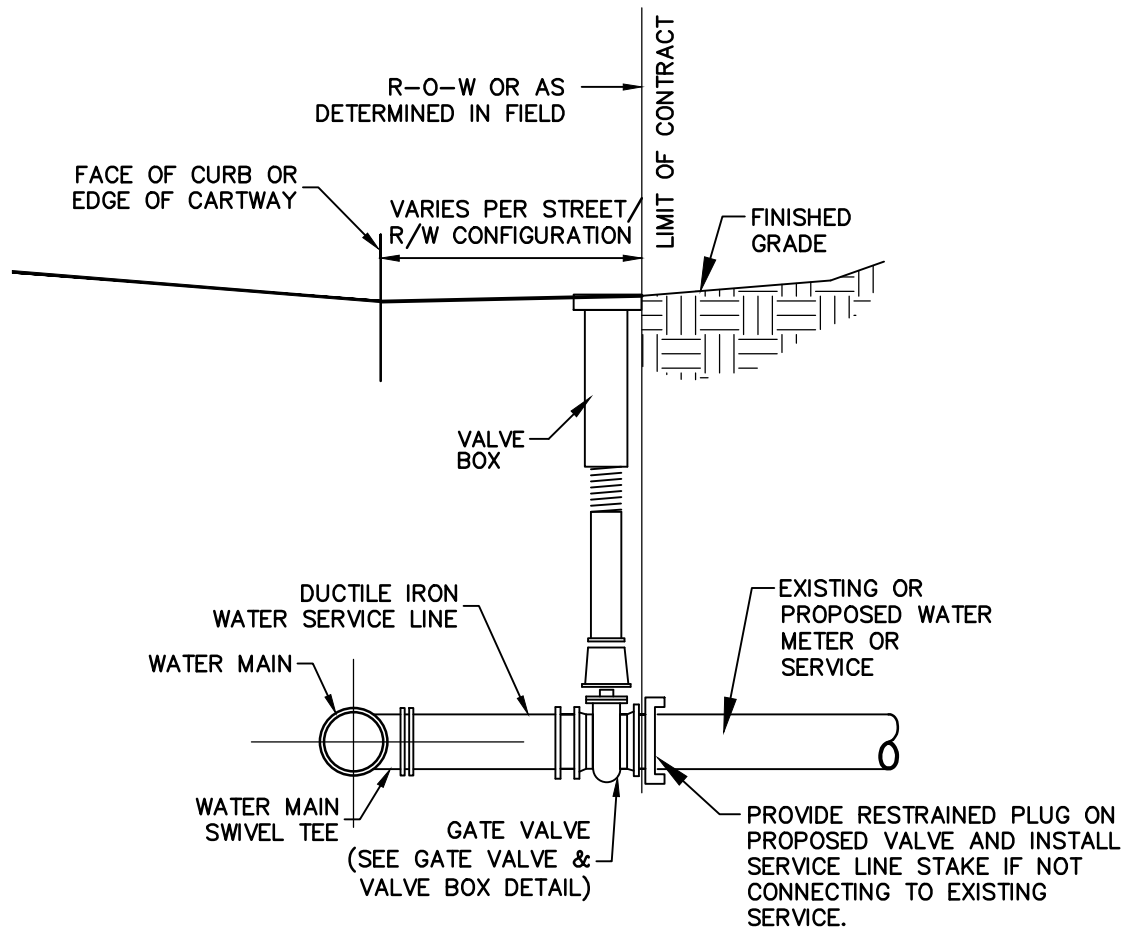
CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— KEC
CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO.
10
SHEET NO.
10 OF 12
PROJECT 001178.0562





**(SERVICE LINES >2" DIA)**

## **WATER SERVICE LINE INSTALLATION DETAIL**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

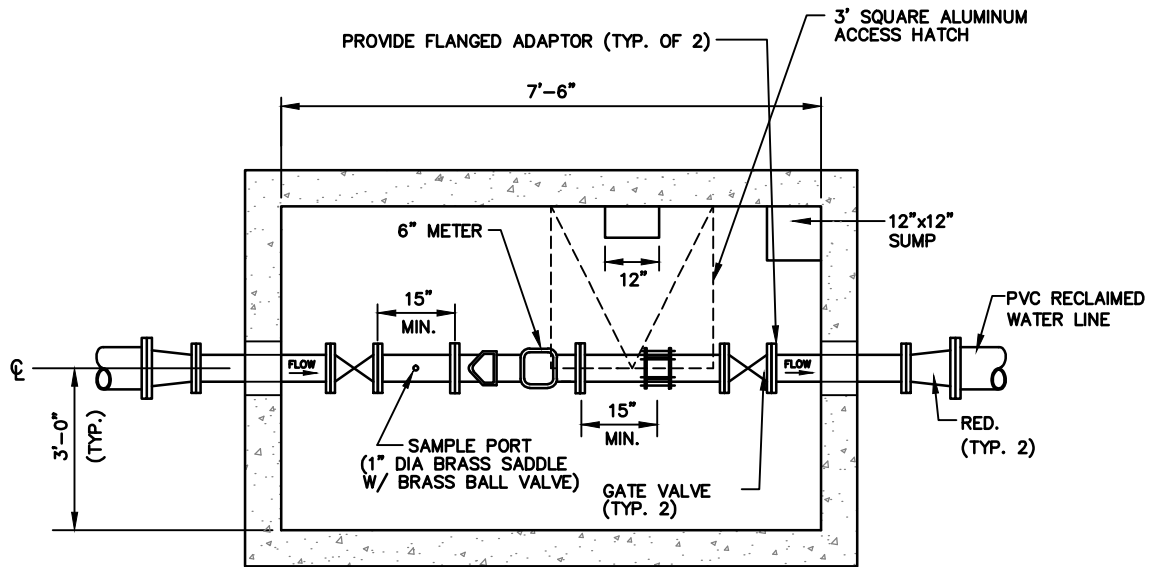
### **RECLAIMED WATER STANDARD DETAIL FOR UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

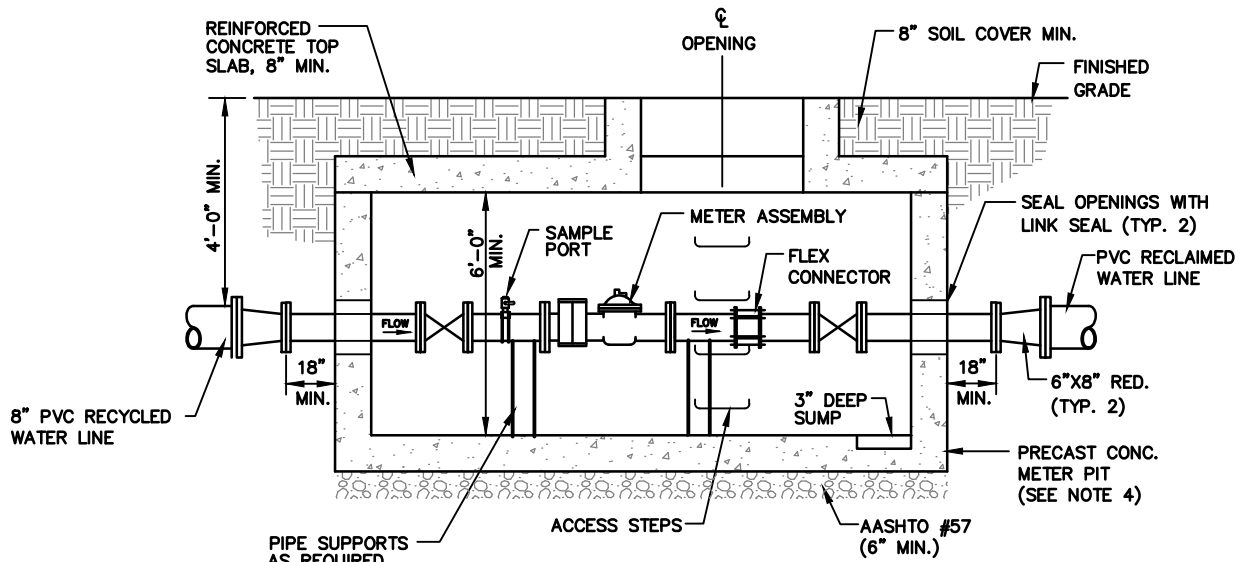
PENNSYLVANIA

PROJ. MGR. — BRB
DESIGN— BRB
CADD— KEC
CHECKED—
SCALE— AS SHOWN
DATE— JUNE 2015

DRAWING NO.
<b>11</b>
SHEET NO.
<b>11 OF 12</b>
PROJECT 001178.0562



PLAN



ELEVATION

**NOTES:**

1. ALL INTERNAL PIPING SHALL BE FLANGED DUCTILE IRON PIPE, CLASS 52.
2. METER PIT DESIGN BY PRECAST CONCRETE MANUFACTURER.
3. CONTRACTOR TO INSTALL PIPE SUPPORTS AS REQUIRED.
4. PRECAST CONCRETE METER PIT TO BE MINIMUM 7'-6" X 6'-0" X 6'-0" HIGH
5. PIPING, VALVES, METERS AND APPURTENANCES TO BE SIZED BASED ON FLOW PROJECTIONS.

**METER PIT DETAIL (HIGH FLOW)**

NOT TO SCALE



UNIVERSITY AREA JOINT AUTHORITY

**RECLAIMED WATER STANDARD DETAIL  
FOR  
UNIVERSITY AREA JOINT AUTHORITY**

CENTRE COUNTY

PENNSYLVANIA

PROJ. MGR. - BRB
DESIGN- BRB
CADD- KEC
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SCALE- AS SHOWN
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DRAWING NO.
12
SHEET NO.
12 OF 12
PROJECT 001178.0562